

**Table 8.3-12—Class 1E Uninterruptible Power Supply System
Failure Modes and Effects Analysis
Sheet 1 of 2**

| Item No. | Component Identification | Function | Failure Mode | Failure Mechanism | Effect on System Safety-related Function | Method of Failure Detection | Remarks |
|----------|---|---|-----------------------------|--|---|--|--|
| 1 | EPSS 480 Vac load center 31BMB, 32BMB, 33BMB, or 34BMB. | AC input power for EUPS battery charger 31BTP02, 32BTP02, 33BTP02 or 34BTP02. | Loss of voltage. | Load center fault or failure such as short.-circuit. | None. Safety-related function is maintained by redundant divisions. | Battery charger power failure alarm in the MCR. | <ul style="list-style-type: none"> a. EUPS Battery BTD01 automatically supplies power to its assigned loads without interruption for a minimum of two hours. b. Respective division battery charger BTP01 is manually placed in service. |
| 2 | Division 1 or division 4 480 Vac load center 31BMC, or 34BMC. | AC input power for division 1 or division 4 battery charger 31BTP01 or 34BTP01. | Loss of voltage. | Load center fault or failure such as short.-circuit. | None. Safety-related function is maintained by redundant divisions. | Battery charger power failure alarm in the MCR. | <ul style="list-style-type: none"> a. UPS Battery BTD01 automatically supplies power to its assigned loads without interruption for a minimum of two hours. b. Respective division battery charger BTP02 is manually placed in service. |
| 3 | Division 2 or division 3 480 Vac load center bus 32BMA, or 33BMA. | AC input power for division 2 or division 3 battery charger 32BTP01 or 33BTP01. | Loss of voltage. | Load center fault or failure such as short.-circuit. | None. Safety-related function is maintained by redundant divisions. | Battery charger power failure alarm in the MCR. | <ul style="list-style-type: none"> a. UPS Battery BTD01 automatically supplies power to its assigned loads without interruption for a minimum of two hours. b. Respective division battery charger BTP02 is manually placed in service. |
| 4 | Battery Chargers 31BTP01, 31BTP02, 32BTP01, 32BTP02, 33BTP01, 33BTP02, 34BTP01, or 34BTP02. | Supply division 250 Vdc distribution bus BUC while maintaining battery 31BTD01, 32BTD01, 33BTD01, or 34BTD01 charged. | Battery charger failure. | Battery charger fault resulting in loss of output. | None. Safety-related function is maintained by redundant divisions. | BDT01 Battery charger DC output failure alarm in the MCR. | <ul style="list-style-type: none"> a. Battery BTD01 automatically supplies power to it assigned loads without interruption for a minimum of two hours. b. Respective division standby battery charger is manually placed in service. |
| 5 | EUPS battery output fused disconnect switch. | Provides continuity or point of isolation from the battery to the EUPS 250 Vdc BUC switchboard. | Device failure. | Isolation device fault resulting in no battery output to the EUPS 250 Vdc BUC switchboard. | None. Safety-related function is maintained by redundant divisions. | BTD01 battery protective device open alarm in the MCR. | In service battery charger will maintain power to respective division EUPS loads. However, this is interruptible power and will be lost if there is a loss of power in the respective division. |
| 6 | EUPS 250 Vdc battery 31BTD01, 32BTD01, 33BTD01 or 34BTD01. | Supplies EUPS 250 Vdc bus 31BUC, 32BUC, 33BUC or 34BUC. | Loss of power from battery. | Battery fault resulting in low or no output. | None. Safety-related function is maintained by redundant divisions. | Degraded battery performance detected during normal surveillance testing; low voltage detected with BUC or battery undervoltage alarm. | In service battery charger will maintain power to respective division EUPS loads. However, this is interruptible power and will be lost if there is a loss of power in the respective division. |
| 7 | EUPS 250 Vdc switchboard 31BUC, 32BUC, 33BUC, or 34BUC. | Supplies 250 Vdc to various loads including the EUPS inverter BRU01. | Ground fault. | Grounding of either the positive or negative leg. | None. | EUPS DC system ground alarm in MCR. | EUPS is operated as ungrounded system so ground fault on one polarity does not result in protective tripping of equipment or prevent operation of supplied equipment. |

**Table 8.3-12—Class 1E Uninterruptible Power Supply System
Failure Modes and Effects Analysis
Sheet 2 of 2**

| Item No. | Component Identification | Function | Failure Mode | Failure Mechanism | Effect on System Safety-related Function | Method of Failure Detection | Remarks |
|----------|--|---|-----------------------|--|---|---|--|
| 8 | EUPS 250 Vdc Switchboard 31BUC, 32BUC, 33BUC, or 34BUC. | Supplies 250 Vdc to various loads including the EUPS inverter BUR01. | Bus failure. | Bus fault, including short-circuit. | None. Safety-related function is maintained by redundant divisions. | BUC bus undervoltage alarm in MCR. | <ul style="list-style-type: none"> a. The parallel DC/DC converters supplied from the respective BRA bus will maintain power to the I&C equipment during normal operation. b. Inverter BRU01 will transfer to the bypass source, which maintains power to the I&C system. |
| 9 | EUPS 480 Vac inverter 31BRU01, 32BRU01, 33BRU01 or 34BRU01. | Supplies 480 Vac MCC 31BRA, 32BRA, 33BRA or 34BRA. | Inverter failure. | No output or inverter malfunction. | None. Safety-related function is maintained by redundant divisions. | Alarm in the MCR indicating bypass source supplying load. | <ul style="list-style-type: none"> a. EUPS loads are automatically transferred in a make-before-break transfer by static bypass switch to bypass source BNB02. b. If static bypass source is not available the I&C loads remain powered from the parallel DC/DC converters and EPSS switchgear and load center control power remains available from the BUC switchboard. |
| 10 | 480 Vac MCC 31BRA, 32BRA, 33BRA or 34BRA. | Supplies 480 Vac to various loads including /DC converters for power supply of safety-related I&C cabinets. | MCC failure. | MCC bus failure, including short.-circuit. | None. Safety-related function is maintained by redundant divisions. | Alarm in the MCR. | <ul style="list-style-type: none"> a. Source breaker of the affected MCC operates to clear the faulted MCC, de-energizing affected loads. b. Safety-related I&C loads of the division remain powered from the parallel DC/DC converters. EPSS control power of the division remains available since it is supplied directly from BUC DC switchboard. |
| 11 | 480 Vac to 24 Vdc converters 31BRW10, 31BRW12, 31BRW16, 32BRW30, 32BRW32, 32BRW36, 33BRW50, 33BRW52, 33BRW56, 34BRW70, 34BRW72 or 34BRW76. | Supplies 24 Vdc power to safety-related I&C cabinets. | Loss of output power. | AC/DC converter failure. | None. | Routine monitoring. | Parallel 250 Vdc to 24 Vdc converter maintains power for safety-related I&C cabinets without interruption. |
| 12 | 250 Vdc to 24 Vdc converters 31BUW11, 31BUW13, 31BUW16, 32BUW31, 32BUW33, 32BUW36, 33BUW51, 33BUW53, 33BUW56, 34BUW71, 34BUW73 or 34BUW76. | Supplies 24 Vdc power to safety-related Vdc I&C cabinets. | Loss of output power. | DC/DC converter failure. | None. | Routine monitoring. | Parallel 480 Vac to 24 Vdc converter maintains power for safety-related I&C cabinets without interruption. |