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.:	**234-8284**
SRP Section:	**14.03.06 – Electrical Systems – Inspection, Tests, Analyses, and Acceptance Criteria**
Application Section:	**14.03.06**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-1

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

DCD Tier 2, Chapter 14.3.2.6, “ITAAC for Electrical Systems” Part j discusses electrical power for non-safety plant systems. Please discuss whether or not part j includes testing of the main generator system. If not, please discuss the tests done for the main generator.

Response

As described in SRP 14.3.6.II (page 14.3.6-8), ITTAC is included to verify the functional arrangement of the electrical power systems provided to support non-safety plant systems to the extent that those systems perform a significant safety function.

Since the main generator (MG) and its associated electrical components, (part of the offsite power system), are non-safety equipment and do not perform a significant safety function, ITTAC is not necessary for the MG and its associated electrical components.

Part j of DCD Tier 2, Chapter 14.3.2.6, “ITAAC for Electrical Systems” is only to verify the functional arrangement of the ac electrical power system by inspection of the as-built system configuration, which is covered by Design Commitment and ITAAC item 1.

Testing of the MG is included in the initial test program (ITP) as part of the unit main power system test, which is described in DCD Tier 2, Subsection 14.2.12.1.110.

Impact on DCD

There is no impact on the DCD.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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Docket No. 52-046

RAI No.:	**234-8284**
SRP Section:	**14.03.06 – Electrical Systems – Inspections, Analyses, and Acceptance Criteria**
Application Section:	**14.3.6**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-2

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the AC electric power distribution system, as discussed in part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.1, please discuss why in Tier 1 an ITAAC is not needed to verify that each Class 1E bus automatically connects to the EDG when both offsite power sources are not available. Otherwise, please include an ITAAC accordingly.

For the AC electric power distribution system, as discussed in part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.1, please discuss why in Tier 1 that an ITAAC is not needed for Class 1E cable sizing to consider derating due to ambient temperature and raceway loading. Otherwise, please include an ITAAC accordingly.

For the AC electric power distribution system, as discussed in part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.1, Design Commitment Item 4 in Chapter 2.6.1.1 discusses electrical equipment in the auxiliary building and EDG building with seismic Category 1 structures. Please discuss what other buildings house Class 1E equipment that are located in seismic Category 1 buildings.

Table 2.6.1-3, Design Commitment item 13 states that Class 1E electric power distribution system cables are routed in seismic Category I structures and in their respective raceway trains. Please discuss why in Column 2 (Inspection, tests and analyses) analyses of the cables is not needed to show that the seismic design basis requirements are bounded.

Response

DCD Tier 1, Subsection 2.6.1.1, and Table 2.6.1-3 (4 of 6) will be revised to add a new ITAAC, as item 13.a, to confirm that the raceway systems for Class 1E electric power distribution system cables are designed to meet seismic Category I requirements.

To verify the Class 1E cable sizes considering ampacity derating, DCD Tier 1, Subsection 2.6.1.1, and Table 2.6.1-3 (6 of 6) will be revised to add a new ITAAC, as item 22.

ITAAC to verify connection of the Class 1E EDGs during a LOOP is addressed in Design Commitment and ITAAC item 15 of DCD Tier 1, Chapter 2.6.2.

As stated in the response to RAI 57-7965, Question 08.03.01-3 (Reference KHNP submittal MKD/NW-15-0089L dated Aug.19, 2015; ML15231A805), other than the auxiliary building (AB) and the EDG building (EDGB), two geographically separated essential service water (ESW) buildings are the only areas where Class 1E equipment are located. Design Commitment and ITAAC item 4 in DCD Tier 1, Subsection 2.6.1.1, and Table 2.6.1-3 (2 of 6) will be revised to incorporate the essential service water (ESW) buildings mentioned above.

Impact on DCD

DCD Tier 1, Subsection 2.6.1.1, and Table 2.6.1-3 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.

3.a All controls required by the design exist in the MCR to operate the electric power distribution system, specifically to open and close the 4.16 kV circuit breakers for the Class 1E buses identified in Table 2.6.1-2.

3.b All controls required by the design exist in the RSR to operate the electric power distribution system, specifically to open and close the 4.16 kV circuit breakers for the Class 1E buses identified in Table 2.6.1-2.

3.c All displays and alarms required by the design exist in the MCR as defined in Table 2.6.1-2.

3.d All displays and alarms required by the design exist in the RSR as defined in Table 2.6.1-2.

4. Class 1E medium voltage switchgears, load centers, and motor control centers are located in the auxiliary building ~~and EDG building~~ with seismic Category I structures and in their respective train areas.

, EDG building, and ESW buildings

5. MT and UATs are separated from the SATs.

6. MT, UATs, and SATs are provided with their own oil pit, drain, fire deluge system.

7.a The MG, UATs, MT, and GCB power feeders are separated from the SATs power feeders.

7.b The MG, UAT, MT, and GCB instrumentation and control circuits are separated from the SATs instrumentation and control circuits.

8. If the normal preferred offsite power supply is not available, Class 1E 4.16 kV medium voltage buses are automatically transferred to the alternate preferred offsite power supply.

9. Instrumentation and control power for Class 1E medium voltage switchgear and load centers is supplied from the Class 1E dc power system in the same train.

10.a Independence is provided between each of the four trains of Class 1E distribution equipment and circuits.

10.b Independence is provided between Class 1E distribution equipment and circuits and non-Class 1E distribution equipment and circuits.

10.c The Class 1E distribution equipment of independent trains, identified in Table 2.6.1-1, is located in separate rooms in the auxiliary building.

11. Class 1E electric power distribution system equipment and circuits are rated to withstand fault currents for the time required to clear the fault from its power source.

12. Equipment and circuits of independent trains including raceway are uniquely identified by their train color and identifying nomenclature.

13.b ~~13.~~ Class 1E electric power distribution system cables are routed in seismic Category I structures and in their respective raceway trains.

14. Class 1E equipment is not prevented from performing its safety functions by design basis harmonic distortion waveforms.

15. Protection is provided for Class 1E equipment from degraded voltage condition.

16. There are no automatic connections between Class 1E trains.

17. Class 1E qualified isolation devices provide independence between Class 1E electric power distribution equipment and non-Class 1E loads.

18. The MT power circuit breaker (PCB) in the switchyard opens in the event of electrical faults in either MT, MG, GCB, UATs, or associated equipment and circuits.

19. The UATs and SATs are designed and sized to meet the worst case loading conditions for all modes of plant operation and accident conditions.

Add

13.a The raceway systems for Class 1E electric power distribution system cables are designed to meet seismic Category I requirements.

20. Overcurrent protection is set for proper coordination of Class 1E ac electric distribution system.

21. The post-fire safe shutdown circuit analysis provides assurance that one success path of shutdown SSCs remains free of fire damage.

22. The Class 1E cables are sized considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.

Add

2.6.1.2 Inspection, Test, Analyses, and Acceptance Criteria

Table 2.6.1-3 specifies the inspections, tests, analyses, and associated acceptance criteria for the ac electrical power distribution system.

Table 2.6.1-3 (2 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3.b All controls required by the design exist in the RSR to operate the electric power distribution system, specifically to open and close the 4.16 kV circuit breakers for the Class 1E buses identified in Table 2.6.1-2.	3.b Tests will be performed using the electric power distribution system controls in the RSR.	3.b All electric power distribution system controls in the as-built RSR open and close the 4.16 kV circuit breakers for the Class 1E buses identified in Table 2.6.1-2.
3.c All displays and alarms required by the design exist in the MCR as defined in Table 2.6.1-2.	3.c Inspections will be performed on the displays and alarms in the MCR.	3.c All displays and alarms exist and can be retrieved in the MCR as defined in Table 2.6.1-2.
3.d All displays and alarms required by the design exist in the RSR as defined in Table 2.6.1-2.	3.d Inspections will be performed on the displays and alarms in the RSR.	3.d All displays and alarms exist and can be retrieved in the RSR as defined in Table 2.6.1-2.
4. Class 1E medium voltage switchgears, load centers, and motor control centers are located in the auxiliary building ~~and EDG building~~ , EDG building, and ESW buildings with seismic Category I structures and in their respective train areas.	4. Inspection of the as-built Class 1E medium voltage switchgears, load centers, and motor control centers will be performed.	4. The as-built Class 1E medium voltage switchgears, load centers, and motor control centers are located in the auxiliary building ~~and EDG building~~ , EDG building, and ESW buildings with seismic Category I structures and in their respective train areas.
5. MT and UATs are separated from the SATs.	5. Inspection and analysis of the as-built MT and UATs will be performed.	5. The as-built MT and UATs are separated from the SATs by 3-hour-rated fire barriers.
6. MT, UATs, and SATs are provided with their own oil pit, drain, fire deluge system.	6. Inspection of the as-built MT, UATs and SATs will be performed.	6. The as-built MT, UATs, and SATs are provided with their own oil pit, drain, fire deluge system.

, EDG building, and ESW buildings

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Table 2.6.1-3 (4 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.c The Class 1E distribution equipment of independent trains , identified in Table 2.6.1-1, is located in separate rooms in the auxiliary building.	10.c Inspection of the as-built Class 1E distribution equipment will be performed.	10.c The as-built Class 1E distribution equipment of independent trains , identified in Table 2.6.1-1, is located in separate rooms in the auxiliary building.
11. Class 1E electric power distribution system equipment and circuits are rated to withstand fault currents for the time required to clear the fault from its power source.	11.a Analyses will be performed to verify the Class 1E distribution equipment and circuits are sized to withstand the maximum fault currents for the time required to clear the fault from its power source	11.a A report exists and concludes that the Class 1E distribution equipment and circuits are sized to carry the worst case load currents for the time required to clear the fault from its power source.
	11.b Inspections will be performed to verify that the ratings of as-built Class 1E distribution equipment and circuits bound the results of the analyses to carry the worst-case load currents for the time required to clear the fault from its power source.	11.b The ratings of as-built Class 1E distribution equipment and circuits bound the results of the analyses to carry the worst-case load currents for the time required to clear the fault from its power source.
12. Equipment and circuits of independent trains including raceway are uniquely identified by their train color and identifying nomenclature.	12. Inspection of the as-built Class 1E equipment and circuits of independent trains including raceway will be performed.	12. The as-built Class 1E equipment and circuits of independent trains including raceway are uniquely identified by their train color and identifying nomenclature.
~~13.~~ 13.b Class 1E electric power distribution system cables are routed in seismic Category I structures and in their respective raceway trains.	~~13.~~ 13.b Inspection of the as-built electric power distribution system cables and raceways will be performed.	~~13.~~ 13.b The as-built Class 1E train cables are routed in seismic Category I Structures and in their respective raceway trains.
14. Class 1E equipment is not prevented from performing its safety functions by design basis harmonic distortion waveforms.	14. Analysis of the as-built electric power distribution system to determine harmonic distortions will be performed.	14. A report exists and concludes that harmonic distortion waveforms do not exceed acceptable voltage distortion limits on the Class 1E electric power distribution system.
Add: 13.a The raceway systems for Class 1E electric power distribution system cables are designed to meet seismic Category I requirements.	13.a Inspections will be performed to verify that the as-built raceway systems for Class 1E electric power distribution system cables are supported by a seismic Category I designed support system	13.a A report exists and concludes that the as-built raceway system for Class 1E electric power distribution system cables are supported by a seismic Category I designed support system

Table 2.6.1-3 (6 of 6)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
19. The UATs and SATs are designed and sized to meet the worst case loading conditions for all modes of plant operation and accident conditions.	19.a Analyses will be performed to verify that the as-built UATs and SATs are sized for the worst case loading conditions for all modes of plant operation and accident conditions.	19.a A report exists and concludes that the as-built UATs and SATs are designed and sized for the worst case loading conditions for all modes of plant operation and accident conditions.
	19.b Inspections will be performed to verify that the ratings of as-built UATs and SATs meet the size requirements determined by the analysis for the worst case loading conditions for all modes of plant operation and accident conditions.	19.b The ratings of the as-built UATs and SATs bound the size requirements determined by the analysis.
20. Overcurrent protection is set for proper coordination of Class 1E ac electric distribution system.	20.a Analysis of the as-built Class 1E ac electrical distribution system overcurrent protection will be performed to verify proper coordination.	20.a A report exists and concludes that the as-built Class 1E ac electric distribution system overcurrent protection coordinates.
	20.b Inspections and tests will be performed on the Class 1E ac electrical distribution system to verify that the as-built overcurrent protection devices setting is in accordance with the results of the analysis for proper coordination.	20.b A report exists and concludes that the as-built Class 1E ac electrical distribution system overcurrent protection devices is set in accordance with the results of the analysis for proper coordination.
21. The post-fire safe shutdown circuit analysis provides assurance that one success path of shutdown SSCs remains free of fire damage.	21. Analysis of post-fire safe shutdown circuit and supporting breaker coordination will be performed.	21. A report exists and concludes that the post-fire safe shutdown circuit analysis provides assurance that one success path of shutdown SSCs remains free of fire damage.
Add 22. The Class 1E cables are sized considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.	22.a An analysis will be performed to verify the Class 1E cables are sized considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.	22.a A report exists and concludes that the Class 1E cables are sized considering due to ambient temperature, cable grouping, and other derating effects as applicable.
	22.b An inspection will be performed to verify that the as -built cable sizes bound the minimum sizes determined by the analysis.	22.b The as-built cable sizes bound the minimum sizes determined by the analysis.

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APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**234-8284**
SRP Section:	**14.03.06 – Electrical Systems – Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**14.3.2.6**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-3

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the EDG System, as discussed part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.2, please confirm that the four Class 1E EDGs are seismic Category I and can withstand seismic design basis loads without loss of safety function and provide an associated ITAAC.

For the EDG System, as discussed part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.2, please discuss why an ITAAC is not necessary for confirming that the each division of the Class 1E combustion air intake and exhaust system is capable of supplying combustion air and of disposing exhaust gases. Otherwise, please provide an ITAAC.

For the EDG System, as discussed part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.2, Table 2.6.2-3, Design Commitment Item 9 discusses the fuel storage capacity of the EDG. Please discuss why an acceptance criteria is not needed for confirming the as-built tank capacity bounds the analyses. Otherwise, please modify the acceptance criteria.

For the EDG System, as discussed part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.2, Table 2.6.2-3, Design Commitment Item 10 discusses the fuel day tank capacity of the EDG. Please discuss why an acceptance criteria is not needed for confirming the as-built tank capacity bounds the analyses. Otherwise, please modify the acceptance criteria.

For the EDG System, as discussed part c of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.2, Table 2.6.2-3, Design Commitment Item 12 discusses the lube oil makeup tank capacity of the EDG. Please discuss why an acceptance criteria is not needed for confirming the as-built tank capacity bounds the analyses. Otherwise, please modify the acceptance criteria.

Response

The four Class 1E EDGs are designed as seismic Category I and can withstand seismic design basis loads without loss of safety function. The associated ITAAC is described in DCD Tier 1, subsection 2.6.2, Table 2.6.2-3, Design Commitment Item 5.a.

For the Class 1E combustion air intake and exhaust system, the associated Design Description and ITAAC will be added in DCD Tier 1, Subsection 2.6.2.1 and Table 2.6.2-1 as follows:

Added description in Subsection 2.6.2.1:

22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.

Added description in Table 2.6.2-1:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.	22. A test of each as-built EDG at 110% of nameplate rating will be performed.	22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.

For DCD Tier 1, subsection 2.6.2, Table 2.6.2-3, Design Commitment Items 9, 10, and 12 will be revised as follows:

Current description:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Each EDG has fuel storage capacity to provide fuel to its EDG for a period of seven days with the EDG supplying the power requirements for the most limiting design basis event.	9. Inspections and analyses will be performed to determine fuel storage capacities and EDG fuel consumption.	9. A report exists and concludes that each EDG has fuel storage capacity to operate the EDG for seven days with the EDG supplying power during the most limiting design basis event.
10. Each day tank provides fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.	10. Inspections and tests will be performed to determine day tank capacities and EDG fuel consumption.	10. A report exists and concludes that each day tank’s capacity is sufficient to provide fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.
12. Each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.	12. Inspections and tests will be performed to determine lube oil makeup tank capacities and EDG lube oil consumption.	12. A report exists and concludes that each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.

Revised description:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Each EDG has the fuel oil storage capacity to provide fuel to its EDG for a period of seven days with the EDG supplying the power requirements for the most limiting design basis event.	9.a Analyses will be performed to determine fuel oil storage capacities and EDG fuel consumption.	9.a A report exists and concludes that each fuel oil storage capacity is sufficient to operate the EDG for seven days with the EDG supplying power during the most limiting design basis event.
	9.b Inspection will be performed to verify that each as-built fuel oil storage tank's capacity bounds the analysis.	9.b The each as-built fuel oil storage tank's capacity bounds the analysis.
10. Each day tank provides fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.	10.a Analyses will be performed to determine day tank capacities and EDG fuel consumption.	10.a A report exists and concludes that each day tank's capacity is sufficient to provide fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.
	10.b Inspection will be performed to verify that each as-built day tank capacity bounds the analysis.	10.b The each as-built day tank's capacity bounds the analysis.
12. Each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.	12.a Analyses will be performed to determine lube oil makeup tank capacities and EDG lube oil consumption.	12.a A report exists and concludes that each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.
	12.b Inspection will be performed to verify that each as-built lube oil makeup tank capacity bounds the analysis.	12.b The each as-built lube oil makeup tank's capacity bounds the analysis.

Impact on DCD

DCD Tier 1, Table 2.6.2-3 will be revised as indicated in the attached markup.

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.

20. When the Class 1E EDG is started by an ESF actuation signal, all Class 1E EDG protection systems, except for overspeed and generator differential current, are automatically bypassed.

21. The moderate-energy piping systems are reconciled with pipe rupture hazards analyses report to ensure that the safety-related SSCs are protected against or are qualified to withstand the environmental effects associated with postulate failures of these piping systems.

22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.

2.6.2.2 <u>Inspection, Test, Analyses, and Acceptance Criteria</u>

Table 2.6.2-3 specifies the inspections, tests, analyses, and associated acceptance criteria for the EDG system.

Table 2.6.2-3 (4 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6.c All displays required by the design exist in the MCR as defined in Table 2.6.2-2.	6.c Inspections will be performed on the displays in the MCR.	6.c All displays exist and be retrieved in the as-built MCR as defined in Table 2.6.2-2.
6.d All displays required by the design exist in the RSR as defined in Table 2.6.2-2.	6.d Inspections will be performed on the displays in the RSR.	6.d All displays exist and be retrieved in the as-built RSR as defined in Table 2.6.2-2.
7. Each mechanical division of EDG and its support systems (A, B, C & D) is physically separated from the other divisions.	7. Inspection of the as-built mechanical divisions will be performed.	7. Each mechanical division of the EDG is physically separated by a divisional wall or a fire barrier.
8.a Each diesel fuel oil transfer pump is capable of transferring oil from the diesel fuel oil storage tank to its corresponding day tank at sufficient pressure and flow to cover the maximum demand at EDG continuous rated load while simultaneously increasing day tank level.	8.a.i Analysis of each diesel fuel oil transfer pump will be performed to determine the required flow rate to support the maximum demand of the EDG at continuous rated load while simultaneously increasing day tank level.	8.a.i A report exists and concludes that each fuel oil transfer pump is sized to transfer fuel oil from the fuel oil storage tank to its as- built corresponding day tank, at a flow rate to support the maximum demand of the Class 1E EDG at continuous rated load while simultaneously increasing day tank level.
	8.a.ii Test of each diesel fuel oil transfer pump will be performed to verify that the fuel oil transfer pump flow rate bounds the analysis.	8.a.ii A report exists and concludes that each diesel fuel oil transfer pump flow rate bounds the analysis.
8.b The diesel fuel oil transfer pumps have sufficient net positive suction head (NPSH).	8.b Test to measure the as-built diesel fuel oil transfer pump suction pressure will be performed. Inspection and analyses to determine NPSH available to each pump will be performed based on test data and as-built data.	8.b A report exists and concludes that as-built calculated NPSH available exceeds each diesel fuel oil transfer pump's NPSH required.
9. Each EDG has fuel storage capacity to provide fuel to its EDG for a period of seven days with the EDG supplying the power requirements for the most limiting design basis event.	~~9. Inspections and analyses will be performed to determine fuel storage capacities and EDG fuel consumption.~~ 9.a Analyses will be performed to determine fuel oil storage capacities and EDG fuel consumption. 9.b Inspection will be performed to verify that each as-built fuel oil storage tank's capacity bounds the analysis.	~~9. A report exists and concludes that each EDG has fuel storage capacity to operate the EDG for seven days with the EDG supplying power during the most limiting design basis event.~~ 9.a A report exists and concludes that each fuel oil storage capacity is sufficient to operate the EDG for seven days with the EDG supplying power during the most limiting design basis event. 9.b The each as-built fuel oil storage tank's capacity bounds the analysis.

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10.a Analyses will be performed to determine day tank capacities and EDG fuel consumption.

10.b Inspection will be performed to verify that each as-built day tank capacity bounds the analysis.

Table 2.6.2-3 (5 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. Each day tank provides fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.	~~10. Inspections and tests will be performed to determine day tank capacities and EDG fuel consumption.~~	~~10. A report exists and concludes that each day tank's capacity is sufficient to provide fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.~~
11. One transfer pump in each train is designed to automatically supply diesel fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.	11. Tests will be performed on the as-built fuel oil transfer pump in each train by providing a test signal of a simulated fuel oil day tank level in only one train at a time.	11. The as-built transfer pump in each train starts automatically to supply diesel fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.
12. Each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.	~~12. Inspections and tests will be performed to determine lube oil makeup tank capacities and EDG lube oil consumption.~~	~~12. A report exists and concludes that each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.~~
13. The starting air system receiver tanks of each EDG have a combined air capacity for five starts of the EDG without replenishing air to the receiver tanks.	13. Tests will be performed with the EDGs and their air start systems.	13. Each EDG is started five times without replenishing air to the receiver tanks.
14. The air intakes for EDG combustion are separated from the EDG exhaust ducts.	14. Inspection and analysis of the as-built EDG air intakes and air exhaust will be performed.	14. The air intake and air exhaust for each EDG are separated. The air intakes and exhausts of the four EDGs are separated by the location of the EDGs on opposite sides of the nuclear island structures.

12.a Analyses will be performed to determine lube oil makeup tank capacities and EDG lube oil consumption.

12.b Inspection will be performed to verify that each as-built lube oil makeup tank capacity bounds the analysis.

12.a A report exists and concludes that each lube oil makeup tank provides lube oil to its respective EDG for seven continuous days of EDG full power rated operation.

12.b The each as-built lube oil makeup tank's capacity bounds the analysis.

10.a A report exists and concludes that each day tank's capacity is sufficient to provide fuel oil for at least 60 minutes plus a minimum additional margin of 10 percent at EDG rated load.

10.b The each as-built day tank's capacity bounds the analysis.

Table 2.6.2-3 (7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. When running ina test mode, an EDG is capable of responding to an automatic start signal.	18. Tests will be performed with each EDG in a test mode configuration. An automatic start signal will be simulated.	18. When running in a test mode, each EDG resets to its automatic control mode upon receipt of a simulated automatic start signal.
19. Each Class 1E EDG is designed and sized to supply power to its train's safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.	19.a Analyses will be performed to verify that each Class 1E EDG is capable of supplying power to its train safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.	19.a A report exists and concludes that each Class 1E EDG is designed and sized to supply power to its train's safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.
	19.b Inspections will be performed to verify that the rating of each as-built Class 1E EDG is in accordance with the size requirements of the analysis.	19.b The rating of each Class 1E EDG bounds the size requirements of the analysis.
20. When the Class 1E EDG is started by an ESF actuation signal, all Class 1E EDG protection systems, except for overspeed and generator differential current, are automatically bypassed.	20. Tests will be performed to verify the as-built Class 1E EDG protection systems.	20. A report exists and concludes that the as-built Class 1E EDG protection systems, except for overspeed and generator differential current, are automatically bypassed when the Class 1E EDG is started by an ESF actuation signal.
21. The moderate-energy piping systems are reconciled with pipe rupture hazards analyses report to ensure that the safety-related SSCs are protected against or are qualified to withstand the environmental effects associated with postulate failures of these piping systems.	21. Inspections and analyses of the as-built moderate-energy piping and safety-related SSCs will be performed.	21. Pipe rupture hazard analysis report exits and concludes that the as-built safety-related SSCs are protected against or are qualified to withstand the effects of postulated pipe failures of the as-built moderate-energy piping system.
22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.	22. A test of each as-built EDG at 110% of nameplate rating will be performed.	22. Each combustion air intake and exhaust system of the EDG is capable of supplying combustion air to the EDG and disposing of EDG exhaust gases during operation at 110% of nameplate rating.

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.:	**234-8284**
SRP Section:	**14.03.06 - Electrical Systems - Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**14.3.6**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-4

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the DC Power System, as discussed part c of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.3, please discuss why an ITAAC is not necessary to confirm that each redundant division of the Class 1E battery and associated charger is located in a separate room. Otherwise, please provide an ITAAC.

For the DC Power System, as discussed part c of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.3, please discuss why an ITAAC is not necessary to confirm that the Class 1E dc power cables are sized to carry the required load currents and to provide minimum design basis voltage at load terminals, considering derating due to ambient temperature and raceway loading. Otherwise, please provide an ITAAC.

For the DC Power System, as discussed part c of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.3, please discuss why an ITAAC is not needed to confirm that the Class 1E batteries have enough capacity to carry the worst case load profile assuming the chargers are unavailable. Otherwise, please provide an ITAAC.

For the DC Power System, as discussed part c of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.3, Table 2.6.3-3, Design Commitment Item 10 discusses independence between Class 1E dc system trains and between Class 1E and non-Class 1E equipment cables. Please explain how the qualification of the isolation devices between Class 1E and non-Class 1E equipment is verified and update Column 2 (Inspections, Tests, and Analyses) if needed.

For the DC Power System, as discussed part c of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.3, please discuss why an ITAAC is not needed to confirm that Class 1E protective devices (circuit breakers/fuses) in the DC power system are sized to supply their load requirements. Otherwise, please provide an ITAAC.

Response

Two new ITAAC items will be added to DCD Tier 1, Subsection 2.6.3.1 and Table 2.6.3-3. Item 13 will be added to confirm by inspection that each train of the Class 1E batteries is located in a separate room. Item 14 will be added to the same subsection and table to confirm by inspection that each Class 1E train dc distribution panel, dc control center and battery charger are located in a separate room.

ITAAC Item 15 will be added to DCD Tier 1, Subsection 2.6.3.1 and Table 2.6.3-3 to confirm by inspection and analysis that the Class 1E dc power system cables are sized to carry the required load currents and to provide minimum design basis voltage at the load terminals, considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.

An ITAAC to verify that the capacities of the Class 1E batteries can carry the worst case load profiles is currently addressed in the Design Commitment and ITAAC for Item 6 of DCD Tier 1, Table 2.6.3-3.

The current ITAAC Item 10 in DCD Tier 1, Table 2.6.3-3 that discusses independence between Class 1E dc system trains and between Class 1E and non-Class 1E equipment cables will be modified to separate these two commitments to be consistent with ITAACs of the AC power system. An additional commitment will be added to demonstrate that the Class 1E qualified isolation devices provide independence between the Class 1E dc distribution equipment and the non-Class 1E dc loads.

ITAAC Item 16 will be added to DCD Tier 1, Subsection 2.6.3.1 and Table 2.6.3-3 to confirm by inspection and analysis that the Class 1E protective devices(circuit breakers/fuses) in the dc power system are rated to supply their required loads and withstand fault currents for the time required to clear the fault from the power source.

Impact on DCD

DCD Tier 1, Subsections 2.6.3.1 and Table 2.6.3-3 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.

8. Class 1E dc power system distribution panels and dc control centers are identified according to their Class 1E trains.

9. Class 1E dc power system cables are identified according to their Class 1E trains.

10. Independence is provided between Class 1E dc system trains and between Class 1E and non-Class 1E equipment cables.

11.a All displays and alarms required by the design exist in the MCR as defined in Table 2.6.3-2.

11.b All displays and alarms required by the design exist in the RSR as defined in Table 2.6.3-2.

12. Each of the four Class 1E dc power trains has a main circuit protection device which has selective coordination with downstream protective devices.

2.6.3.2 Inspection, Test, Analyses, and Acceptance Criteria

Table 2.6.3-3 specifies the inspections, tests, analyses, and associated acceptance criteria for the dc power system.

Table 2.6.3-3 (3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. Class 1E dc power system distribution panels and dc control centers are identified according to their Class 1E trains.	8. Inspection of the as-built Class 1E dc distribution panels and dc control centers will be performed.	8. The as-built Class 1E dc power system distribution panels and dc control centers are identified according to their Class 1E trains.
9. Class 1E dc power system cables are identified according to their Class 1E trains.	9. Inspection of the as-built Class 1E dc power system cables will be performed.	9. The as-built Class 1E dc power system cables are identified according to their Class 1E trains.
10. Independence is provided between Class 1E dc system trains and between Class 1E and non-Class 1E equipment cables.	10. Inspection of the as-built Class 1E dc power system will be performed.	10. Physical separation or electrical isolation exists in accordance with RG 1.75 between Class 1E dc system trains and between Class 1E and non-Class 1E equipment cables.
11.a All displays and alarms required by the design exist in the MCR as defined in Table 2.6.3-2.	11.a Inspections will be performed on the displays and alarms in the MCR.	11.a All displays and alarms exist and can be retrieved in the MCR as defined in Table 2.6.3-2.
11.b All displays and alarms required by the design exist in the RSR as defined in Table 2.6.3-2.	11.b Inspections will be performed on the displays and alarms in the RSR.	11.b All displays and alarms exist and can be retrieved in the RSR as defined in Table 2.6.3-2.
12. Each of the four Class 1E dc power trains has a main circuit protection device which has selective coordination with downstream protective devices.	12.a Analyses will be performed to verify the main circuit protection devices have selective coordination with the downstream protective devices.	12.a A report exists and concludes that each of the four Class 1E dc power trains has a main circuit protection device which has selective coordination with the downstream protective devices.
	12.b Inspection of the as-built main circuit protection devices in the as-built dc control centers will be performed.	12.b The as-built main circuit protection device in each of the four Class 1E dc power trains is the same as that used in the coordination analysis.

"A"

10.a Independence is provided between each of the four trains of Class 1E dc distribution equipment and circuits.	10.a Tests will be performed on the as-built Class 1E dc distribution equipment and circuits by providing a test signal in only one train at a time.	10.a The test signal is present in the as-built Class 1E train under test.
10.b Independence is provided between Class 1E dc distribution equipment and circuits and non-Class 1E dc distribution equipment and circuits.	10.b Tests will be performed on the as-built Class 1E and non-Class 1E dc distribution equipment and circuits by providing a test signal in only one train for Class 1E or one division for non-Class 1E at a time.	10.b The test signal is present in the as-built Class 1E train or non-Class 1E division under test.
10.c Class 1E qualified isolation devices provide independence between Class 1E dc distribution equipment and non-Class 1E dc loads.	10.c.i Type tests, analyses, or a combination of type tests and analyses will be performed to verify the qualification of isolation devices.	10.c.i A report exists and concludes that the Class 1E dc distribution equipment is isolated from as-built non-Class 1E dc loads by Class 1E qualified isolation devices in accordance with NRC RG 1.75
	10.c.ii Inspection of the as-built Class 1E dc distribution equipment will be performed.	10.c.ii Class 1E qualified isolation devices are provided between the as-built Class 1E dc distribution equipment and non-Class 1E dc loads.

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
13. The Class 1E batteries of each train are located in a separate room.	13. Inspection of the as-built Class 1E batteries will be performed.	13. The as-built Class 1E batteries of each train are located in a separate room.
14. The Class 1E dc distribution panel, dc control center and battery chargers of each train are located in a separate room.	14. Inspection of the as-built Class 1E dc distribution panel, dc control center and battery chargers will be performed.	14. The as-built Class 1E dc distribution panel, dc control center and battery chargers of each train are located in a separate room.
15. The Class 1E dc power system cables are sized to carry required load currents and to provide minimum design basis voltage at load terminals, considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.	15.a Analysis will be performed to verify the Class 1E dc power system cables are sized to carry required load currents and to provide minimum design basis voltage at load terminals, considering derating due to ambient, cable grouping, and other derating effects as applicable.	15.a A report exists and concludes that the Class 1E dc power system cables are sized to carry required load currents and to provide minimum design basis voltage at load terminals, considering derating due to ambient temperature, cable grouping, and other derating effects as applicable.
	15.b Inspection will be performed to verify the size of the as-built Class 1E dc power system cables installed bound the minimum size required by the analysis.	15.b The as-built Class 1E dc power system cables are sized to bound the minimum sizes determined by the analysis.
16. The Class 1E protective devices(circuit breakers/fuses) in the dc power system are rated to supply their required loads and withstand fault currents for the time required to clear the fault from the power source.	16.a Analysis will be performed to verify the Class 1E protective devices(circuit breakers/fuses) in the dc power system are rated to supply their required loads and withstand fault currents for the time required to clear the fault from the power source.	16.a A report exists and concludes that the Class 1E protective devices(circuit breakers/fuses) in the dc power system are rated to supply their required loads and withstand fault currents for the time required to clear the fault from the power source.
	16.b Inspection will be performed to verify that the ratings of the as-built Class 1E protective devices(circuit breakers/fuses) in the dc power system bound the size requirements of the analysis.	16.b The ratings of the as-built Class 1E protective devices(circuit breakers/fuses) in the dc power system bound the size requirements of the analysis.

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.:	**234-8284**
SRP Section:	**14.03.06 – Electric systems – Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	**14.3.6**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-5

Chapter 2.6 Tier 1 and Chapter 14.3.2.6 Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the containment electrical Penetration Assemblies, as discussed in part g of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.5, please discuss why an ITAAC is not necessary to confirm that separate penetrations are provided for medium voltage circuits, low voltage circuits, control power circuits, and instrumentation signal circuits. Otherwise, please provide an ITAAC.

Response

DCD Tier 1, Subsection 2.6.5.1 and Table 2.6.5-1(2 of 2) will be revised to include separation of penetrations per voltage level as a new ITAAC item.

Impact on DCD

DCD Tier 1, Subsection 2.6.5.1 and Table 2.6.5-1 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.

2.6.5 Containment Electrical Penetration Assemblies

2.6.5.1 Design Description

Containment electrical penetration assemblies (EPAs) are provided for electrical cables passing through the containment. Containment EPAs are classified as seismic Category I.

Containment EPA is designed as follows:

1. The electric power, control, and instrumentation cables pass through the wall of reactor containment building (RCB) via the EPAs.

2. Each EPA can withstand the seismic design basis loads without loss of safety function.

3. Each EPA as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.

4. Independence is provided between trains of EPAs and between EPAs containing Class 1E cables and EPAs containing non-Class 1E cables.

5. The primary and secondary protection devices for each EPA are designed and sized to protect EPA from overload and fault current.

2.6.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.5-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the containment EPAs.

ADD

6. Separate penetrations are provided for medium voltage and low voltage power, control, and instrumentation circuits.

Table 2.6.5-1 (2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
3. Each EPA as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.	3.a Type tests, analyses, or a combination of type tests and analyses will be performed on each EPA located in a harsh environment.	3.a A report exists and concludes that each EPA as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.
	3.b Inspections will be performed on each as-built EPA located in a harsh environment.	3.b A report exists and concludes that each as-built EPA as being qualified for a harsh environment is bounded by the tested or analyzed conditions.
4. Independence is provided between trains of EPAs and between EPAs containing Class 1E cables and EPAs containing non-Class 1E cables.	4. Inspection of the as-built EPAs will be performed.	4. Physical separation exists in accordance with NRC RG 1.75 between as-built trains of EPA and between EPAs containing Class 1E cables and EPAs containing non-Class 1E cables.
5. The primary and secondary protection devices for each EPA are designed and sized to protect EPA from overload and fault current.	5.a Analyses will be performed to verify that the primary and secondary protection devices are sized to protect EPA from overload and fault current.	5.a A report exists and concludes that the as-built primary and secondary protection devices are designed and sized to protect EPA from overload and fault current.
	5.b Inspection of the rating of the primary and secondary protection devices will be performed.	5.b A report exists and concludes that the as-built primary and secondary protection for each EPA meets the protective device selection and setting requirements of the analysis.

ADD

6. Separate penetrations are provided for medium voltage and low voltage power, control, and instrumentation circuits.	6. Inspection of the as-built penetrations for the medium voltage and low voltage power, control, and instrumentation circuits will be performed.	6. Each as-built penetration contains only medium voltage or low voltage power or only control or instrumentation circuits.

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.:	**234-8284**
SRP Section:	**14.03.06 – Electrical Systems – Inspections, Tests, Analyses, and Acceptance Criteria**
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Question No. 14.03.06-6

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the Alternate AC Source, as discussed in part h of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.6, please discuss why an ITAAC is not necessary to confirm that the AAC source is capable of providing power at the set voltage and frequency to the Class 1E bus after receiving a start signal. Otherwise, please provide an ITAAC.

For the Alternate AC Source, as discussed in part h of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.6, please discuss why an ITAAC is not necessary to confirm that controls exist in the MCR and RSR to start, stop, and synchronize the AAC power source. Otherwise, please provide an ITAAC.

Response

ITAAC item 2.c will be added to DCD Tier 1, Table 2.6.6-1 to require a test to verify that the AAC source is capable of supplying rated power to the class 1E bus at the proper voltage and frequency during an SBO or a LOOP condition.

For consistency of ITAAC between the EDG system and the AAC source, DCD Tier 1, Table 2.6.2-3 (7 of 7) item 19 will be revised to include a similar test of the EDG system to ensure its capability of supplying rated power on a LOOP condition.

DCD Tier 1 Subsection 2.6.6.1 and Table 2.6.6-1 Item 4 will also be clarified to add to the existing ITAAC that the AAC source is brought up to the required voltage and frequency before being connected to the train A and train B Class 1E buses after receiving a start signal. Tier 2, Table 14.3.4-2 (5 of 7) will be appropriately revised to be consistent with the Tier 1 ITAAC.

Lastly, DCD Tier 1, Subsection 2.6.6.1 and Table 2.6.6-1 (3 of 3) will be revised to add a new ITAAC, as item 11, to confirm that the controls in the MCR and RSR are capable of starting, stopping and synchronizing the AAC power sources to the train A and train B 1E buses.

Impact on DCD

DCD Tier 1, Subsection 2.6.6.1, Tables 2.6.2-3 and 2.6.6-1, and DCD Tier 2, Table 14.3.4-2 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.

Table 2.6.2-3 (7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. When running ina test mode, an EDG is capable of responding to an automatic start signal.	18. Tests will be performed with each EDG in a test mode configuration. An automatic start signal will be simulated.	18. When running in a test mode, each EDG resets to its automatic control mode upon receipt of a simulated automatic start signal.
19. Each Class 1E EDG is designed and sized to supply power to its train's safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.	19.a Analyses will be performed to verify that each Class 1E EDG is capable of supplying power to its train safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.	19.a A report exists and concludes that each Class 1E EDG is designed and sized to supply power to its train's safety-related loads after a LOOP or a LOOP concurrent with LOCA conditions.
	19.b Inspections will be performed to verify that the rating of each as-built Class 1E EDG is in accordance with the size requirements of the analysis.	19.b The rating of each Class 1E EDG bounds the size requirements of the analysis.
	19.c Test will be performed to verify that the Class 1E EDG is capable of supplying rated power at proper voltage and frequency.	19.c A report exists and concludes that each Class 1E EDG is capable of supplying rated power at proper voltage and frequency.
20. When the Class 1E EDG is started by an ESF actuation signal, all Class 1E EDG protection systems, except for overspeed and generator differential current, are automatically bypassed.	20. Tests will be performed to verify the as-built Class 1E EDG protection systems.	20. A report exists and concludes that the as-built Class 1E EDG protection systems, except for overspeed and generator differential current, are automatically bypassed when the Class 1E EDG is started by an ESF actuation signal.
21. The moderate-energy piping systems are reconciled with pipe rupture hazards analyses report to ensure that the safety-related SSCs are protected against or are qualified to withstand the environmental effects associated with postulate failures of these piping systems.	21. Inspections and analyses of the as-built moderate-energy piping and safety-related SSCs will be performed.	21. Pipe rupture hazard analysis report exits and concludes that the as-built safety-related SSCs are protected against or are qualified to withstand the effects of postulated pipe failures of the as-built moderate-energy piping system.

2.6.6 Alternate AC Source

2.6.6.1 Design Description

The alternate ac (AAC) source supplies power to safety-related loads to maintain the plant in a safe shutdown condition during station blackout (SBO). The AAC source also provides power to the permanent non-safety (PNS) buses during a loss of offsite power (LOOP) condition. The AAC source can be connected to Class 1E trains and PNS trains as shown on Figure 2.6.1-1. The AAC source is a gas turbine generator (GTG) that is independent from the EDGs and the offsite power sources.

The AAC source is designed as follows:

1. The functional arrangement of the AAC source is as 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.

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.

   Add: , brought up to the required voltage and frequency,

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.

5. The AAC source is installed in the separate building.

6. The GTG has sufficient fuel oil storage capacity to supply power to the required SBO loads for 24 hours.

7. The GTG fuel oil system is non safety-related and independent from that of the Class 1E EDGs.

8.a Each fuel oil transfer pump is capable of transferring oil from the fuel oil storage tank to its corresponding day tank at sufficient pressure and flow to cover the maximum demand at GTG continuous rated load while simultaneously increasing day tank level.

8.b The fuel oil transfer pumps have sufficient net positive suction head (NPSH).

9. One fuel oil transfer pump is designed to automatically supply fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.

10. The air intakes for the GTG combustion are separated from the GTG exhaust ducts.

Add

11. All controls required by the design exist in the MCR and RSR to start and stop the AAC GTG and to synchronize the AAC GTG to its respective Class 1E bus.

2.6.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6.6-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the AAC source.

Table 2.6.6-1 (1 of 3)

2.c A report exists and concludes that the AAC source is capable of supplying rated power at proper voltage and frequency.

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.c Tests will be performed to verify that the AAC source is capable of supplying rated power at proper voltage and frequency.	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.

The AAC source is started, brought up to the required voltage and frequency,

Tests will be performed to verify that the as-built AAC source is started, brought up to the required voltage and frequency,

The as-built AAC source is started, brought up to the required voltage and frequency,

Table 2.6.6-1 (3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. One fuel oil transfer pump is designed to automatically supply fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.	9. Tests will be performed on the as-built fuel oil transfer pump by providing a test signal of a simulated fuel oil day tank level.	9. The as-built fuel oil transfer pump starts automatically to supply fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.
10. The air intakes for the GTG combustion are separated from the GTG exhaust ducts.	10. Inspection and analysis of the as-built GTG air intakes and air exhaust will be performed.	10. The air intake and air exhaust are separated by analyzed distance and orientation.

Add

11. All controls required by the design exist in the MCR and RSR to start and stop the AAC GTG and to synchronize the AAC GTG to its respective Class 1E bus.	11. Tests will be performed using the AAC GTG controls in the MCR and RSR.	11. All controls in the as-built MCR and RSR room start and stop the AAC GTG and to synchronize the AAC GTG to its respective Class 1E bus

Table 14.3.4-2 (5 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
2-31	2.6.3 ITAAC #4	The Class 1E dc power system cables are routed in raceway systems within their respective trains.	8.3.2.1.2 19.1.5
2-32	2.6.4 ITAAC #1	The Class 1E 120 Vac I&C power system is separated into four subsystems, trains A, B, C, and D that supply power to the plant protection system channels A, B, C, and D. The Class 1E I&C power system includes four separate and independent 120 Vac power distribution panel, and each system is powered from a 125 Vdc control center via a 125 Vdc/120 Vac static inverter.	8.3.2.1.2.2 19.1.3
2-33	2.6.4 ITAAC #4	When dc input power to the Class 1E inverter power supply unit is lost, input to the Class 1E inverter power supply unit is provided by the regulating transformer without interruption of power supply to the loads.	8.3.2 19.1.3
2-34	2.6.6 ITAAC #1	The alternate ac (AAC) power source supplies power to safety-related loads to maintain the plant in a safe shutdown condition during station blackout (SBO). The AAC power source also provides power to the permanent non-safety (PNS) buses during a loss of offsite power (LOOP) condition. The AAC power source is a gas turbine generator (GTG) that is independent from the EDGs and the offsite power sources.	8.4.1.2 8.4.1.3 19.1.3
2-35	2.6.6 ITAAC #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 c[illegible] circuit breaker at the no[illegible]E A[illegible] breakers during SBO co[illegible] Add , brought up to the required voltage and frequency,	8.3.1.1.1 19.1.3
2-36	2.6.6 ITAAC #4	The AAC source can be started and connected manually to the Class 1E train A or train B bus within 10 minutes in the event of SBO.	8.4.1.3 19.1.3
2-37	2.6.6 ITAAC #6	The GTG has fuel oil storage capacity enough to supply power to the required loads for 24 hours.	9.5.9 19.1.3
2-38	2.7.1.5 ITAAC #11.a	The AFWS is designed to be either manually actuated or automatically actuated by an auxiliary feedwater actuation signal (AFAS) from the engineered safety feature actuation system (ESFAS) or diverse protection system (DPS).	10.4.9 19.1.3

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.:	**234-8284**
SRP Section:	**14.3.6 – Electrical Systems – Inspections, Tests, Analysis, and Acceptance Criteria**
Application Section:	**14.3.6**
Date of RAI Issue:	**10/05/2015**

Question No. 14.03.06-7

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems. GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems. For the Lightning Protection and Grounding System, as discussed in part f of DCD Tier 2 Chapter 14.3.2.6 and DCD Tier 1 Chapter 2.6.7, Table 2.6.7-1, Item 4 discusses equipment grounding. Please discuss whether this includes the ground bus of switchgear, load centers, MCCs, switchboards and revise the ITAAC and DCD Tier 1 as necessary.

Response

As described in part j of Subsection 8.3.1.1.8 of DCD Tier 2, the switchgears, load centers, MCCs, and other electrical cabinets are equipped with ground buses for the equipment grounding and each of them is electrically connected to the equipment enclosure.

In order to clearly indicate the boundaries of equipment grounding in the ITAAC, KHNP will revise part 4 of Subsection 2.6.7.1 and item 4 of Table 2.6.7-1 of DCD Tier 1. Also, part j of Subsection 8.3.1.1.8 of DCD Tier 2 will be revised to be consistent with the design features of the grounding system.

Impact on DCD

DCD Tier 1, Subsection 2.6.7.1, Table 2.6.7-1, and Tier 2, Subsection 8.3.1.1.8 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.

2.6.7 Lightning Protection and Grounding System

2.6.7.1 Design Description

The grounding and lightning protection system is provided for personnel and equipment protection from the effects of transient overvoltage that can occur in electrical systems due to electrical faults or lightning strikes. The grounding and lightning protection system is divided into subsystems such as neutraling grounding, equipment grounding, instrumentation grounding, and lightning protection, and connected to the plant ground grid. The ground conductor spacing and quantity are designed to be sufficient to limit touch voltages to tolerable values.

1. The functional arrangement of the grounding and lightning protection system is as described in the Design Description of Subsection 2.6.7.1.

2. Lightning protection systems are provided for buildings, structures and transformers located outside of the buildings. Surge arrestors are provided for main transformers, auxiliary transformers.

3. Neutral grounding is installed at the ground bus of main generator, main transformer, unit auxiliary transformers, standby auxiliary transformers, load center transformers, low voltage dry-type distribution transformers, EDGs, and AAC GTG.

4. Equipment grounding is installed ~~around~~ at all metal structures such as buildings, tanks, transformers, transmission structures, equipment enclosure, including grounding busbar and raceway.

   add

5. The instrumentation grounding system is a separate radial ground system that consists of instrumentation ground bus and insulated cables.

6. The plant ground grid consists of buried, interconnected bare copper conductors and ground rods forming a plant ground grid that is designed to limit personnel step and touch voltages to an acceptable level during a ground fault.

Table 2.6.7-1 (1 of 2)

Grounding and Lightning Protection System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the grounding and lightning protection system is as described in the Design Description of Subsection 2.6.7.1.	1. Inspection of the as-built grounding and lightning protection system will be performed.	1. The as-built grounding and lightning protection system conforms with the functional arrangement as described in the Design Description of Subsection 2.6.7.1.
2. Lightning protection systems are provided for buildings, structures and transformers located outside of the buildings. Surge arrestors are provided for main transformers, and auxiliary transformers.	2. Inspection of the as-built lightning protection systems will be performed.	2. Lightning protection systems are provided for buildings, structures, and transformers located outside the buildings. Surge arrestors are provided for main transformers and auxiliary transformers.
3. Neutral grounding is installed at the ground bus of main generator, main transformer, unit auxiliary transformers, standby auxiliary transformers, load center transformers, low voltage dry-type distribution transformers, EDGs, and AAC GTG.	3. Inspection of the as-built neutral grounding system will be performed.	3. Neutral grounding is installed at the ground bus of the main generator, main transformer, unit auxiliary transformer, standby auxiliary transformer, and load center.
4. Equipment grounding is installed ~~around~~ [at] all metal structures such as buildings, tanks, transformers, transmission structures, equipment enclosure, [add: including grounding busbar] and raceway.	4. Inspection of the as-built equipment grounding system will be performed.	4. Equipment grounding is installed ~~around~~ [at] all metal structures such as buildings, tanks, transformers, transmission structures, equipment enclosure, [add: including grounding busbar] and raceway.
5. The instrumentation grounding system is a separate radial ground system that consists of instrumentation ground bus and insulated cables.	5. Inspection of the as-built instrumentation grounding system will be performed.	5. The instrumentation grounding system is a separate radial ground system that consists of instrumentation ground bus and insulated cables.

grid in two locations. The IPB is grounded in accordance with manufacturer's recommendation.

g. The onsite medium-voltage ac distribution system is resistance grounded at the neutral point of the low-voltage windings of the UATs and SATs. The UAT and SAT secondary neutral relays are provided protection against internal ground faults in transformer low-voltage windings, as well as the backup ground fault protection for the medium-voltage bus.

h. The neutral point of the EDG and AAC GTG windings is grounded through distribution transformers and loading resistors sized for continuous operation with a ground fault. A ground overvoltage relay connected to the secondary winding of each distribution transformer provides protection against generator stator ground fault.

i. Ground fault protection of the low-voltage ac distribution system is provided by an overcurrent relay located in the neutral of the transformer secondary winding. It is set to coordinate with downstream ground fault protective devices.

buses   and MCCs   are

j. The ground ~~bus~~ of all switchgears, load centers, ~~MCCs, and control cabinets is~~ connected to the plant ground grid through at least two parallel paths. add

k. Each major piece of equipment, metal structure, or metallic tank has two diagonally opposed ground connections.

l. The underground electrical duct bank and door frame are grounded with bare copper cable.

The ground buses of other electrical cabinets are connected to the plant ground grid through at least one path.

m. The dc systems are ungrounded.

n. Plant instrumentation is grounded through separate radial grounding systems that consist of isolated instrumentation ground buses and insulated cables. The instrumentation grounding systems are connected to the station grounding grid at one point only and insulated from all other grounding circuits. The I&C

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

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Question No. 14.03.06-8

Chapter 2.6, Tier 1 and Chapter 14.3.2.6, Tier 2 provide information on the ITAAC of electrical systems.

GDC 17 requires that onsite and offsite power systems provide sufficient capacity and capability and furthermore, GDC 18 requires the testing of electric power systems.

For the Lighting System, as discussed part f of DCD Tier 2 Chapter 14.2.3.6 and DCD Tier 1 Chapter 2.6.8, Table 2.6.8-1, please discuss why an ITAAC is not necessary to confirm that supports for the emergency lighting system fixtures in Class 1E equipment areas can withstand seismic design basis loads. Otherwise, please provide an ITAAC.

Response

As stated in the response to RAI 204-8237, Question 09.05.03-7 (Reference KHNP submittal MKD/NW-15-0254L dated Nov. 12, 2015; ML15316A470), the lighting system equipment, including normal, emergency ac, and emergency dc lighting fixtures located in safety-related areas are classified into seismic Category II. Also, in general, verification of the seismic Category II equipment is not included in Chapter 2 of Tier 1 (Design Description and ITAAC).

For this reason, the ITAAC for lighting systems does not include verification of structural integrity of the lighting system equipment located in safety-related areas.

Impact on DCD

There is no impact on the DCD.

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.