2.5.2 Class 1E Uninterruptible Power Supply

1.0 Description

The Class 1E uninterruptible power supply (EUPS) system provides Class 1E power to safety-related, dc loads, and uninterruptible ac power to safety-related and select non-safety-related loads during normal and abnormal operations.

2.0 Arrangement

2.1 The functional arrangement of EUPS equipment is shown in Figure 2.5.2-1—Class 1E Uninterruptible Power Supply System Functional Arrangement.

2.2 Equipment identified as Class 1E in Table 2.5.2-2—Class 1E Uninterruptible Power Supply Electrical Equipment Design are located as listed in Table 2.5.2-1—Class 1E Uninterruptible Power Supply System Electrical Equipment Location.

2.3 There are four EUPS divisions.

2.4 Equipment identified as Class 1E in Table 2.5.2-2 and located in a Safeguard Building as listed in Table 2.5.2-1 are located above elevation 0’ 0”.

3.0 Mechanical Design Features, Electrical and Seismic Classifications

3.1 Equipment listed as Class 1E in Table 2.5.2-2 are qualified as Seismic Category I and can withstand seismic design basis loads without loss of safety function.

4.0 I&C Design Features, Alarms, Displays and Controls

4.1 Displays listed in Table 2.5.2-2 are retrievable in the main control room (MCR) and the remote shutdown station (RSS) as listed in Table 2.5.2-2.

5.0 Electrical Considerations

5.1 Physical separation exists between EUPS Class 1E equipment listed in Table 2.5.2-2 and non-Class 1E equipment.

5.2 Non-safety-related loads connected to the EUPS are electrically isolated from the EUPS by an isolation device.

5.3 Without an emergency power supply system (EPSS) alternate feed installed, independence is maintained between the four EUPS divisions.

5.4 With the alternate feed installed from EPSS division 1 to division 2; independence is maintained between the load group created by EUPS divisions 1 and 2, and divisions 3 and 4. EUPS divisions 3 and 4 are independent of each other.

5.5 With the alternate feed installed from EPSS division 2 to division 1; independence is maintained between the load group created by EUPS divisions 1 and 2, and divisions 3 and 4. EUPS divisions 3 and 4 are independent of each other.

5.6 With the alternate feed installed from EPSS division 3 to division 4; independence is maintained between the load group created by EUPS divisions 3 and 4, and divisions 1 and 2. EUPS divisions 1 and 2 are independent of each other.

5.7 With the alternate feed installed from EPSS division 4 to division 3; independence is maintained between the load group created by EUPS divisions 3 and 4, and divisions 1 and 2. EUPS divisions 1 and 2 are independent of each other.

5.8 Deleted.

5.9 Deleted.

5.10 EUPS switchboards, MCCs, transformers, panelboards, and converters as listed in Table 2.5.2-2 and their feeder breakers and load breakers are sized to supply their load requirements.

5.11 EUPS cables and buses are sized to supply their assigned load requirements.

5.12 Each EUPS battery is able to provide power for starting and operating design loads for a minimum of two hours when the ac supply to the battery charger is lost.

5.13 Each EUPS battery charger supplies assigned EUPS loads while maintaining the respective EUPS battery charged.

5.14 The EUPS inverters are sized to power the design EUPS loads on the respective supplied MCC.

5.15 EUPS operating voltage remains within the terminal voltage range of the supplied safety-related equipment during the battery duty cycle.

5.16 EUPS switchboards, MCCs, transformers and panelboards listed in Table 2.5.2-2 are rated to withstand fault currents for the time required to clear the fault from its power source.

5.17 The feeder and load circuit breakers for EUPS switchboards, MCCs and panelboards are rated to interrupt fault currents.

5.18 EUPS interrupting devices (e.g., circuit breakers and fuses) are coordinated so that the circuit interrupting device closest to the fault open before other devices.

5.19 Harmonic distortion does not prevent safety-related equipment from performing safety functions.

6.0 Inspection, Tests, Analyses and Acceptance Criteria

Table 2.5.2-3 lists the EUPS ITAAC.

Table 2.5.2-1—Class 1E Uninterruptible Power Supply System Electrical Equipment Location (2 Sheets)

Description	Tag Number (1)	Location
Battery Charger	31BTP01	Division 1 Safeguard Building
Battery Charger	31BTP02	Division 1 Safeguard Building
Battery Charger	32BTP01	Division 2 Safeguard Building
Battery Charger	32BTP02	Division 2 Safeguard Building
Battery Charger	33BTP01	Division 3 Safeguard Building
Battery Charger	33BTP02	Division 3 Safeguard Building
Battery Charger	34BTP01	Division 4 Safeguard Building
Battery Charger	34BTP02	Division 4 Safeguard Building
Battery	31BTD01	Division 1 Safeguard Building
Battery	32BTD01	Division 2 Safeguard Building
Battery	33BTD01	Division 3 Safeguard Building
Battery	34BTD01	Division 4 Safeguard Building
Inverter	31BRU01	Division 1 Safeguard Building
Inverter	32BRU01	Division 2 Safeguard Building
Inverter	33BRU01	Division 3 Safeguard Building
Inverter	34BRU01	Division 4 Safeguard Building
Switchboard	31BUC	Division 1 Safeguard Building
Switchboard	32BUC	Division 2 Safeguard Building
Switchboard	33BUC	Division 3 Safeguard Building
Switchboard	34BUC	Division 4 Safeguard Building
Motor Control Center	31BRA	Division 1 Safeguard Building
Motor Control Center	32BRA	Division 2 Safeguard Building
Motor Control Center	33BRA	Division 3 Safeguard Building
Motor Control Center	34BRA	Division 4 Safeguard Building
Transformer	31BGT01	Division 1 Safeguard Building
Transformer	32BGT01	Division 2 Safeguard Building
Transformer	33BGT01	Division 3 Safeguard Building
Transformer	34BGT01	Division 4 Safeguard Building
120 Vac Panelboard	31BGA01	Division 1 Safeguard Building
120 Vac Panelboard	32BGA01	Division 2 Safeguard Building
120 Vac Panelboard	33BGA01	Division 3 Safeguard Building
120 Vac Panelboard	34BGA01	Division 4 Safeguard Building

Table 2.5.2-1—Class 1E Uninterruptible Power Supply System Electrical Equipment Location (2 Sheets)

Description	Tag Number (1)	Location
AC/DC Converter	31BRW10	Division 1 Safeguard Building
DC/DC Converter	31BUW11	Division 1 Safeguard Building
AC/DC Converter	31BRW12	Division 1 Safeguard Building
DC/DC Converter	31BUW13	Division 1 Safeguard Building
AC/DC Converter	31BRW16	Division 1 Diesel Building
DC/DC Converter	31BUW16	Division 1 Diesel Building
AC/DC Converter	32BRW30	Division 2 Safeguard Building
DC/DC Converter	32BUW31	Division 2 Safeguard Building
AC/DC Converter	32BRW32	Division 2 Safeguard Building
DC/DC Converter	32BUW33	Division 2 Safeguard Building
AC/DC Converter	32BRW36	Division 2 Diesel Building
DC/DC Converter	32BUW36	Division 2 Diesel Building
AC/DC Converter	33BRW50	Division 3 Safeguard Building
DC/DC Converter	33BUW51	Division 3 Safeguard Building
AC/DC Converter	33BRW52	Division 3 Safeguard Building
DC/DC Converter	33BUW53	Division 3 Safeguard Building
AC/DC Converter	33BRW56	Division 3 Diesel Building
DC/DC Converter	33BUW56	Division 3 Diesel Building
AC/DC Converter	34BRW70	Division 4 Safeguard Building
DC/DC Converter	34BUW71	Division 4 Safeguard Building
AC/DC Converter	34BRW72	Division 4 Safeguard Building
DC/DC Converter	34BUW73	Division 4 Safeguard Building
AC/DC Converter	34BRW76	Division 4 Diesel Building
DC/DC Converter	34BUW76	Division 4 Diesel Building

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.5.2-2—Class 1E Uninterruptible Power Supply Electrical Equipment Design (3 Sheets)

Description	Tag Number (1)	IEEE Class 1E	MCR/RSS Displays
Battery Charger	31BTP01	Yes	Output Current / Output Current
Battery Charger	31BTP02	Yes	Output Current / Output Current
Battery Charger	32BTP01	Yes	Output Current / Output Current
Battery Charger	32BTP02	Yes	Output Current / Output Current
Battery Charger	33BTP01	Yes	Output Current / Output Current
Battery Charger	33BTP02	Yes	Output Current / Output Current
Battery Charger	34BTP01	Yes	Output Current / Output Current
Battery Charger	34BTP02	Yes	Output Current / Output Current
Battery	31BTD01	Yes	Battery Current / Battery Current
Battery	32BTD01	Yes	Battery Current / Battery Current
Battery	33BTD01	Yes	Battery Current / Battery Current
Battery	34BTD01	Yes	Battery Current / Battery Current
Inverter	31BRU01	Yes	N/A / N/A
Inverter	32BRU01	Yes	N/A / N/A
Inverter	33BRU01	Yes	N/A / N/A
Inverter	34BRU01	Yes	N/A / N/A
Switchboard	31BUC	Yes	Bus Voltage / Bus Voltage
Switchboard	32BUC	Yes	Bus Voltage / Bus Voltage
Switchboard	33BUC	Yes	Bus Voltage / Bus Voltage
Switchboard	34BUC	Yes	Bus Voltage / Bus Voltage
Motor Control Center	31BRA	Yes	Bus Voltage / Bus Voltage
Motor Control Center	32BRA	Yes	Bus Voltage / Bus Voltage
Motor Control Center	33BRA	Yes	Bus Voltage / Bus Voltage
Motor Control Center	34BRA	Yes	Bus Voltage / Bus Voltage
Transformer	31BGT01	Yes	N/A / N/A
Transformer	32BGT01	Yes	N/A / N/A
Transformer	33BGT01	Yes	N/A / N/A
Transformer	34BGT01	Yes	N/A / N/A

Table 2.5.2-2—Class 1E Uninterruptible Power Supply Electrical Equipment Design (3 Sheets)

Description	Tag Number (1)	IEEE Class 1E	MCR/RSS Displays
120 Vac Panelboard	31BGA01	Yes	N/A / N/A
120 Vac Panelboard	32BGA01	Yes	N/A / N/A
120 Vac Panelboard	33BGA01	Yes	N/A / N/A
120 Vac Panelboard	34BGA01	Yes	N/A / N/A
AC/DC Converter	31BRW10	Yes	N/A / N/A
DC/DC Converter	31BUW11	Yes	N/A / N/A
AC/DC Converter	31BRW12	Yes	N/A / N/A
DC/DC Converter	31BUW13	Yes	N/A / N/A
AC/DC Converter	31BRW16	Yes	N/A / N/A
DC/DC Converter	31BUW16	Yes	N/A / N/A
AC/DC Converter	32BRW30	Yes	N/A / N/A
DC/DC Converter	32BUW31	Yes	N/A / N/A
AC/DC Converter	32BRW32	Yes	N/A / N/A
DC/DC Converter	32BUW33	Yes	N/A / N/A
AC/DC Converter	32BRW36	Yes	N/A / N/A
DC/DC Converter	32BUW36	Yes	N/A / N/A
AC/DC Converter	33BRW50	Yes	N/A / N/A
DC/DC Converter	33BUW51	Yes	N/A / N/A

Table 2.5.2-2—Class 1E Uninterruptible Power Supply Electrical Equipment Design (3 Sheets)

Description	Tag Number (1)	IEEE Class 1E	MCR/RSS Displays
AC/DC Converter	33BRW52	Yes	N/A / N/A
DC/DC Converter	33BUW53	Yes	N/A / N/A
AC/DC Converter	33BRW56	Yes	N/A / N/A
DC/DC Converter	33BUW56	Yes	N/A / N/A
AC/DC Converter	34BRW70	Yes	N/A / N/A
DC/DC Converter	34BUW71	Yes	N/A / N/A
AC/DC Converter	34BRW72	Yes	N/A / N/A
DC/DC Converter	34BUW73	Yes	N/A / N/A
AC/DC Converter	34BRW76	Yes	N/A / N/A
DC/DC Converter	34BUW76	Yes	N/A / N/A

1) Equipment tag numbers are provided for information only and are not part of the certified design.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
2.1	The functional arrangement of the EUPS is as shown on Figure 2.5.2-1.	An inspection of the as-built system will be performed.	The as-built EUPS conforms to the functional arrangement as shown in Figure 2.5.2-1.
2.2	Equipment identified as Class 1E in Table 2.5.2-2 is located as listed in Table 2.5.2-1.	An inspection will be performed.	The equipment listed as Class 1E in Table 2.5.2-2 is located as listed in Table 2.5.2-1.
2.3	There are four EUPS divisions.	An inspection will be performed.	The EUPS four divisions are configured as shown in Figure 2.5.2-1.
2.4	Equipment identified as Class 1E in Table 2.5.2-2 and located in a Safeguard Building as listed in Table 2.5.2-1 are located above elevation 0’ 0”.	An inspection will be performed.	Equipment identified as Class 1E in Table 2.5.2-2 and located in a Safeguard Building as listed in Table 2.5.2-1 are located above elevation 0’ 0”.
3.1	Equipment listed as Class 1E in Table 2.5.2-2 are qualified as Seismic Category I and can withstand seismic design basis loads without loss of safety function.	a. Type tests, analyses, or a combination of type tests and analyses will be performed on the equipment listed as Class 1E in Table 2.5.2-2 using analytical assumptions, or under conditions, which bound the Seismic Category I design requirements. b. Inspections will be performed of the as-built Class 1E equipment listed in Table 2.5.2-2 to verify that the equipment including anchorage is installed as specified on the construction drawings.	a. Tests/analysis reports exist and conclude that the equipment listed as Class 1E in Table 2.5.2-2 can withstand seismic design basis loads without loss of safety function. b. Inspection reports exist and conclude that the as-built Class 1E equipment listed in Table 2.5.2-2 including anchorage is installed as specified on the construction drawings.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
4.1	Displays listed in Table 2.5.2-2 are retrievable in the MCR and RSS as listed in Table 2.5.2-2.	A test will be performed.	a. Displays listed in Table 2.5.2-2 as being retrieved in the MCR can be retrieved in the MCR. b. Displays listed in Table 2.5.2-2 as being retrieved in the RSS can be retrieved in the RSS.
5.1	Physical separation exists between EUPS Class 1E equipment listed in Table 2.5.2-2 and non-Class 1E equipment.	An inspection will be performed.	The EUPS Class 1E equipment listed in Table 2.5.2-2 is separated from non-Class 1E equipment by at least 3 feet horizontally and at least 5 feet vertically.
5.2	Non-safety-related loads connected to the EUPS are electrically isolated from the EUPS by an isolation device.	a. Type tests, analyses, or a combination of type tests and analyses of the isolation devices will be performed. b. An inspection will be performed.	a. The isolation devices used between the EUPS and non-safety-related loads provide electrical isolation. b. An inspection report exists and concludes there is an electrical isolation device between non-safety-related loads connected to the EUPS, and the EUPS.
5.3	Without an EPSS alternate feed installed, independence is maintained between the four EUPS divisions.	Testing will be performed by providing a test signal in each Class 1E division, one division at a time.	Without an alternate feed installed, the test signal exists only in the EUPS division under test when a test signal is applied in each EPSS division.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.4	With the alternate feed installed from EPSS division 1 to division 2; independence is maintained between the load group created by EUPS divisions 1 and 2, and divisions 3 and 4. EUPS divisions 3 and 4 are independent of each other.	Testing will be performed by providing a test signal in each Class 1E division; one division at a time while the alternate feed is installed from EPSS division 1 to division 2.	a. A test signal exists only in the load group created by Class 1E divisions 1 and 2 when the test signal is provided in Class 1E division 1 or 2. b. A test signal exists only in the division under test when the test signal is provided in Class 1E division 3 or 4.
5.5	With the alternate feed installed from EPSS division 2 to division 1; independence is maintained between the load group created by EUPS divisions 1 and 2, and divisions 3 and 4. EUPS divisions 3 and 4 are independent of each other.	Testing will be performed by providing a test signal in each Class 1E division; one division at a time while the alternate feed is installed from EPSS division 2 to division 1.	a. A test signal exists only in the load group created by Class 1E divisions 1 and 2 when the test signal is provided in Class 1E division 1 or 2. b. A test signal exists only in the division under test when the test signal is provided in Class 1E division 3 or 4.
5.6	With the alternate feed installed from EPSS division 3 to division 4; independence is maintained between the load group created by EUPS divisions 3 and 4, and divisions 1 and 2. EUPS divisions 1 and 2 are independent of each other.	Testing will be performed by providing a test signal in each Class 1E division; one division at a time while the alternate feed is installed from EPSS division 3 to division 4.	a. A test signal exists only in the load group created by Class 1E divisions 3 and 4 when the test signal is provided in Class 1E division 3 or 4. b. A test signal exists only in the division under test when the test signal is provided in Class 1E division 1 or 2.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.7	With the alternate feed installed from EPSS division 4 to division 3; independence is maintained between the load group created by EUPS divisions 3 and 4, and divisions 1 and 2. EUPS divisions 1 and 2 are independent of each other.	Testing will be performed by providing a test signal in each Class 1E division; one division at a time while the alternate feed is installed from EPSS division 4 to division 3.	a. A test signal exists only in the load group created by Class 1E divisions 3 and 4 when the test signal is provided in Class 1E division 3 or 4. b. A test signal exists only in the division under test when the test signal is provided in Class 1E division 1 or 2.
5.8	Deleted.	Deleted.	Deleted.
5.9	Deleted.	Deleted.	Deleted.
5.10	EUPS switchboards, MCCs, transformers, panelboards, and converters as listed in Table 2.5.2-2 and their feeder breakers and load breakers are sized to supply their load requirements.	a. An analysis will be performed. b. An inspection will be performed.	a. Equipment sizing studies for the specified EUPS switchboards, MCCs, and transformers as listed in Table 2.5.2-2, and their feeder breakers and load breakers, concludes their ratings are greater than their analyzed load requirements. b. The ratings of the installed EUPS switchboards, MCCs, transformers, panelboards, and converters as listed in Table 2.5.2-2 and their feeder breakers and load breakers meet the analysis criteria.
5.11	EUPS cables and buses are sized to supply their assigned load requirements.	a. An analysis will be performed. b. An inspection will be performed.	a. Equipment sizing studies for the as-built EUPS cables and buses concludes they are sized to supply analyzed load requirements. b. The ratings of the installed EUPS cables and buses meet the analysis criteria.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.12	Each EUPS battery is able to provide power for starting and operating design loads for a minimum of two hours when the ac supply to the battery charger is lost.	a. An analysis will be performed.	a. Analysis concludes the specified EUPS battery is able to provide power for starting and operating analyzed design loads for a minimum time of two hours while battery terminal voltage remains above minimum voltage required for the design loads.
		b. A battery discharge test will be performed.	b. The capacity of the installed EUPS battery is equal to or greater than the analyzed battery design duty cycle.
5.13	Each EUPS battery charger supplies assigned EUPS loads while maintaining the respective EUPS battery charged.	a. An analysis will be performed.	a. Analysis concludes each specified EUPS battery charger rating is greater than the analyzed load requirements.
		b. A battery charger capacity test will be performed.	b. Each installed EUPS battery charger can maintain an output current that can supply the assigned EUPS loads while maintaining the respective EUPS battery charged.
5.14	The EUPS inverters are sized to power the design EUPS loads on the respective supplied MCC.	a. An analysis will be performed.	a. Analysis concludes each specified EUPS inverter rating is greater than the analyzed load requirements.
		b. An inspection will be performed.	b. The ratings of the installed EUPS inverters meet the analysis criteria.
5.15	EUPS operating voltage remains within the terminal voltage range of the supplied safety-related equipment during the battery duty cycle.	An analysis will be performed.	EUPS operating voltage remains within the terminal voltage range of the supplied safety-related equipment during the battery duty cycle.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.16	EUPS switchboards, MCCs, transformers and panelboards listed in Table 2.5.2-2 are rated to withstand fault currents for the time required to clear the fault from its power source.	a. An analysis will be performed.	a. Short-circuit studies for the EUPS switchboards, MCCs, transformers, and panelboards as listed in Table 2.5.2-2 concludes the equipment current capability is greater than the analyzed fault currents for the time required to clear the fault from its power source as determined by circuit interrupting device coordination analysis.
		b. An inspection will be performed.	b. The ratings of the installed EUPS switchboards, MCCs, transformers and panelboards listed in Table 2.5.2-2 meet the analysis criteria.
5.17	The feeder and load circuit breakers for EUPS switchboards, MCCs and panelboards are rated to interrupt fault currents.	a. An analysis will be performed.	a. Short-circuit studies for EUPS switchboards, MCC, and panelboard feeder and load circuit breakers, concludes the current interrupting capability is greater than the analyzed fault currents.
		b. An inspection will be performed.	b. The ratings of the installed EUPS switchboards, MCC and panelboard feeder and load circuit breakers meet the analysis criteria.

Table 2.5.2-3—Class 1E Uninterruptible Power Supply ITAAC (7 Sheets)

Commitment Wording		Inspections, Tests, Analyses	Acceptance Criteria
5.18	EUPS interrupting devices (e.g., circuit breakers and fuses) are coordinated so that the circuit interrupting device closest to the fault open before other devices.	a. An analysis will be performed.	a. Equipment protection and coordination studies for the EUPS interrupting devices (e.g., circuit breakers and fuses) concludes they are coordinated so that the circuit interrupting device closest to the fault open before other devices.
		b. An inspection will be performed.	b. The ratings of the installed EUPS interrupting device (e.g., circuit breakers and fuses) meet the analysis criteria.
5.19	Harmonic distortion does not prevent safety-related equipment from performing safety functions.	An analysis will be performed.	Analysis of the Class 1E buses concludes that total harmonic distortion does not exceed 5 percent voltage distortion on the Class 1E buses.

Next File