REVISED 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.:	**61-7984**
SRP Section:	**08.03.01 – AC Power System**
Application Section:	**8.3.1**
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Question No. 08.03.01-7

DCD Tier 2, Section 8.3.1.1.3, Class 1E Emergency Diesel Generator (EDG), provides the descriptions the EDG and related information. Since GDC 17 relates to the safety related onsite power system's capacity and capability, the staff has the following questions to evaluate that the EDG system meets the requirements.

1. Target Reliability Factor: DCD Tier 2, Section 8.3.1.1.3, states that the EDG units have the minimum target reliability factor of 0.95 in accordance with NRC RG 1.9. Since the reliability factor is dependent on all other factors (redundancy of EDGs, frequency of LOOP, and probable time needed to restore offsite power), a higher reliability of the EDGs will result in a lower probability of a station blackout with a corresponding decrease in coping duration for certain plant. Since this is a site specific item to verify the reliability during the operation of the plant, the staff considers this should be a COL item and should be added in the DCD Section 8.3.1 and Chapter 1. A COL applicant that references the APR1400 design certification will establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended in RG 1.155. Also please discuss the methodology and relevant attributes of the reliability program.

2. Generator information: Provide a description of the generator type and pertinent characteristics (including cooling type, Brushless, Seismic category, etc.). Please include these EDG details in Table 8.3.1-6, Electrical Equipment Ratings and Component Data. Discuss the generator's supporting systems or provide reference where these are discussed elsewhere in the DCD.

3. Loading Sequence Time: DCD Tier 2, Section 8.3.1.1.3.6, states that the EDGs are started on an engineered safety features actuation system (ESFAS) and ready for operation within 17 seconds. In Table 8.3.1-2, Class 1E Loads, load sequence time is provided for loading Class 1E equipment to the EDG, which shows loading sequence

time from 5 seconds to 30 seconds. Please clarify if this loading sequence time begins after the 17 seconds as mentioned in Section 8.3.1.1.3.6.

4. Starting and Loading: Table 8.3.1-2, Class 1E Loads, shows that large induction motors are started in quick succession, from 5 to 30 seconds, and as a result, can cause a voltage reduction at the bus. This could cause a running motor to stall, or prevent a motor from starting. Explain how the EDG can adequately supply the Class 1E loads and can accept large loads in quick succession, accomplish recovery from transients without tripping or causing the EDG to overspeed. Explain how the voltage and frequency are restored to within 10% and 2% of nominal respectively with load step increase in accordance with RG 1.9.

5. Capacity Margin: RG 1.9 states that the uncertainties inherent in safety load estimates at an early stage of design are sometimes of such magnitudes that it is prudent to provide a reasonable margin in selecting the load capabilities of the EDGs. Please discuss the margins provided for EDGs, specifically for capacity, voltage, frequency, etc.

6. Tripping Devices: DCD Tier 2, Section 8.3.1.1.3.3, Tripping Devices, does not address certain mechanical and electrical trips, including Low Essential Service Water Pressure, Governor Failure, High Bearing Temperature, High Winding Temperature, Rotating Diode Failure, and Generator Field Ground. Please add these trip/alarm signals if applicable or provide justification for not including the aforementioned trips.

7. Alarm and annunciation: DCD Tier 2, Section 8.3.1.1.3.3, states that “The operating condition of each Class 1E EDG is monitored in the MCR and RSR. Trouble alarms for Class 1E EDG and devices are indicated in the MCR and RSR”. The staff finds that details of the alarm and annunciations to survey the variables are not addressed in this section. Provide a list of EDG indications and alarms for MCR, RSR and local display. Furthermore, please confirm if the tripping devices mentioned in this section are also annunciated/displayed locally, in addition to MCR and RSR, so that EDG monitoring, trending, and in-service testing programs can be established.

8. Permissive: DCD Tier 2, Section 8.3.1.1.3.5, states that EDG operational mode selection (Local/Remote) is provided at the EDG local control panel. Please confirm if the switching to “Local” mode requires a permissive electrical interlock from the MCR.

9. EDG Support System: In DCD Tier 2, Section 8.3.1.1.3, three of the EDG subsystems are mentioned (Starting air system, Fuel Oil Storage and Transfer Systems, and EDG Cooling Systems) and a cross-reference to Section 9.5 is provided for these systems. However, other support systems, such as EDG Lubrication system, Air Intake and Exhaust system, and HVAC system are not mentioned in this section. In Section 8.3.1.1.3, please provide, for completeness, the appropriate cross reference to Chapter 9 for these other support systems.

Response – Rev.1

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

1. Target Reliability Factor:

   The target reliability factor of the EDG units was assumed to be 0.95 from a conservative approach, not knowing the definitive target reliability to be chosen by the COL applicant. The same approach was considered for the offsite power design characteristic group.

   However, since the EDG target reliability and the offsite power design characteristic group mentioned in DCD Tier 2, Subsection 8.4.1.2 are subject to change with the site conditions and specific design of the COL applicant, the COL applicant is to validate the SBO coping duration according to the method specified in RG 1.155.

   The management items of the EDG reliability program includes the following items: 1) Reliability monitoring, 2) Routine checks, 3) Performance of surveillance, 4) Equipment and material maintenance, 5) Investigation and analysis of events, 6) Implementation of a reliability database system, and 7) Resolution and termination of problems.

   DCD Tier 2, Subsections 8.3.1.1.3, 8.4.1.2, and 8.4.3 will be revised to add two COL items 8.4(3) and 8.3(11). COL Item 8.4(3) will add that the COL applicant is to validate the SBO coping duration in accordance with the methods specified in RG 1.155. COL Item 8.3(11) will add that the COL applicant is to establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended in RG 1.155.

2. Generator information:

   The electric generator is a horizontal open drip-proof type air-cooled AC synchronous generator, complete with the excitation system and voltage regulator system.

   The excitation system is an external DG shaft-driven static exciter that controls the field current of generator, thereby controlling the output of the generator. The exciter is designed to operate in conjunction with the voltage regulator and includes provisions to permit local manual adjustment of generator output voltage if the regulator is out of service.

   The voltage regulator system is provided to adjust the DG output voltage and manual adjustment of the setpoint. The regulator type is typically static solid-state type.

   The electric generator, excitation system and voltage regulator system are Class 1E and seismic Category I.

   DCD Tier 2, Subsection 8.3.1.1.3.8 will be retitled as ‘Electric Generator and Subsystems’ and include a description of the components described above. The deleted sections have been incorporated into the revised Subsection 8.3.1.1.3.2. The level of detail provided in the above response is not consistent with the information contained in Table 8.3.1-6 and therefore is not appropriate to incorporate.

3. Loading Sequence Time:

The EDGs are started on a Loss of Offsite Power (LOOP) and/or an ESFAS signal (SIAS, AFAS or CSAS) and ready for operation within 17 seconds. The meaning of ready for operation within 17 seconds is the maximum amount of time required for EDG starting and acceleration up to the rated voltage and frequency before the EDG output breaker closes and is connected to the associated Class 1E 4.16 kV bus ready to take on load. Therefore, the table 8.3.1-2 loading sequence times represent the time immediately after the 17 seconds from the onset of a LOOP and the EDG output breaker is closed.

4. Starting and Loading:

Once the EDG loading requirements are set up, the EDG manufacturer has to design the EDG and its support systems such that the EDG set shall be capable of meeting the given motor starting requirements without exceeding the following limitations during and immediately following a load application or rejection period. These design requirements are incorporated into the vendor procurement specification for the EDG.

A) At no time during the loading sequence shall voltage decrease to less than 75% of nominal or shall frequency decrease to less than 95% of nominal.

B) During recovery from transients caused by step load increases or resulting from the disconnection of the largest single load, the speed of the Emergency Diesel Generator set shall not exceed 75% of difference between nominal speed and the overspeed trip setpoint or 115% of nominal, whichever is lower.

C) Voltage shall be restored to within 10% of nominal and frequency shall be restored to within 2% of nominal in less than 2 seconds in accordance with RG 1.9.

To satisfy the voltage and frequency transient requirements of RG 1.9, the generator takes advantage of the fast acting governor, static exciter, and voltage regulator. In addition, the generator inertia and reactance value will be adjusted to meet the requirements. After selection of the manufacturer, the load sequence analysis report will be developed and evaluated. Modeling of generator, engine, governor, excitation system, transformer, cable and motor loads are required for the computer simulation.

5. Capacity Margin:

For the evaluation of EDG load capability, the loading conditions of steady state and transient status need to be considered. During the early stage of design, the EDG should have a continuous load rating equal to the sum of the conservatively estimated connected loads that the diesel generator would power at any one time, plus a 10 to 15 percent margin. The electric motor drive ratings should be calculated using conservative estimates of these characteristics (e.g., pump runout conditions and motor efficiencies of 90 percent or less, and power factors of 85 percent or less) as per RG 1.9.

Additional margin is not considered for the EDG voltage and frequency limits since the EDG transient simulation is performed under the full load condition including the

capacity margin (i.e., 10% to 15%) and evaluates the limited peak value of voltage and frequency as per the design requirement of RG 1.9.

6. Tripping Devices:

KHNP will revise the mechanical trips in DCD Tier 2, Subsection 8.3.1.1.3.3 as shown below.

a. High temperature – in the high temperature cooling water loop
b. Low pressure – in the high or low temperature cooling water loop
c. High pressure – in the crankcase
d. Low pressure – in the lubrication system
e. High temperature – in the lubrication system
f. Low level – in the lubrication system
g. Low level – at the fuel oil day-tank
h. High temperature – at the diesel engine or generator bearings
i. High temperature – at the diesel generator winding
j. Governor failure

The trip on Low Essential Service Water Pressure is covered by “b. Low pressure – in the high/low temperature cooling water loop.”

Concerning the electrical trips during testing listed in Subsection 8.3.1.1.3.3, the rotating diode failure is covered by “e. Excitation fault protection,” and the generator field ground is covered by “f. Generator loss-of-field protection.”

7. Alarm and annunciation:

The following alarms from the associated relays are provided in the MCR and RSR:

a. Differential/over-speed/emergency stop
b. Reverse power
c. Loss of field
d. Overcurrent with voltage restraint
e. Ground overvoltage
f. Phase (negative phase sequence) unbalance
g. Diesel generator fail to start
h. Running unloaded
i. Cranking
j. Subsystem trouble (ac generator, fuel oil system, lube oil system, cooling water system, starting system, excitation loss, and miscellaneous)

In addition, the diagnostic monitoring and display system (DMDS) provides further detailed information in the EDG control room of the EDG monitoring and alarms, trending display and analysis of parameters, and on-line testing.

DCD Tier 2, Subsections 8.3.1.1.3.3 and 8.3.1.1.3.9 will be revised to include the above information

8. Permissive:

Switching to “LOCAL” mode does not require a permissive interlock from the MCR. Emergency start and emergency trip functions are not blocked by having the control switch selected to the “LOCAL” mode. The emergency start and trip functions are always available to be operated from the local and remote locations whether the selector switch is positioned to “LOCAL” or “REMOTE.” The status of the Local/Remote switch position is displayed in the MCR.

In addition, when the Local/Remote selector switch is in the “REMOTE” position, the following controls are available in the MCR: 1) Control switch for governor speed and load control and 2) Control switch for output voltage adjustment.

9. EDG Support System:

The EDG Lubrication system, Air Intake and Exhaust system, and HVAC system are described in DCD Subsections 9.5.7, 9.5.8, and 9.4.5, respectively. DCD Tier 2, Subsection 8.3.1.1.3.2 will be retitled and revised to include the cross references to Chapter 9 for the associated support system description.

Impact on DCD

DCD Tier 2, Table 1.8-2, Subsections 8.3.1.1.3, 8.3.1.1.3.2, 8.3.1.1.3.3, 8.3.1.1.3.8, 8.3.1.1.3.9, 8.3.1.1.3.10, 8.3.1.1.3.11, 8.3.1.1.3.12, 8.3.3, 8.4.1.2, and 8.4.3 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.

Table 1.8-2 (11 of 29)

Item No.	Description
COL 8.3(1)	The COL applicant is to provide and to design a mobile generator and its support equipment.
COL 8.3(2)	The COL applicant is to describe and provide detailed ground grid and lightning protection.
COL 8.3(3)	The COL applicant is to provide testing, inspection, and monitoring programs for detecting insulation degradation of underground and inaccessible power cables within the scope of 10 CFR 50.65.
COL 8.3(4)	The COL applicant is to provide protective device coordination.
COL 8.3(5)	The COL applicant is to provide insulation coordination of surge and lightning protection.
COL 8.3(6)	The COL applicant is to develop the maintenance program to optimize the life and performance of the batteries.
COL 8.3(7)	The COL applicant is to provide short circuit analysis of onsite dc power system with actual data.
COL 8.3(8)	The COL applicant is to describe any special features of the design that would permit online replacement of an individual cell, group of cells, or entire battery.
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.
COL 9.1(1)	The COL applicant is to provide operational procedures and maintenance program as related to leak detection and contamination control.
COL 9.1(2)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations.
COL 9.1(3)	The COL applicant is to address the load-handling procedures. Load-handling procedures are established for component handling procedures and plant operating procedures in accordance with ASME B30.2. ASME B30.2 requires establishing component handling procedures that include (1) a safe load path for lifting heavy loads to perform special handling component inspections, (2) acceptance criteria prior to lift, and (3) use of steps and proper sequence in handling the load. ASME B30.2 requires plant operating procedure guidelines that include appropriate crane operator training and crane inspections. ASME B30.2 also requires that the load-handling procedures include preparing operating procedures for preoperational load testing and checkouts of interlocks, brakes, hoisting cables, control circuitry, and lubrication of OHLHS equipment.

Add

COL 8.4(3) The COL applicant is to validate the SBO coping duration according to the method specified in RG 1.155.

COL 8.3(11) The COL applicant is to establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended in RG 1.155.

Item #1

The characteristics of the generator exciter and voltage regulator provide satisfactory starting and acceleration of sequenced loads and provide reasonable assurance of rapid voltage recovery when starting large motors. The ratings of the switchgear, load center, and MCC shown in Table 8.3.1-6 indicate sufficient capacity to supply power to the safety equipment during all operating modes.

8.3.1.1.3 Class 1E Emergency Diesel Generators

Each EDG train and its associated auxiliaries are installed in a separate room within physically separate seismic Category I structures that provide protection against tornadoes, hurricanes, external missiles, and seismic phenomena and are electrically isolated from the circuits of other EDGs trains and non-Class 1E circuits. Each EDG room is a separate fire area with 3-hour fire-rated walls, floors, and ceilings. Each EDG room is provided with its own independent ventilation system that automatically maintains the design room temperature for proper equipment operation and personnel access. The EDG room HVAC system and other EDG support auxiliaries are powered from the same electrical train as the EDG.

The EDG controls and monitoring instrumentation, with exception of the sensors and other equipment that are necessarily mounted on the EDG or its associated piping, are installed in free-standing, floor-mounted panels. These panels are designed for their normal vibration environment and are qualified to seismic Category I requirements.

The EDG units have the minimum target reliability factor of 0.95 in accordance with NRC RG 1.9 (Reference 10) and NRC RG 1.155 (Reference 11).

The EDG system provides the requirements with respect to the bypassed and inoperable status indication as described in Subsection 7.5.1.3.

8.3.1.1.3.1 Starting Initiating Circuits

The EDGs are started in the event of the following occurrences:

Add

a. Automatic (through load sequencer logic shown in Figure 7.3-4)

The COL applicant is to establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended in RG 1.155 (COL 8.3(11)).

Item #1

1) Initiation of an engineered safety feature actuation signal (ESFAS):

a) Safety injection actuation signal (SIAS)

b) Auxiliary feedwater actuation signal (AFAS)

c) Containment spray actuation signal (CSAS)

2) Initiation of a two-out-of-four loss of vo
the Class 1E 4.16 kV bus to which the E

b. Normal manual

Local switch actuation in EDG control room

c. Emergency manual

Emergency manual actuation is accomplish
pushbuttons in the MCR and RSR.

The EDG support systems consist of EDG fuel oil system, EDG engine cooling system, EDG starting air system, EDG lubrication system, air intake and exhaust system, and HVAC system. The following DCD Tier 2 Sections provide a description of the associated EDG support system: The EDG fuel oil system is described in Subsection 9.5.4. The EDG engine cooling system is described in Subsection 9.5.5. The EDG starting air system is described in Subsection 9.5.6. The EDG lubrication system is described in Subsection 9.5.7. The air intake and exhaust system is described in Subsection 9.5.8. The HVAC system is described in Subsection 9.4.5.

8.3.1.1.3.2 ~~Starting Mechanism and System~~ EDG Support Systems

Item #9

~~Each EDG has an independent air starting system with storage to provide at least five starts. The EDG starting air system is described in Subsection 9.5.6.~~

8.3.1.1.3.3 Tripping Devices

The following mechanical trips are provided to protect the EDGs during testing:

Item #6

a. High temperature – ~~in the cooling water system~~ in the high temperature cooling water loop

b. Low temperature – ~~in the cooling water system~~ in the high or low temperature cooling water loop

c. High pressure – in the crankcase

d. Low pressure – ~~in the lube oil~~ in the lubrication system

e. High temperature – ~~in the lube oil~~ in the lubrication system Item #6

f. Low level – ~~in the lube oil~~ in the lubrication system

g. Low level – in the fuel oil day-tank

h. ~~Low level – in the cooling water system~~ High temperature - at the diesel engine or generator bearings

i. ~~High temperature – in the diesel engine bearings~~ High temperature - at the diesel generator winding

Add j. Governor failure

These mechanical trips are bypassed in the event of an engineered safety features (ESF) actuation condition concurrent with a LOOP. The design of the bypass circuitry meets the requirements of IEEE Std. 603 and NRC RG 1.9.

The following electrical trips are provided to protect the EDGs during testing:

a. Generator overcurrent protection

b. Generator overvoltage or undervoltage protection

c. Generator negative sequence current protection

d. Generator underfrequency protection

e. Excitation fault protection

f. Generator loss-of-field protection

g. Generator reverse power protection

h. Generator ground fault protection

i. Generator voltage controlled overcurrent protection

All signals of the protective relay trip, except the trip signals listed below, are bypassed during the operation of the Class 1E EDG in a LOCA condition.

a. Engine overspeed

b. Generator differential current

c. Manual emergency trip

d. Diesel engine stop lever

The operating condition of each Class 1E EDG is monitored in the MCR and RSR. ~~Trouble alarms for Class 1E EDG and devices are indicated in the MCR and RSR.~~

Item #7

The following alarms from the following relays are provided in the MCR and RSR:
a. Differential/overspeed/emergency stop
b. Reverse power
c. Loss of field
d. Overcurrent with voltage restraint
e. Ground overvoltage
f. Phase (negative phase sequence) unbalance
g. Diesel generator fail to start
h. Running unloaded
i. Cranking
j. Subsystem trouble (ac generator, fuel oil system, lube oil system, cooling water system, starting system, excitation loss, and miscellaneous).

8.3.1.1.3.4 Interlocks

Each Class 1E 4.16 kV bus can
train associated Class 1E EDG,

a. The interlock circuits
normal and alternate
UAT and SAT.

b. The EDG is permitte
synchronizing both so

c. The incoming circuit breakers are manually closed after synchronizing the offsite power sources with the Class 1E 4.16 kV bus when the preferred power supply is restored from a LOOP or SBO event.

d. The electrical interlocks of the circuit breaker are provided to prevent the automatic closing of an EDG breaker onto an energized or faulted bus.

8.3.1.1.3.8 ~~Fuel Oil Storage and Transfer Systems~~ Electric Generator and Subsystems

Item #2

~~The Class 1E EDG fuel oil system is described in Subsection 9.5.4.~~

~~8.3.1.1.3.9~~ ~~Cooling Systems~~

~~The diesel generator engine cooling system is described in Subsection 9.5.5.~~

8.3.1.1.3.~~10~~ Instrumentation and Control Systems

9

Controls are provided in the MCR and RSR for each EDG for the following operations:

a. Manual synchronization

b. Manual speed, load, and voltage adjustment

c. Emergency start and stop pushbuttons

A local control panel is provided at the EDG room for the following operations:

Item #2

a. Normal or maintenance selection

b. Remote or local selection

c. Automatic or manual selection

d. Manual or automatic voltage regulation

e. Manual start and stop

f. Manual emergency stop

g. Reset (normal/emergency stop)

h. Manual voltage adjustment

The electric generator is a horizontal open drip-proof type air-cooled AC synchronous generator. The generator subsystems include the exciter and voltage regulator.

The excitation system is an external DG shaft-driven static exciter that controls the field current of generator, thereby controlling the output of the generator. The exciter is designed to operate in conjunction with the voltage regulator and include provisions to permit local manual adjustment of generator output voltage if the regulator is out of service.

The voltage regulator system is provided to adjust the DG output voltage and manual adjustment of the setpoint. The regulator type is typically static solid-state type. The electric generator, excitation and voltage regulator systems are Class 1E and seismic Category I.

i. Manual speed adjustment

j. Auxiliary equipment control switches

The dc power source for the EDG I&C system is a part of the same load group as the respective EDG and is described in Subsection 8.3.2.

The status of each Class 1E 4.16 kV breaker position is indicated in the MCR and RSR and at the circuit breaker cubicle. The analog instrumentation for the EDG provides the following indicators in the MCR and RSR:

Item #7

a. Output voltage

b. Output frequency

c. Output ampere

d. Output watts

e. Output vars

f. Power factor

Add

Each emergency diesel generator set is equipped with one diagnostic monitoring and display system (DMDS).
The DMDS is designed to ensure the maximum availability and reliability of the diesel generator set. The main functions of the DMDS are as follows:
a. Monitoring and recording the DG system alarms
b. Validation of start configuration
c. Starting sequence: monitoring and failure identification
d. Diesel generator operating assistance, including CRT based emergency and normal procedures
e. Identification of the causes for diesel generator malfunction causes identification
f. Support diesel generator engine predictive maintenance
The DMDS equipment for each diesel generator set is located in the local EDG control room.

8.3.1.1.3.~~11~~ Prototype Qualification Program

10

The qualification program of Class 1E equipment is in accordance with IEEE Std. 323 (Reference 14), IEEE Std. 344 (Reference 15), and the applicable equipment standards.

The environmental qualifications of mechanical and electrical equipment are described in Section 3.11.

8.3.1.1.3.~~12~~ Protective Relaying System

11

The basic criterion for the protective relaying system in accordance with IEEE Std. 242 (Reference 16) is that it promptly initiates, with precision and reliability, the operation of

The ground detector has an alarm in the MCR to monitor constant grounding and recording. The ground detector has high sensitivity.

8.3.3 Combined License Information

COL 8.3(1) The COL applicant is to provide and to design a mobile generator and its support equipment.

COL 8.3(2) The COL applicant is to describe and provide detailed ground grid and lightning protection.

COL 8.3(3) The COL applicant is to provide testing, inspection, and monitoring programs for detecting insulation degradation of underground and inaccessible power cables within the scope of 10 CFR 50.65.

COL 8.3(4) The COL applicant is to provide protective device coordination.

COL 8.3(5) The COL applicant is to provide insulation coordination of surge and lightning protection.

COL 8.3(6) The COL applicant is to develop the maintenance program to optimize the life and performance of the batteries.

COL 8.3(7) The COL applicant is to provide a short-circuit analysis of the onsite dc power system with actual data.

COL 8.3 (8) The COL applicant is to describe any special features of the design that would permit online replacement of an individual cell, group of cells, or entire battery.

8.3.4 References

Add

1. IEEE Std. 141-1993, “IEEE Recommended Practice for Electric Power Distribution for Industrial Plants,” Institute of Electrical and Electronics Engineers, 1993.

COL 8.3(11) The COL applicant is to establish procedures to monitor and maintain EDG reliability during plant operations to verify the selected reliability level target is being achieved as intended in RG 1.155.

Item #1

a. The first design factor is the redundancy of the onsite emergency alternating current (EAC) power system. The onsite EAC power system for the APR1400 consists of two redundant systems that have four independent Class 1E EDGs. One Class 1E EDG (train A or B) is required to operate the ac-powered decay heat removal systems. Therefore, the EAC power configuration group selected for the APR1400 is group "C" in accordance with Table 3 of NRC RG 1.155.

b. The second design factor is the reliability of the onsite EAC power sources. The APR1400 selects a target EDG reliability of 0.95. The reliable operation of the EAC power sources is provided reasonable assurance by a reliability program that is in accordance with NRC RG 1.9 (Reference 5) and NRC RG 1.155 Position C.1.2.

c. The third design factor is the expected frequency of a LOOP. The offsite power system is site-specific and not part of the APR1400. Therefore, the offsite power design characteristic group for the APR1400 is selected as "P3" for conservatism in accordance with Table 4 of NRC RG 1.155.

d. The fourth design factor is the probable time needed to restore offsite power. This factor is incorporated into the "P3" grouping addressed previously.

Based on the above condition, the SBO coping duration for the APR1400 is 16 hours in accordance with Table 2 of NRC RG 1.155.

8.4.1.3 Alternate AC Power Source

The 4.16 kV non-Class 1E AAC GTG is provided as an AAC source to mitigate the SBO in accordance with Position C.3.3 of NRC RG 1.155. 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. This design meets the requirements of Criterion 4 for NRC RG 1.155, Position C.3.3.5. The reliability of the AAC power system meets or exceeds 95 percent as determined in accordance with NSAC-108 (Reference 6). The SBO loads for the AAC GTG are shown in Table 8.3.1-4. The AAC power source for the APR1400 is designed to meet the requirements of 10 CFR 50.63, NRC RG 1.155, and NUMARC 87-00 (Reference 7).

Add

However, since the preceding factors are subject to change as per the site conditions and site specific design, the COL applicant is to validate the SBO coping duration according to the method specified in RG 1.155. (COL 8.4(3))

Item #1

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.

Item #1

Add

COL 8.4(3) The COL applicant is to validate the SBO coping duration according to the method specified in RG 1.155.

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.