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.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-55

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 Section 14.2.12.1.114 discusses the non-Class 1E DC Power Systems Test. Parts 3.1, 3.2 and 3.3 state test methods for the batteries and battery chargers of the 125Vdc, 250Vdc, and AAC 125Vdc power systems, respectively. Each states that the discharge and charging tests will be performed, which the staff understands is for the batteries. Please discuss the tests for the battery chargers to verify that the battery charger dc output meets design criteria.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

In the developed general revision of Subsection 14.2.12.1.114, the discharge test stated in Part 3.1.1 is for the batteries and the charging test stated in Part 3.1.2 is for the battery chargers. Related items to verify that the battery charger dc output meets design criteria are included in the following Parts: Objectives 1.3, 1.8, and 1.9; Test Methods 3.1.2 and 3.5; Data Required 4.2; and Acceptance Criteria 5.2, 5.4, 5.5, and 5.6.

Impact on DCD

The upgraded DCD Tier 2, Subsections 14.2.12.1.114 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) 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.

5.2 The 480 V_{ac} source and feeder circuit breakers actuates locally and remotely.

5.3 The bus interlocks, alarms, meters, annunciators and protective relays actuates as designed.

5.4 The 480V normal auxiliary power system actuate as designed.

14.2.12.1.114 Non-Class 1E DC Power Systems Test

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1 To demonstrate~~verify ~~the battery and battery chargers have sufficient capacity to supply the power to the specified busloads~~

~~1.2 To verify the proper performance of the battery chargers~~

1.4

~~1.3~~ To verify that the battery does not discharge through the battery charger during a loss of ~~AC power~~ to the battery charger

ac input power

Add "A" (next page)

~~1.4~~ To verify proper operation of the ~~following systems:~~non-Class 1E ~~DC~~ system alarms and status indications

1.7

dc

~~1.1.1 125 Vdc power system~~

~~1.1.2 120 Vac instrument and control power system~~

~~1.1.3 250 Vdc power system~~

~~1.1.4 AAC source 125 Vdc power system~~

chargers

1.8

~~1.5~~ To verify proper operation of the battery ~~charger~~ with its output voltage regulation and ripple within design value

1.1 To verify the capacity and capability of the batteries to carry the worst case load profiles.
1.2 To verify the battery chargers have sufficient capacity to supply the power to the specified bus loads while simultaneously recharging the batteries after its duty cycle test.
1.3 To verify the proper performance of the battery chargers in the float and equalization mode.

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"A"

1.5 To determine the voltage which would be available at the non-Class 1E inverters if the batteries were discharged to the minimum voltage limit.

1.6 To verify that the voltage available to non-Class 1E inverters exceed the design minimum.

1.9

~~1.6~~ To verify the standby battery ~~charger~~ chargers can supply the proper voltage to the ~~Class 1E 125V and 250V DC MCC~~ non-Class 1E dc control center.

2.0 PREREQUISITES

2.1 Construction activities on the non-Class 1E dc power system have been completed. including construction acceptance tests

2.2 Non-Class 1E dc power system instrumentation has been calibrated.

2.3 Support systems required for operation of the non-Class 1E power system are completed and operational. dc

2.4 Test instrumentation is available and calibrated.

2.5 Batteries are fully charged.

2.7 The non-Class 1E inverters are operable.
2.8 Required load test devices for the non-Class 1E inverters are available.

2.6 Load banks are available for discharge test.

2.9 ~~2.7~~ Operation of all breakers and cables ~~is~~has been verified.

2.10 ~~2.8 Ventilation systems are in operation as needed.~~ Battery room ventilation is available.

3.0 TEST METHOD

~~3.1 Demonstrate that the batteries and battery chargers of the 125 V_{dc} power system meet design capacities by performing discharge and charging tests.~~

~~3.2 Demonstrate that the batteries and battery charges of the 250 V_{dc} power system meet design capacities by performing discharge and charging tests.~~

3.1 Demonstrate that the batteries and battery chargers meet design capacities by performing discharge and charging tests as follows:
3.1.1 Perform battery modified performance test or service test per IEEE Std. 450-2010 as endorsed by NRC RG 1.129.
3.1.2 Perform battery charger capacity test to verify battery charger output meets design requirements.

~~3.3 Demonstrate that the battery and charger of the alternate ac source 125 Vdc power system meet design capacity by performing a discharge and charging test.~~

3.2

battery bank minimum voltage limit

~~3.4~~3.3 Verify that ~~minimum bank~~ and individual cell limits are not exceeded during battery discharge tests.

Add "B" (next page)

~~3.5~~4 ~~Verify the proper operation of the inverters, manual transfer switches, frequency synchronization, and blocking diodes.~~

~~3.6~~5 ~~Verify that the inverters automatically transfer the input to the regulating transformer upon loss of preferred power.~~

~~3.7~~6 ~~Place the battery chargers on equalize and verify the dc equalizing voltage does not result in driving the inverter, relieving the rectifier from carrying the inverter load.~~

~~3.8~~7 ~~Verify proper operation of all protective devices, controls, interlocks, alarms, computer inputs, and ground detection.~~

~~3.9~~8 ~~Verify the operation of bus transfer devices.~~

4.0 DATA REQUIRED

Add "C" (next page)

~~4.1 Battery voltage and load current without charger~~

~~4.2 Charger float voltage and current~~

~~4.3 Test discharge recording of voltage, current, temperature, capacity in ampere-hours, and individual cell voltages~~

~~4.4 Charger voltage and current as battery eliminator~~

~~4.5 Inverter voltage, frequency, and current from preferred~~alternate ~~source (regulation transformer)~~

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"B"

3.3 After the non-Class 1E inverter is loaded to its design capacity, measure the voltage drop from the battery to the inverter input.

3.4 Determine the minimum available voltage at the non-Class 1E inverters from the measured voltage drops and the battery minimum voltage limit.

3.5 Verify the performance of battery chargers (including standby battery chargers), batteries, and dc control centers meets design requirements.

3.6 Verify the proper operation of all protective devices, controls, interlocks, alarms, status indications, computer inputs, and ground detection.

"C"

4.1 Records of discharge test for battery terminal voltage, current, temperature, capacity, and individual cell voltages

4.2 Records of charging test for battery charger float voltage and current, and charging time

4.3 Records of the non-Class 1E inverter input voltages

~~4.6 Inverter voltage, frequency, and current from battery source (preferred source)~~

4.4

4.5 System status indications

~~4.7~~ Setpoints at which alarms, interlocks, and controls activate

5.0 ACCEPTANCE CRITERIA (including standby battery chargers) are capable of operating within design requirements.

5.1 The non-Class 1E dc power system supplies the loads as described ~~in Subsection~~Table 8.3.2~~.1.1~~-2.

~~5.2 Standby battery chargers can supply proper voltage to 125V/250V DC MCC and manually transfer from normal battery chargers.~~

5.2

~~5.3~~ The battery chargers ~~are capable of operating within design value.~~

5.3

duty cycle test requirements

~~5.4~~ The battery shall demonstrate its ability to meet the ~~test requirements for duty cycle within design value.~~

~~5.5 Battery chargers can supply the designed load current, and at the same time, can charge the battery within design value after the battery discharge test of duty cycle.~~

Add "D" (next page)

~~5.6 With the battery chargers in the float and equalization mode and battery connected, each battery charger supplies constant setting voltage.~~

annunciator

5.7 Simulation of the ~~125V DC MCC device for ground fault detection~~ and under voltage relay initiates the actuation of ~~IPS~~ alarm and indicating light.

non-Class 1E dc control center bus ground protective relay

5.8 Open/Trip of battery ~~feeders output~~ breakers initiates the actuation of ~~IPS~~ alarm and indicating light.

feeder

annunciator

annunciator

5.9 Open/Trip of battery charger incoming breakers with opening of standby battery chargers incoming breaker initiates the actuation of ~~IPS~~ alarm and indicating light.

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"D"

5.4 The battery chargers (including standby battery chargers) can supply the designed load current, and at the same time, can charge the battery within 24 hours after the battery duty cycle test.

5.5 With the battery charger in the float mode and battery connected, each battery charger suppliesconstant setting voltage.

5.6 With the battery charger in the equalization mode and battery connected, each battery charger supplies constant setting voltage.

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annunciator

5.10 Closure of the battery test panel breakers initiates the actuation of ~~IPS~~ alarm and indicating light.

5.11 Open/Trip of battery charger output breaker initiates the actuation of annunciator alarms and indicating light.

dc

5.12

5.11 Simulation of the ~~DC~~ output ~~fail under current and over voltage~~ of the battery ~~chargers~~ initiates the actuation of ~~IPS~~ alarm and indicating light.

charger ac annunciator failure (under current)

5.14

5.12 Simulation of the ~~AC~~ input failure of the battery chargers initiates the actuation of ~~IPS~~ alarm and indicating light.

The battery

5.15

5.13 ~~Battery~~ does not discharge through the ~~charger during a loss of AC power.~~

battery charger during a loss of ac input power to the battery charger.

~~5.14 The standby battery chargers are capable of operating within design value.~~

5.16 The minimum available input voltage for the non-Class 1E inverters equals or exceeds 100 V for 125 Vdc system or 200 V for 250 Vdc system.

~~5.15 Standby battery chargers can supply the designed load current, and at the same time, can charge the battery within design value.~~

~~5.16 With standby battery chargers incoming breaker close, opening of standby battery chargers output breaker initiates the actuation of IPS alarm and indicating light.~~

5.17 The proper operation of the non-Class 1E dc system alarms and status indications.

14.2.12.1.115 Class 1E DC Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~ verify the battery and battery chargers have sufficient capacity to supply specified busloads

1.2 To verify the proper performance of the battery chargers in the float and equalization mode

1.3 To verify that the battery does not discharge through the battery chargers during a loss of AC power.

5.13 Simulation of the dc under voltage and over voltage of the battery charger initiates the actuation of annunciator alarm and indicating light.

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RAI No.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-56

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 Section 14.2.12.1.115 discusses the Class 1E DC Power Systems Test and the objective is stated as “To demonstrate that the Class 1E dc power system is capable of supplying power as designed in the different operating modes.” Please clarify whether this test demonstrates the Class 1E is capable to perform as designed in the required operating modes.

Part 3.1, states test methods for the batteries and battery chargers and that the discharge and charging tests will be performed, which the staff understands is for the batteries. Please discuss the tests for the battery chargers to verify that the battery charger dc output meets design criteria.

Please discuss how the electrical independence and redundancy of power supplies for safety related functions are checked for the Class 1E DC power system.

Please discuss how this test determines the voltage which would be available at the Class 1E inverters exceeds the design minimum if the batteries were discharged to the minimum voltage limit.

Response

KHNP has reviewed the subject question and understands the staff’s request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted

items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

In the developed general revision of Subsection 14.2.12.1.115, the capacity and capability of Class 1E dc system in the required operating modes is demonstrated by the tests as described in Parts 1.1, 1.2, 3.1.1, 3.1.2, 5.1, 5.2, and 5.3.

The discharge test stated in Part 3.1.1 is for the batteries and the charging test stated in Part 3.1.2 is for the battery chargers. Related items to verify that the battery charger dc output meets design criteria are included in the following Parts: Objectives 1.3, 1.8, and 1.9; Test Methods 3.1.2 and 3.5; Data Required 4.2; and Acceptance Criteria 5.2, 5.4, 5.5, and 5.6.

The electrical independence and redundancy of power supplies for safety related functions are tested and verified as stated in Parts 1.10, 3.7, and 5.18.

The minimum voltages of the battery bank and individual cells are checked and verified in accordance with Parts 3.2 and 4.1. The minimum available voltage at the Class 1E inverters is tested and verified as stated in Parts 1.5, 1.6, 3.3, 3.4, 4.3, and 5.16.

Impact on DCD

The upgraded DCD Tier 2, Subsections 14.2.12.1.115 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) 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.

5.10 Closure of the battery test panel breakers initiates the actuation of IPS alarm and indicating light.

5.11 Simulation of the DC output fail under current and over voltage of the battery chargers initiates the actuation of IPS alarm and indicating light.

5.12 Simulation of the AC input failure of the battery chargers initiates the actuation of IPS alarm and indicating light.

5.13 Battery does not discharge through the charger during a loss of AC power.

5.14 The standby battery chargers are capable of operating within design value.

5.15 Standby battery chargers can supply the designed load current, and at the same time, can charge the battery within design value.

5.16 With standby battery chargers incoming breaker close, opening of standby battery chargers output breaker initiates the actuation of IPS alarm and indicating light.

14.2.12.1.115 Class 1E DC Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1~~ To ~~demonstrate~~ verify the battery and battery chargers have sufficient capacity to supply specified busloads

~~1.2~~ To verify the proper performance of the battery chargers in the float and equalization mode

1.3

charger during a loss of ac input power to the battery charger.

~~1.3~~ To verify that the battery does not discharge through the battery ~~chargers during a loss of AC power.~~

1.4

1.1 To verify the capacity and capability of the batteries to carry the worst case load profiles.
1.2 To verify the battery chargers have sufficient capacity to supply the power to the specified bus loads while simultaneously recharging the batteries after its duty cycle test.

Add "A" (next page)

1.7 ~~1.4~~ To verify proper operation of the Class 1E ~~dc power system is capable of supplying power as designed in the different operating modes~~~~DC~~ ~~System~~ alarms and status indications

dc system

1.8 ~~1.5~~ To verify the proper operation of the battery charger with its output voltage regulation and ripple within design value

125 Vdc control center.

1.9 ~~1.6~~ To verify the standby battery ~~charger~~ can supply the proper voltage to the Class 1E ~~125V DC MCC~~

Add "B" (next page)

2.0 PREREQUISITES

chargers

2.1 Construction activities on the Class 1E dc power system have been completed.

including construction acceptance tests

2.2 Class 1E dc power system instrumentation has been calibrated.

2.3 Support systems required for operation of the Class 1E dc power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

2.5 Batteries are fully charged.

2.6 Load banks are available for discharge test.

Add "C" (next page)

2.9 ~~2.7~~ Operation of all breakers and cables has been verified.

2.10 ~~2.8~~ ~~Ventilation systems are in operation as needed~~.

Battery room ventilation is available.

3.0 TEST METHOD

Add "D" (next page)

~~3.1 Demonstrate that the batteries and battery chargers meet design capacities by performing discharge and charging tests~~.

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"A"

1.5 To determine the voltage which would be available at the Class 1E inverters if the batteries were discharged to the minimum voltage limit.

1.6 To verify that the voltage available to Class 1E inverters exceed the design minimum.

"B"

1.10 To verify the electrical independence and redundancy of the Class 1E dc power supplies for safety-related functions.

"C"

2.7 The Class 1E inverters are operable.

2.8 Required load test devices for the Class 1E inverters are available.

"D"

3.1 Demonstrate that the batteries and battery chargers meet design capacities by performing discharge and charging tests as follows:

3.1.1 Perform battery modified performance test or service test per IEEE Std. 450-2010 as endorsed by NRC RG 1.129.

3.1.2 Perform battery charger capacity test to verify battery charger output meets design requirements.

3.2 Verify that ~~minimum bank~~ and individual cell limits are not exceeded during battery discharge test.

battery bank minimum voltage limit

~~3.3 Verify the proper operation of the inverters, manual transfer switches, frequency synchronization, and blocking diodes.~~

~~3.4 Verify that the inverters automatically transfer input to the regulating transformer upon loss of preferred power.~~

~~3.5 Place the battery chargers on equalize and verify dc equalizing voltage does not result in driving the inverter, relieving the rectifier from carrying the inverter load.~~

~~3.6 Verify proper operation of all protective devices, controls, interlocks, alarms, computer inputs, and ground detection.~~

~~3.7 Verify the proper operation of the vitalClass 1E 120V instrumentation and control power system status information subsystem.~~

~~3.8 Verify proper operation of bus transfer devices.~~

Add "E" (next page)

4.0 DATA REQUIRED

~~4.1 Battery voltage and load current without charger~~

~~4.2 Charger float voltage and current~~

4.3 Records of the Class 1E inverter input voltages

~~4.3 Test discharge recordings of voltage, current, temperature, capacity in ampere-hours, and individual cell voltages~~

~~4.4 Charger voltage and current as battery eliminator~~

~~4.5 Inverter voltage, frequency, and current from alternate preferred source (regulating transformer).~~

4.1 Records of discharge test for battery terminal voltage, current, temperature, capacity, and individual cell voltages
4.2 Records of charging test for battery charger float voltage and current, and charging time

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"E"

3.3 After the Class 1E inverter is loaded to its design capacity, measure the voltage drop from the battery to the inverter input.

3.4 Determine the minimum available voltage at the Class 1E inverters from the measured voltage drops and the battery minimum voltage limit.

3.5 Verify the performance of battery chargers (including standby battery chargers), batteries, and dc control centers meets design requirements.

3.6 Verify the proper operation of all protective devices, controls, interlocks, alarms, status indications, computer inputs, and ground detection.

3.7 Verify the electrical independence and redundancy of the Class 1E dc power supplies for safety-related functions in accordance with NRC RG 1.41.

~~4.6~~ ~~Inverter voltage, frequency, and current from battery source (preferred source).~~

4.4 → ~~4.7~~ Setpoints at which alarms, interlocks, and controls activate

4.5 → ~~4.8~~ System status ~~information subsystem~~ indications

5.0 ACCEPTANCE CRITERIA

5.1 The Class 1E dc power system supplies the loads as described in ~~Subsection~~Table 8.3.2~~.~~-1~~.2~~.
(including standby battery chargers) are capable of operating within design requirements.

5.2 The battery chargers ~~are capable of operating within design value.~~

The battery

duty cycle test requirements

5.3 ~~Battery~~ shall demonstrate its ability to meet the ~~test requirements for duty cycle within design value.~~

Add "F" (next page) →

~~5.4 Battery chargers can supply the designed load current, and at the same time, can charge the batter within design value after the battery discharge test of duty cycle.~~

~~5.5 With the battery chargers and the battery connected each battery charger supplies constant voltage within design value.~~

dc control center

annunciator alarm and indicating light

5.7 → ~~5.6~~ Simulation of the Class 1E ~~DC MCC~~ bus ground protective relay and ~~under voltage~~ relay initiates the actuation of ~~alarm~~.

under voltage

5.8 → ~~5.7~~ Open/Trip of battery feeder breakers initiates the actuation of annunciator alarm and indicating light

5.9 Open/Trip of battery charger incoming breakers with opening of standby battery charger incoming breaker initiates the actuation of annunciator alarm and indicating light.

5.10 → ~~5.8~~ ~~Close~~ of battery test panel breakers initiates the actuation of annunciator alarm and indicating light.

Closure

dc

(under current)

annunciator alarm

5.12 → ~~5.9~~ Simulation of the ~~DC~~ output failure ~~and under voltage and over voltage~~ of the battery charger initiates the actuation of ~~alarm~~ and indicating light.

5.11 Open/Trip of battery charger output breaker initiates the actuation of annunciator alarms and indicating light.

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"F"

5.4 The battery chargers (including standby battery chargers) can supply the designed load current, and at the same time, can charge the battery within 24 hours after the battery duty cycle test.

5.5 With the battery charger in the float mode and battery connected, each battery charger supplies constant setting voltage.

5.6 With the battery charger in the equalization mode and battery connected, each battery charger supplies constant setting voltage.

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5.13 Simulation of the dc under voltage and over voltage of the battery charger initiates the actuation of annunciator alarm and indicating light.

5.10 Simulation of the ~~AC~~ input failure of the battery chargers initiates the actuation of ~~alarm~~ and indicating light.

ac

5.14

annunciator alarm

~~5.11 Verify that bus voltage of Class 1E DC Control centers.~~

5.15 The battery

~~5.12 Battery~~ does not discharge through the ~~charger during a loss of AC power.~~

battery charger during a loss of ac input power to the battery charger.

14.2.12.1.116 Offsite Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To verify that the offsite power system is capable of supplying the power as designed to the unit through the two preferred power circuits

1.2 To verify the power generated by the turbine generator can be fed to grid through the offsite power system

2.0 PREREQUISITES

2.1 Construction activities on the offsite power system have been completed.

2.2 Offsite power system instrumentation has been calibrated.

2.3 Support systems required for operation of the offsite power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify operation of the switchyard protective relaying system.

5.16 The minimum available input voltage for the Class 1E inverters equals or exceeds 100 Vdc.
5.17 The proper operation of the Class 1E 125 Vdc system alarms and status indications.
5.18 Each electrical division operates independently of other divisions.

REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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Docket No. 52-046

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Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-57

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 Section 14.2.1.12.1.110 discusses the Unit Main Power System Test. Part 3.6 states, “verify the operation of interlocks, alarms, and protective relays.” Please discuss how this test verifies that the backup relay protection scheme works for simulated single failures by verifying operation of the primary and backup relay systems.

Response

KHNP has reviewed the subject question and understands the staff’s request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

Protection of the major components (e.g., main generator, main transformer, and unit auxiliary transformers) of the unit main power system is provided by three multifunction protective systems (MPSs). When a protective function in one MPS detects a fault, the MPS provides a signal (e.g., trip and/or alarm) for operation of a lockout relay and associated protective equipment. The MPSs of major components are provided with a two-out-of-three (2oo3) coincidence logic in order to preclude spurious operation of protective equipment due to any erroneous operation of any single MPS and to provide reasonable assurance of secure operation of the protective equipment under a fault condition. Upon receipt of at least two individual signals out of three MPSs, the lockout relay is energized and trips the associated protective device(s).

In the preoperational tests phase, operation of the protection scheme is checked and verified by circuit operational tests, which ensure the relay protection scheme works in the event of a single failure.

Impact on DCD

The upgraded DCD Tier 2, Subsections 14.2.12.1.110 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) 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.

5.13 De-energizing of the alarm relay for the 480V MCC initiates an alarm.

5.14 The 480V LC feeder breakers closed in the connected position.

14.2.12.1.110 Unit Main Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate that the unit main power system is capable of supplying power to designated loads and transmitting power from the main generator to the transmission system

including construction acceptance tests

2.0 PREREQUISITES

2.1 Construction activities on the unit main power system have been completed.

Support systems required for operation of the unit main power system are operational.

2.2 The offsite power ~~distributions~~ system is available.

2.3 ~~Buses and equipment have been voltage tested with acceptable results.~~

The turbine and main generator, switchyard, and switchgears are available for synchronized operation.

2.4 ~~Equipment has been visually inspected.~~

Meters, relays, and protective devices have been calibrated and tested.

2.5 ~~Control power is available.~~

~~2.6 Plant conditions are such that the main generator can be operated.~~

3.0 TEST METHOD

~~3.1 Demonstrate the ability of the main transformers to supply power to the unit auxiliary transformers from the offsite power source.~~

3.1

~~3.2~~ Demonstrate the ability of the main transformers to transmit power from the main generator to the offsite power ~~transmission~~ system ~~at rated voltage and load~~.

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3.2 ~~3.3~~ Demonstrate the ability of the main generator to generate ~~designed voltage and load.~~ power.

3.3 ~~3.4~~ Demonstrate the ability of the unit auxiliary transformers to supply station ~~loads.~~ auxiliaries.

3.4 ~~3.5~~ Verify the operation of the generator circuit breaker.

3.5 ~~3.6~~ Verify the operation of interlocks, alarms, and protective relays.

3.6 ~~3.7~~ Verify the operation of the main generator auxiliary systems.

4.0 DATA REQUIRED

4.1 Main generator operating data ~~at load~~

4.2 Main transformer operating data

4.3 Unit auxiliary transformer operating data

4.4 Generator circuit breaker operating data

4.5 ~~4.4~~ Setpoints ~~of alarms, interlocks, and controls~~ at which alarm, interlocks, and protective relays activate

5.0 ACCEPTANCE CRITERIA

5.1 The unit main power system operates as described in ~~Subsection~~subsection 8.3.1.1~~.~~ Subsection 8.2.1.

~~5.2 The main transformers can be supply power to the unit auxiliary transformers from the offsite power source.~~ transmits

5.2 ~~5.3~~ The main transformers ~~can transmit~~ power from the main generator to the offsite power ~~transmission~~ system ~~at rated voltage and load~~.

5.3 ~~5.4~~ The main generator ~~can generate designed voltage and load.~~ generates power as designed.

5.4 ~~5.5~~ The unit auxiliary transformers ~~can be~~ supply station ~~loads.~~ auxiliaries.

5.5 ~~5.6~~ The generator circuit breaker ~~is~~ operates as designed.

5.6 ~~5.7~~ The interlocks, alarms, and protective relays ~~are operates~~ as designed. operate

5.7 ~~5.8~~ The main generator auxiliary systems ~~are operates~~ as designed.

14.2.12.1.111 13,800V Normal Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~verify the manual transfer operation between UAT and SAT each other

1.2 To verify the fast auto transfer operation from UAT to SAT

1.3 To verify the residual voltage transfer operation from UAT to SAT

1.4 To verify the operation of the non-Class 1E 13,800V ~~normal auxiliary power system~~switchgear protective relays

1.5 To verify the CCS trouble/disabled status indications and alarms

2.0 PREREQUISITES

2.1 Construction activities on the 13,800V normal auxiliary power system ~~have~~has been completed.

2.2 ~~13~~The13,800V normal auxiliary power system instrumentation has been calibrated.

2.3 Support systems required for operation of the 13,800V normal auxiliary power system are completed and operational.

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.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-58

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 Section 14.2.1.12.1.111 discusses the 13,800 V normal auxiliary power system test. Please discuss how this test verifies the alignment of the 13.8kV buses to the alternate offsite supply, upon a loss of normal offsite power supply. This request stems from discussion at the February 2016 meeting with the applicant.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

The alignment of the 13.8 kV and 4.16 kV buses to the alternate offsite power supply upon a loss of normal offsite power supply is demonstrated by the automatic bus transfer tests for the 13.8 kV and 4.16 kV auxiliary power systems. The general revision of DCD Tier 2, Subsections 14.2.12.1.108 (4.16 kV Class 1E), 14.2.12.1.111 (13.8 kV non-Class 1E), and 14.2.12.1.112 (4.16 kV non-Class 1E) have incorporated changes to comprise the test methods and acceptance criteria for the automatic bus transfer tests.

Detailed procedures for the bus transfer tests for the 4.16 kV and 13.8 kV auxiliary power systems will be developed and provided by the COL applicant as specified by COL 14.2(2).

Impact on DCD

The upgraded DCD Tier 2, Subsections 14.2.12.1.108, 14.2.12.1.111, and 14.2.12.1.112 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) 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.

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5.7 MMIS communication shall be performed as designed

5.8 Alarm verification functions of RMS computer & SRDC is verified

5.9 When power fail, the network server shall be transferred to other computer as designed

5.10 Digital and analog input test shall be as designed

5.11 Monitor sample containment isolation valve operate as designed

5.12 ESFAS-CPIAS is operated from the high radiation alarm of containment operating/upper operating area radiation monitor

5.13 ESFAS-FHEVAS is operated from the high radiation alarm of spent fuel pool area radiation monitor

5.14 Alarm form monitor to MMI display is verified

14.2.12.1.108 4,160V Class 1E Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

and/or

1.1 To ~~demonstrate~~verify the local ~~and~~ remote operation of ~~4,160V~~ the Class 1E ~~systems~~4,160V switchgear(SWGR) ~~supply~~ breaker

~~1.2 To verify the manual transfer operation of supply breaker~~

~~1.3 To verify the fast auto transfer operation from unit auxiliary transformer(UAT) breaker to standby auxiliary transformer(SAT) breaker~~

~~1.4 To verify the residual voltage transfer operation from UAT breaker to SAT breaker~~

1.2 To verify the automatic transfer (fast and residual voltage) of the buses from the unit auxiliary transformer (UAT) to the standby auxiliarytransformer (SAT)
1.3 To verify the manual transfer operation of SWGR incoming breakers
1.4 To verify the operation of the protective relays

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1.5 To verify the operation of system instrumentation and controls
1.6 To verify the operation of system annunciation

~~1.5 To verify the operation of the Class 1E 4,160V SWGR protective relays~~

~~1.6 To verify the component control system(CCS) trouble/disabled status indications and alarms at annunciator panels~~

~~1.7 To verify the operation of system annunciation~~

~~1.8 To verify the function of sequence of event (SOE) signal properly~~

2.0 PREREQUISITES

2.1 Construction activities including construction acceptance tests on the 4,160V Class 1E auxiliary power system have been ~~have been~~were completed.

2.2 The 4,160V Class 1E auxiliary power system instrumentation has been calibrated.

2.3 Support systems required for operation of the 4,160V Class 1E auxiliary power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

2.5 ~~All~~The voltage of all 4~~.16 kV~~,160V feeders and buses ~~voltage~~ are tested ~~with~~and within acceptable ~~results~~limits.

2.6 The 4~~.16 kV~~,160V power is available from the ~~normal and alternate engineered safety feature (ESF) transformer sources.~~ UAT and SAT.

2.7 SWGR ~~Switchgear~~ assembly, breakers, control and protective equipment/ circuits have been inspected and tested, and are capable of being placed into service.

2.8 The emergency diesel generator and alternate ac power sources are available.

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3.0 TEST METHOD

3.1 Demonstrate the operability of the ~~feeder and cross-tie protective circuit~~ breakers locally ~~and~~ remotely.

4,160V SWGR breakers

and/or

3.2 Demonstrate the operability of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of meters and annunciators.

~~3.4 Load the systems to the extent practicable and verify that the full load voltage is within system design parameters. Verify the capability of bus loads to start and operate properly when connected to the 4,160V Class 1E buses.~~

on undervoltage condition (loss of voltage and degraded voltage condition).

3.4

~~3.5~~ Verify the 4,160V ~~and 480V~~ safety-related systems load shed as designed ~~on undervoltage~~during under voltage condition~~.~~

3.5

~~3.6~~ Verify the 4,160V Class 1E buses can be energized from power sources including the ~~unit auxiliary transformer, respective standby auxiliary transformer~~, emergency diesel generators, and the alternate ac source.

power

UAT, SAT

3.6 Demonstrate the automatic transfer of the Class 1E 4,160V SWGR from the UAT to SAT.

3.7 Demonstrate the manual transfer of the Class 1E 4,160V SWGR from the UAT to SAT and from the SAT to UAT.

4.0 DATA REQUIRED

~~4.1 Full load bus voltage data~~

4.1

~~4.2~~ Setpoints at which alarms, interlocks, and protective relays activate

4.2

~~4.3~~ System response to low bus voltage

5.0 ACCEPTANCE CRITERIA

5.1 The 4,160V Class 1E auxiliary power system operates as described in ~~Subsection~~subsection 8.3.1.1.2.

Subsection

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5.2 The 4,160V SWGR ~~supply~~ breakers are ~~closed and tripped in the test and connected positions.~~ operated correctly locally and/or remotely.

~~5.3 The diesel generators supply breakers are closed and tripped in the test and connected positions.~~

~~5.4 The tie PCB of AAC SWGR closed and tripped in the test position.~~

~~5.5 The Class 1E 4,160V SWGR diesel generator supply power circuit breaker (PCB) should not be closed in manual mode.~~

~~5.6 The normal and alternate power circuit breakers closed only manually in synchrony mode after the diesel generator feed PCB is close.~~

~~5.7~~ Power supply to the 4,160V SWGR is transferred manually from UAT source to SAT source and from SAT source to UAT source. (5.3)

~~5.8~~ With the 4,160V bus voltage and SAT voltage synchronized, a fast automatic transfer within specified time ~~auto transfer~~ from UAT to SAT breaker occurs when the unit protection trip circuit is actuated. (5.4)

~~5.9 Actuation of the SAT protection trip relays, trip and block their associated breakers, and their statuses are indicated.~~

~~5.10 The 4,160V bus voltage and SAT voltage not synchronized when the UAT supply breaker is tripped, residual voltage transfer operation from UAT breaker to SAT breaker occurs.~~

~~5.11 Actuation of overcurrent relays initiate an alarm annunciation, trip the associated closed supply breaker, and block the closing circuit of all incoming breakers.~~

~~5.12 Upon actuation of an overcurrent relays at the 4,160V Class 1E incoming breakers.~~

5.5 With the 4,160V bus voltage and SAT voltage not synchronized, a residual voltage transfer from UAT source to SAT source occurs when unit protection trip and bus residual voltage are actuated.

5.6 Actuation of the protection trip relays, trip and block their associated breakers, and their statuses are indicated.

~~5.14 Actuation of under voltage relay or negative phase sequence relay initiates system annunciation.~~

~~5.14 Loss of 125V DC control power to the bus under voltage relays initiated system annunciation.~~

~~5.15 Actuation of secondary under voltage relays at the UAT & SAT of SWGRs initiate system annunciation.~~

~~5.16 Actuation of under voltage relay of SWGR trips the tiebreaker and initiates system annunciation.~~

~~5.17 LC XFMR Feed PCB closed and tripped in the test position.~~

14.2.12.1.109 480V Class 1E Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~verify the operation of the 4,160V SWGR feeder breaker in both test and connected positions

1.2 To verify that the 4,160V SWGR feeder breaker protective relays function properly

1.3 To verify the operation of the 480V ~~Class 1E auxiliary power system~~LC incoming and feeder breaker in both test and connected positions

1.4 To verify that the 480V LC incoming and LC feeder breaker protective relays function properly

1.5 To verify that the trouble/disabled status indication and alarms function properly

1.6 To verify the operation of the 480V feeder breaker in connected position

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5.5 The unit auxiliary transformers can be supply station loads.

5.6 The generator circuit breaker is operates as designed.

5.7 The interlocks, alarms, and protective relays are operates as designed.

5.8 The main generator auxiliary systems are operates as designed.

14.2.12.1.111 13,800V ~~Normal~~ Auxiliary Power System Test

Non-Class 1E

Change to 'A' in page 12/12

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1 To demonstrate~~verify the manual transfer operation between UAT and SAT each other

~~1.2 To verify the fast auto transfer operation from UAT to SAT~~

~~1.3 To verify the residual voltage transfer operation from UAT to SAT~~

~~1.4 To verify the operation of the non-Class 1E 13,800V normal auxiliary power system~~switchgear protective relays

~~1.5 To verify the CCS trouble/disabled status indications and alarms~~

2.0 PREREQUISITES

including construction acceptance tests

2.1 Construction activities on the 13,800V ~~normal~~ auxiliary power system have been ~~have~~has ~~been~~ completed.

non-Class 1E

2.2 ~~13~~The13,800V ~~normal~~ auxiliary power system instrumentation has been calibrated.

non-Class 1E

non-Class 1E

2.3 Support systems required for operation of the 13,800V ~~normal~~ auxiliary power system are completed and operational.

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2.4 Test instrumentation is available and calibrated.

2.5 ~~Unit auxiliary transformers available.~~

The 13,800V power is available from the UAT and SAT.

2.6 ~~All 13.8 kV feeders and buses have been voltage tested with acceptable results.~~

The voltage of all 13,800V feeders and buses are tested and within acceptable limits.

SWGR

2.7 ~~Switchgear~~ assembly, breakers, control and protective equipment/ circuits have been inspected and tested and are capable of being placed into service.

3.0 TEST METHOD

3.4 Verify the 13,800V buses can be energized from power sources including the UAT and SAT.

3.5 Demonstrate the automatic transfer of the non-Class 1E 13,800V SWGR from the UAT to SAT.

3.1 Demonstrate the operability of the ~~13.8 kV feeder circuit breakers locally and remotely.~~

13,800V SWGR breakers locally and/or remotely.

3.2 Demonstrate the operability of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of meters and annunciators.

3.6 Demonstrate the manual transfer of the Class 1E 4,160V SWGR from the UAT to SAT and from the SAT to UAT.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays activate.

5.0 ACCEPTANCE CRITERIA

non-Class 1E

5.1 The 13,800V ~~normal~~ auxiliary power system operates as described in

Subsection

~~Subsection~~subsection 8.3.1.1.1.1.

5.2 The 13,800V ~~switchgear incoming breakers should be closed and tripped in the test and connected positions.~~

SWGR breakers are operated correctly locally and/or remotely.

Power supply

5.3 ~~The power supplied~~ to the 13,800V ~~switchgear~~ transferred manually from UAT source to SAT source and from SAT source to UAT source.

SWGR is

SWGR

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5.4 With the 13,800V ~~switchgear bus~~ voltage and SAT voltage synchronized, the fast automatic transfer within specified time from UAT source to SAT source occurs only when the unit protection trip actuated.

SWGR

5.5 With the 13,800V ~~bus~~ voltage and SAT voltage not synchronized, a residual voltage transfer from UAT source to SAT source occurs when unit protection trip and bus residual voltage are actuated.

5.6 Actuation of ~~overcurrent relay initiates an annunciation alarm, trips the closed supply breaker and blocks the closing circuit of both 13,800V switchgear supply breakers.~~ the protection trip relays, trip and block their associated breakers, and their statuses are indicated.

14.2.12.1.112 4,160V ~~Normal~~ Auxiliary Power System Test

Non-Class 1E

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1 To demonstrate~~verify ~~the operation of the Class 1E and non-Class 1E~~ 4,160V ~~normal auxiliary power~~switchgear protective relays

~~1.2 To verify the CCS trouble/disabled status indications and alarms~~

~~1.3 To verify the manual transfer operation between UAT & SAT each other.~~

~~1.4 To verify the fast auto transfer operation from UAT to SAT~~

~~1.5 To verify the residual voltage transfer operation from UAT to SAT~~

~~1.6 To verify the operation of~~ ~~system~~ ~~annunciation~~

2.0 PREREQUISITE

including construction acceptance tests

2.1 Construction activities on the 4,160V ~~normal~~ auxiliary power system have been completed.

non-Class 1E

Change to 'B' in page 12/12

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2.2 The 4,160V ~~normal~~ non-Class 1E auxiliary power system instrumentation has been calibrated.

2.3 Support systems required for operation of the 4,160V ~~normal~~ non-Class 1E auxiliary power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

2.5 ~~All 4.16 kV feeders and buses have been voltage tested with acceptable results.~~ The voltage of all 4,160V feeders and buses are tested and within acceptable limits.

2.6 The 4,160V ~~4.16 kV~~ power is available from the ~~unit auxiliary transformer, standby auxiliary transformer, and alternate ac source.~~ UAT and SAT to the 4,160V non-Class 1E auxiliary power system.

2.7 ~~Switchgear~~ 2.8 SWGR assembly, breakers, control and protective equipment/circuit have been inspected and tested and are capable of being placed into service.

2.7 The 4,160V power is available from the alternate ac power source to the 4,160V permanent non safety buses.

2.9 The alternate ac source is available.

3.0 TEST METHOD

~~3.1 Demonstrate the operability of the feeder protective circuit breakers from the permanent non-safety buses to the safety loads buses.~~

~~3.2 Demonstrate the operability of the feeder protective circuit breakers from the unit auxiliary transformer to the non-safety loads locally and remotely.~~ 3.1 Demonstrate the operability of the 4,160V SWGR breakers locally and/or remotely.

~~3.3 Demonstrate the operability of the feeder and cross-tie protective circuit breakers for the permanent non-safety loads locally and remotely.~~ 3.2

~~3.4~~ Demonstrate the operability of the bus interlocks, alarms, and protective relays. 3.3

~~3.5~~ Verify the operation of meters and annunciators.

3.4 Verify the non-Class 1E 4,160V SWGRs can be energized from power sources including the UAT and SAT.
3.5 Verify the permanent non-safety buses can be energized from the UAT, SAT, and alternate ac power source.

~~3.6 Verify the permanent non-safety buses can be energized from the unit auxiliary transformer, standby auxiliary transformers, and alternate ac source.~~

~~3.7 Demonstrate the operation of the bus transfer for the permanent non-safety buses (Preferred 1 [normal] supply power to Preferred 2 [alternate] supply power).~~

3.6 Demonstrate the automatic transfer of the non-Class 1E 4,160V SWGR from the UAT to SAT.
3.7 Demonstrate the manual transfer of the Class 1E 4,160V SWGR from the UAT to SAT and from the SAT to UAT.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays activate

~~4.2 System response to transfer of Preferred 1 (normal) supply power to Preferred 2 (alternate) supply power~~

5.0 ACCEPTANCE CRITERIA

5.1 The 4,160V ~~normal~~ non-Class 1E auxiliary power system supplies the loads as described in ~~Subsection~~subsection 8.3.1.1.1.2.

5.2 The 4,160V ~~switchgear bus tiebreakers closed and tripped in the test position.~~ SWGR breakers are operated correctly locally and/or remotely.

~~5.3 The 4,160V switchgear bus tiebreaker closed and tripped in the connected position.~~

~~5.4 Actuation of overcurrent relay initiates an annunciation alarm, trips the bus tiebreakers.~~

~~5.5 When an overcurrent relay for the 4,160V bus tiebreakers actuated, the overcurrent status recorded on the fault recorder.~~

~~5.6 Actuation of bus under voltage relay initiates alarm annunciation and trip the bus tiebreakers.~~

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~~5.7 De-energizing of 125V DC failure relay initiates an alarm.~~

5.3 Power supply

SWGR is

~~5.8 The power supplied~~ to the 4,160V ~~switchgear~~ transferred manually from UAT source to SAT source and from SAT source to UAT source.

~~5.9 The power supplied to the 4,160V switchgear transferred manually.~~

5.4

SWGR

~~5.10~~ With the 4,160V ~~switchgear bus~~ voltage and SAT voltage synchronized, the fast automatic transfer from UAT source to SAT source occurs within specified time only when the unit protection trip is actuated.

5.5

SWGR

~~5.11~~ With the 4,160V ~~bus~~ voltage and SAT voltage not synchronized, a residual voltage transfer from UAT source to SAT source occurs when unit protection trip and bus residual voltage are actuated.

5.6

~~5.12~~ Actuation of ~~overcurrent relay initiates an annunciation alarm, trips the closed supply breaker and blocks the closing circuit of both 4,160V switchgear supply breakers.~~ the protection trip relays, trip and block their associated breakers, and their statuses are indicated.

~~5.13 Actuation of negative sequence overvoltage relay initiates an alarm~~

~~5.14 De-energizing of 125V DC failure relay initiates an alarm~~

14.2.12.1.113 480V Normal Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the operation of the 480V normal auxiliary power system

2.0 PREREQUISITES

2.1 Construction activities on the 480V normal auxiliary power system have been completed.

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'A'

1.1 To verify the local and/or remote operation of the non-Class 1E 13,800V switchgear (SWGR) breakers
1.2 To verify the automatic transfer (fast and residual voltage) of the buses from the unit auxiliary transformer (UAT) to the standby auxiliary transformer (SAT)
1.3 To verify the manual transfer operation of SWGR incoming breakers
1.4 To verify the operation of the protective relays
1.5 To verify the operation of system instrumentation and controls
1.6 To verify the operation of system annunciation

'B'

1.1 To verify the local and/or remote operation of the non-Class 1E 4,160V switchgear (SWGR) breakers
1.2 To verify the automatic transfer (fast and residual voltage) of the buses from the unit auxiliary transformer (UAT) to the standby auxiliary transformer (SAT)
1.3 To verify the manual transfer operation of SWGR incoming breakers
1.4 To verify the operation of the protective relays
1.5 To verify the operation of system instrumentation and controls
1.6 To verify the operation of system annunciation

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.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-59

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 Section 14.2.1.12.1.108 discusses the 4.16kV Class 1E Auxiliary Power System Test. Part 3.5 states, verify the 4,160V and 480V safety-related systems load shed as designed on undervoltage." Please discuss whether this includes degraded voltage conditions and loss-of voltage conditions.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

Upon a loss of voltage or degraded voltage condition, each loss of voltage relay (LVR) or degraded voltage relay (DVR) on the 4.16 kV switchgear will send an individual detection signal to initiate an automatic start of the associated EDG and will also send load shedding signals to the Class 1E 4.16 kV switchgear loads, as discussed in the response to the RAI 61-7984, Question 8.3.1-6 (MKD/NW-15-0131L dated September 8, 2015, ML15251A247).

The general revision of DCD Tier 2, Subsection 14.2.12.1.108 has incorporated a proposed change to Part 3.4 to clarify that load shedding of the 4.16 kV safety loads occurs on undervoltage conditions (i.e., loss of voltage and degraded voltage condition) of the switchgear.

The general revision of DCD Tier 2, Subsections 14.2.12.1.109 (480 V Class 1E) and 14.2.12.1.113 (480 V non-Class 1E) and Tables 14.2-1 and 14.2-7 are also included in this response to provide completed revisions of the initial test plans for other electrical systems.

Impact on DCD

The upgraded DCD Tier 2, Subsection 14.2.12.1.108 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) will be revised as shown in the Attachment to the response to Question 14.02-58 of this RAI.

The upgraded DCD Tier 2, Subsections 14.2.12.1.109 and 14.2.12.1.113, Tables 14.2-1 and 14.2-7 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.

5.14 Actuation of under voltage relay or negative phase sequence relay initiates system annunciation.

5.14 Loss of 125V DC control power to the bus under voltage relays initiated system annunciation.

5.15 Actuation of secondary under voltage relays at the UAT & SAT of SWGRs initiate system annunciation.

5.16 Actuation of under voltage relay of SWGR trips the tiebreaker and initiates system annunciation.

5.17 LC XFMR Feed PCB closed and tripped in the test position.

14.2.12.1.109 480V Class 1E Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1 To demonstrateverify the operation of the 4,160V SWGR feeder breaker in both test and connected positions~~

~~1.2 To verify that the 4,160V SWGR feeder breaker protective relays function properly~~

~~1.3 To verify the operation of the 480V Class 1E auxiliary power systemLC incoming and feeder breaker in both test and connected positions~~

~~1.4 To verify that the 480V LC incoming and LC feeder breaker protective relays function properly~~

~~1.5 To verify that the trouble/disabled status indication and alarms function properly~~

~~1.6 To verify the operation of the 480V feeder breaker in connected position~~

1.1 To verify the local and/or remote operation of the Class 1E 480V load center (LC) and motor control center (MCC) breakers
1.2 To verify the operation of the protective relays
1.3 To verify the operation of system instrumentation and controls
1.4 To verify the operation of system annunciation

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2.0 PREREQUISITES

2.1 Construction activities including construction acceptance tests on the 480V Class 1E auxiliary power system have been ~~have been~~were completed.

2.2 The 480V Class 1E auxiliary power system instrumentation has been calibrated.

2.3 Support systems required for operation of the 480V Class 1E auxiliary power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

~~2.5 Buses and equipment have been meggered with acceptable results.~~

~~2.6 Applicable equipment has been~~inspected ~~visually inspected~~.

2.5 The voltage of all 480V feeders and buses are tested and within acceptable limits.
2.6 The 4,160V Class 1E auxiliary power is available.

3.0 TEST METHOD

3.1 Demonstrate the operability of the ~~480 Vac source and feeder circuit~~ 480V LC and MCC breakers locally ~~and~~ and/or remotely.

3.2 Demonstrate the operability of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of meters and annunciators.

3.4 Perform energization of 480V Class 1E auxiliary power system.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays activate

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5.2 The 480V LC and MCC breakers are operated correctly locally and/or remotely.
5.3 Actuation of the protection trip relays, trip and block their associated breakers, and their statuses are indicated.

5.0 ACCEPTANCE CRITERIA

Class

5.1 The 480V ~~Class~~class 1E auxiliary power system operates as described in ~~Subsection~~subsection 8.3.1.1.2.

Subsection

~~5.2 The feeder breaker of 4,160V SWGR can be closed and tripped in the test and connected positions.~~

~~5.3 Actuation of the overcurrent relays associated with the 4,160V SWGR feeder breakers trip its breaker and initiates an alarm.~~

~~5.4 The 480V LC incoming breakers closed and tripped in the test position.~~

~~5.5 The 480V LC incoming breakers closed in the connected position.~~

~~5.6 Actuation of the temperature detector relay for the 480V LC transformers initiates alarm.~~

~~5.7 Actuation of the neutral overcurrent relay for the 480V LC transformers trip its 4,160V SWGR feeder breaker and 480V LC incoming breaker and initiates alarm.~~

~~5.8 Actuation of the under voltage relay for the 480V LC initiates the bus under voltage alarm.~~

~~5.9 Actuation of the alarm relay for the 480V LC initiates DC power loss alarm.~~

~~5.10 The 480V LC feeder breakers closed and tripped in the test position.~~

~~5.11 Actuation of the ground overcurrent relay associated with the 480V LC feeder breakers tripped and initiates an alarm.~~

~~5.12 Actuation of the under voltage relay for the 480V motor control center(MCC) initiates trouble alarm.~~

~~5.5 The unit auxiliary transformers can be supply station loads.~~

~~5.6 The generator circuit breaker is operates as designed.~~

~~5.7 The interlocks, alarms, and protective relays are operates as designed.~~

~~5.8 The main generator auxiliary systems are operates as designed.~~

14.2.12.1.111 13,800V Normal Auxiliary Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~verify the manual transfer operation between UAT and SAT each other

1.2 To verify the fast auto transfer operation from UAT to SAT

1.3 To verify the residual voltage transfer operation from UAT to SAT

1.4 To verify the operation of the non-Class 1E 13,800V ~~normal auxiliary power system~~switchgear protective relays

1.5 To verify the CCS trouble/disabled status indications and alarms

2.0 PREREQUISITES

2.1 Construction activities on the 13,800V normal auxiliary power system ~~have~~has been completed.

2.2 ~~13~~The13,800V normal auxiliary power system instrumentation has been calibrated.

2.3 Support systems required for operation of the 13,800V normal auxiliary power system are completed and operational.

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5.7 De-energizing of 125V DC failure relay initiates an alarm.

5.8 The power supplied to the 4,160V switchgear transferred manually from UAT source to SAT source and from SAT source to UAT source.

5.9 The power supplied to the 4,160V switchgear transferred manually.

5.10 With the 4,160V switchgear bus voltage and SAT voltage synchronized, the fast automatic transfer from UAT source to SAT source occurs within specified time only when the unit protection trip is actuated.

5.11 With the 4,160V bus voltage and SAT voltage not synchronized, a residual voltage transfer from UAT source to SAT source occurs when unit protection trip and bus residual voltage are actuated.

5.12 Actuation of overcurrent relay initiates an annunciation alarm, trips the closed supply breaker and blocks the closing circuit of both 4,160V switchgear supply breakers.

5.13 Actuation of negative sequence overvoltage relay initiates an alarm

5.14 De-energizing of 125V DC failure relay initiates an alarm

14.2.12.1.113 480V ~~Normal~~ Auxiliary Power System Test

Non-Class 1E

1.0 ~~OBJECTIVE~~OBJECTIVES

~~1.1 To demonstrate the operation of the 480V normal auxiliary power system~~

1.1 To verify the local and/or remote operation of the non-Class 1E 480V load center (LC) and motor control center (MCC) breakers
1.2 To verify the operation of the protective relays
1.3 To verify the operation of system instrumentation and controls
1.4 To verify the operation of system annunciation

2.0 PREREQUISITES

2.1 Construction activities on the 480V ~~normal~~ auxiliary power system have been completed.

Non-Class 1E

including construction acceptance tests

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The

2.2 480V ~~normal~~ auxiliary power system instrumentation has been calibrated.

Non-Class 1E

2.3 Support systems required for operation of the 480V ~~normal~~ auxiliary power system are completed and operational.

Non-Class 1E

2.4 Test instrumentation is available and calibrated.

~~2.5 Buses and equipment have been meggered with acceptable results.~~

~~2.6 Equipment has been visually inspected.~~

2.5 The voltage of all 480V feeders and buses are tested and within acceptable limits.

2.~~7~~6 4,160V ~~normal~~ auxiliary power is available.

Non-Class 1E

3.0 TEST METHOD

3.1 Demonstrate the operability of the ~~480 V_{ac} source and feeder circuit~~ breakers locally ~~and~~ remotely.

480V LC and MCC

and/or

3.2 Demonstrate the operability of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of meters and annunciators.

3.4 Perform energization of 480V ~~normal~~ auxiliary power system.

Non-Class 1E

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays activate

5.0 ACCEPTANCE CRITERIA

non-Class 1E

5.1 The 480V ~~normal~~ auxiliary power system operates as described in ~~Subsections~~subsection 8.3.1.1.1.3.

Subsection

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5.2 ~~The 480 V_{ac} source and feeder circuit breakers actuates locally and remotely.~~ The 480V LC and MCC breakers are operated correctly locally and/or remotely.

5.3 ~~The bus interlocks, alarms, meters, annunciators and protective relays actuates as designed.~~ Actuation of the protection trip relays, trip and block their associated breakers, and their statuses are indicated.

~~5.4 The 480V normal auxiliary power system actuate as designed.~~

14.2.12.1.114 Non-Class 1E DC Power Systems Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~verify the battery and battery chargers have sufficient capacity to supply the power to the specified busloads

1.2 To verify the proper performance of the battery chargers

1.3 To verify that the battery does not discharge through the battery charger during a loss of AC power to the battery charger

1.4 To verify proper operation of the ~~following systems:~~non-Class 1E DC system alarms and status indications

~~1.1.1 125 Vdc power system~~

~~1.1.2 120 Vac instrument and control power system~~

~~1.1.3 250 Vdc power system~~

~~1.1.4 AAC source 125 Vdc power system~~

1.5 To verify proper operation of the battery charger with its output voltage regulation and ripple within design value

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Table 14.2-1 (5 of 5)

Subsection	Test
14.2.12.1.110	Unit main power system test non-Class 1E
14.2.12.1.111	13,800V ~~normal~~ auxiliary power system test non-Class 1E
14.2.12.1.112	4,160V ~~normal~~ auxiliary power system test
14.2.12.1.113	480V ~~normal~~ auxiliary power system test non-Class 1E
14.2.12.1.114	Non-Class 1E dc power systems test
14.2.12.1.115	Class 1E dc power systems test
14.2.12.1.116	Offsite power system test
14.2.12.1.117	Balance-of-plant piping thermal expansion measurement test
14.2.12.1.118	Balance-of-plant piping vibration measurement test
14.2.12.1.119	Containment integrated leak rate test and structural integrity test
14.2.12.1.120	Fuel transfer tube functional test and leak test
14.2.12.1.121	Equipment hatch functional test and leak test
14.2.12.1.122	Containment personnel airlock functional test and leak test
14.2.12.1.123	Containment electrical penetration assemblies test
14.2.12.1.124	Containment isolation valves leakage rate test
14.2.12.1.125	Loss of instrument air test
14.2.12.1.126	Mid-loop operations verification test
14.2.12.1.127	Seismic monitoring instrumentation test
14.2.12.1.128	Auxiliary steam system test
14.2.12.1.129	Containment isolation valves test
14.2.12.1.130	Post-accident monitoring instrumentation test
14.2.12.1.131	Electrical and I&C equipment areas HVAC system test
14.2.12.1.132	Auxiliary building controlled area HVAC system test
14.2.12.1.133	Auxiliary building clean area HVAC system test
14.2.12.1.134	Leakage detection system test
14.2.12.1.135	Leakage control and detection of system outside of containment
14.2.12.1.136	RCP Vibration Monitoring System
14.2.12.1.137	NSSS Integrity Monitoring System (Pre-core)
14.2.12.1.138	Core Protection Calculator System Test
14.2.12.1.139	Diverse Indication System Test

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Table 14.2-7 (2 of 18)

RG 1.68 APP. A	Subsection #	Individual Test
1.a.2.l	-	Not applicable This is not a design feature of the APR1400
1.a.3	14.2.12.1.41 14.2.12.1.42 14.2.12.1.43 14.2.12.1.51	Internals vibration monitoring system test Loose parts monitoring system test Acoustic leak monitoring system test Pre-core reactor coolant system expansion measurements
1.a.4	14.2.12.1.35	Reactor coolant system hydrostatic test
1.b.1.a	14.2.12.1.27 14.2.12.1.36	Digital rod control system test Control element drive mechanism cooling system test
1.b.1.b	14.2.12.1.32	Reactor power cutback system test
1.b.1.c	14.2.12.1.28	Reactor regulating system test
1.b.1.d	14.2.12.1.54	Pre-core control element drive mechanism performance test
1.b.2.a	14.2.12.1.12 14.2.12.1.14 14.2.12.1.84	Concentrated boric acid subsystem test Reactor makeup subsystem test Heat tracing system test
1.b.2.b	14.2.12.1.60	Pre-core boration / dilution measurements
1.b.2.c	14.2.12.1.58 14.2.12.1.112 14.2.12.1.113 14.2.12.1.114	Pre-core chemical volume control system integrat 4,160 V ~~normal~~ auxiliary power system test 480 V ~~normal~~ auxiliary power system test Non-Class 1E dc power systems test
1.b.3	-	Not applicable This is not a design feature of the APR1400.
1.c.1	14.2.12.1.23 14.2.12.1.24	Engineered safety features – component control system test Plant protection system test
1.c.2	14.2.12.1.47 14.2.12.1.54	Pre-core instrument correlation Pre-core control element drive mechanism performance test
1.c.3	14.2.12.1.39 14.2.12.1.115	Integrated engineered safety features / loss of power test Class 1E dc power systems test
1.c.4	14.2.12.1.49	Diverse protection system test

non-Class 1E

non-Class 1E

Table 14.2-7 (4 of 18)

RG 1.68 APP. A	Subsection #	Individual Test
1.e.8	14.2.12.1.69	Condensate system test
1.e.9	14.2.12.1.68	Feedwater system test
1.e.10	14.2.12.1.73	Heater drains system test
1.e.11	14.2.12.1.52 14.2.12.1.67 14.2.12.1.69	Pre-core reactor coolant and secondary water chemistry data Main condenser and condenser vacuum systems test Condensate system test
1.e.12	14.2.12.1.67	Main condenser and condenser vacuum systems test
1.f.1	14.2.12.1.71	Circulating water system test
1.f.2	-	Exception The COL applicant is to prepare the pre-operational test of cooling tower and associated auxiliaries.
1.f.3	-	Exception The COL applicant is to prepare the pre-operational test of raw water and service water cooling systems.
1.g.1	14.2.12.1.110 14.2.12.1.111 14.2.12.1.112 14.2.12.1.113 14.2.12.1.116	Unit main power system test non-Class 1E 13,800 V ~~normal~~ auxiliary power system test non-Class 1E 4,160 V ~~normal~~ auxiliary power system test non-Class 1E 480 V ~~normal~~ auxiliary power system test Offsite power system test
1.g.2	14.2.12.1.108 14.2.12.1.109 14.2.12.1.81	4,160 V Class 1E auxiliary power system test 480 V Class 1E auxiliary power system test Emergency lighting system test
1.g.3	14.2.12.1.86 14.2.12.1.87 14.2.12.1.88 14.2.12.1.89 14.2.12.1.90	Emergency diesel generator mechanical system test Emergency diesel generator electrical system test Emergency diesel generator auxiliary systems test Alternate AC source system test Alternate AC source support systems test
1.g.4	14.2.12.1.81 14.2.12.1.114 14.2.12.1.115	Emergency lighting system test Non-Class 1E dc power systems test Class 1E dc power systems test
1.h.1.a	14.2.12.1.117 14.2.12.1.118	BOP piping thermal expansion measurement test BOP piping vibration measurement test

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.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-60

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 Section 14.2.1.12.1.116 discusses the offsite power system test. Please confirm that this test includes demonstrating the operation of protective relaying, alarms, and control devices of the main, unit auxiliary and standby auxiliary transformers.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

After a more detailed review of the initial plant test plan for the electrical items, KHNP has developed a general revision of DCD Tier 2, Subsections 14.2.12.1.108 through 14.2.12.1.116 to clarify the test methods and acceptance criteria and to keep consistency with DCD Tier 2 Chapter 8 as well as the other subsections of Chapter 14.

The offsite power system test does include demonstrating the operation of protective relaying and alarms of the main, unit auxiliary, and standby auxiliary transformers (MT, UATs, and SATs; collectively called power transformers).

The general revision of DCD Tier 2, Subsection 14.2.12.1.116 has incorporated a change by adding a new Part 3.5 to clearly indicate demonstrating the operation of protective relaying, alarms, and associated control devices of the power transformers.

Impact on DCD

The upgraded DCD Tier 2, Subsections 14.2.12.1.116 included in the enclosure of KHNP's letter (Reference KHNP submittal MKD/NW-16-0156L, dated February 24, 2016; ML16056A002) 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.

5.10 Simulation of the AC input failure of the battery chargers initiates the actuation of alarm and indicating light.

5.11 Verify that bus voltage of Class 1E DC Control centers.

5.12 Battery does not discharge through the charger during a loss of AC power.

14.2.12.1.116 Offsite Power System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To verify that the offsite power system is capable of supplying the power as designed to the ~~unit~~ station auxiliaries through the two preferred power circuits

~~1.2 To verify the power generated by the turbine generator can be fed to grid through the offsite power system~~

2.0 PREREQUISITES

2.1 Construction activities including construction acceptance tests on the offsite power system have been completed.

2.2 ~~Offsite~~ The offsite power system instrumentation has been calibrated.

2.3 Support systems required for operation of the offsite power system are completed and operational.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify the operation of the switchyard protective relaying system.

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3.2 Verify operation of switchyard power circuit breakers and ~~motor-operated disconnects~~ from main control room, switchyard ~~relay house~~, and its local control cabinet~~.~~

3.3 ~~Verify operation of interlock between the two separate offsite power connections.~~

3.4 Verify operation of the switchyard ~~125 V~~dc power system and its associated controls, alarms, and ~~batteries.~~

~~3.5~~ Verify the operation of the switchyard ~~480 V~~ac auxiliary power system and its associated controls, alarms, and annunciators.

3.5 Verify the operation of the protective relaying, alarm, and associated control devices of the main, unit auxiliary, and standby auxiliary transformers.

3.6 Demonstrate the ability of the normal and alternate preferred power circuits to supply power from the offsite power source to the station auxiliaries.

4.0 DATA REQUIRED

4.1 ~~Setpoints~~Set points ~~at which alarms and interlocks occur~~

4.2 ~~Setpoints~~Set points ~~of the protective relays~~

4.2 Switchyard operating data
4.3 Main transformer operating data
4.4 Unit auxiliary transformer operating data
4.5 Standby auxiliary transformer operating data

5.0 ACCEPTANCE CRITERIA

5.1 The offsite power system operates as described in ~~Subsection~~subsection 8.2.1.

5.2 The switchyard protective relaying system ~~actuates as design~~

5.3 The switchyard power circuit breakers and ~~motor-operated disconnects~~ from main control room, switchyard ~~relay house~~ and its local control cabinet ~~operates as design.~~

~~5.4 The interlock between the two separate offsite power connections actuates as design.~~

~~5.5~~ The switchyard ~~125 V~~dc power system and its associated controls, alarms, and ~~batteries actuates~~ as ~~design.~~

5.5 → ~~5.6~~ The switchyard ~~480 V~~ac auxiliary power system and its associated controls, alarms, and annunciators operate as ~~design.~~designed.

14.2.12.1.117 Balance-of-Plant Piping Thermal Expansion Measurement Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To ~~demonstrate~~verify that the ~~balance-of-plant (BOP) components are free to~~following piping systems expand ~~thermally as designed~~within acceptable limits during ~~initial plant heatup~~heat-up and return to ~~their baseline cold~~an acceptable position ~~after the initial cooldown to ambient temperatures~~ when cooled down without adverse constraint.

1.1.1 Chemical volume and control system

1.1.2 Safety injection/Shutdown cooling system

1.1.3 Reactor coolant system branch piping

1.1.4 Reactor coolant gas vent system

1.1.5 Steam generator blow down system

1.1.6 Main steam system (Steam generator to MSIVs)

1.1.7 Main feed water system (Inside containment)

1.1.8 Auxiliary feed water system (Inside containment)

1.1.9 Auxiliary steam system

1.1.10 Auxiliary feed water pump turbine system

5.6 The protective relaying, alarm, and associated control devices of the main, unit auxiliary, and standby auxiliary transformers operate as designed.

5.7 The normal and alternate preferred power circuits supply power from the offsite power source to the station auxiliaries.

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.:	**282-8238**
SRP Section:	**14.02 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**11/02/2015**

Question No. 14.02-61

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 Section 14.2.12.4.8 discusses the Loss of Offsite Power Test. Please discuss how this test demonstrates that upon a loss of offsite power, there is an automatic transfer from offsite power to the onsite emergency diesel generators.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 1)

The initial test program to demonstrate an automatic transfer from offsite power to the onsite emergency diesel generators (EDGs) upon a loss of offsite power (LOOP) is addressed by the preoperational test described in DCD Tier 2 Subsection 14.2.12.1.87.

The preoperational test stated in Part 3.3 of Subsection 14.2.12.1.87, which was provided in the revised response to the RAI 191-8210, Question 14.2-13 (reference KHNP submittal: MKD/NW-16-0684L dated June 28, 2016; ML16180A271), evaluates the ability of EDG start and closing

of associated circuit breakers on an undervoltage condition of the 4.16 kV Class 1E bus, which is meant to simulate a LOOP.

Specific test procedures for alignment of the Class 1E buses to EDG upon a LOOP will be developed and provided by the COL applicant as specified by COL 14.2(2).

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.