Enclosure 2

MFN 15-073, Revision 2

GEH Revised Response to RAI 08.02-2

ABWR DCD Revision 6 Markups

2.12.1 Electrical Power Distribution System

Design Description

The AC Electrical Power Distribution (EPD) System consists of the transmission network (TN), the plant switching stations, the Main Power Transformer (MPT), the Unit Auxiliary Transformers (UAT), the Reserve Auxiliary Transformer(s) (RAT(s)), the plant main generator (PMG) output circuit breaker, the medium voltage metal-clad (M/C) switchgear, the low voltage power center (P/C) switchgear, and the motor control centers (MCCs). The distribution system also includes the power, instrumentation and control cables and bus ducts to the distribution system loads, and the protection equipment provided to protect the distribution system equipment. The EPD System within the scope of the Certified Design starts at the low voltage terminals of the MPT and the low voltage terminals of the RAT(s) and ends at the distribution system loads. Interface requirements for the TN, plant switching stations, MPT, and RAT(s) are specified below.

The plant EPD System can be supplied power from multiple power sources; these are independent transmission lines from the TN, the PMG, and the combustion turbine generator (CTG). In addition, the EPD System can be supplied from three onsite Class 1E Standby Power Sources (Emergency Diesel Generators (DGs)). The Class 1E portion of the EPD System is shown in Figure 2.12.1.

During plant power operation, the PMG supplies power through the PMG output circuit breaker through the MPT to the TN, and to the UATs. When the PMG output circuit breaker is open, power is backfed from the TN through the MPT to the UATs.

The UATs can supply power to the non-Class 1E load groups of medium voltage M/C power generation (PG) and plant investment protection (PIP) switchgear, and to the three Class 1E divisions (Division I, II, and III) of medium voltage M/C switchgear.

The RAT(s) can supply power to the non-Class 1E load groups of medium voltage M/C PG and PIP switchgear, and to the three Class 1E divisions (Division I, II, and III) of medium voltage M/C switchgear.

Non-Class 1E load groups of medium voltage M/C switchgear are supplied power from a UAT with an alternate power supply from a RAT. In addition, the non-Class 1E medium voltage M/C switchgear can be supplied power from the CTG.

Class 1E medium voltage M/C switchgear are supplied power directly (not through any bus supplying non-Class 1E loads) from at least a UAT or a RAT. Class 1E medium voltage M/C switchgear can also be supplied power from their own dedicated Class 1E DG or from the non-Class 1E CTG.

The UATs are sized to supply their load requirements, during design operating modes, of their respective Class 1E divisions and non-Class 1E load groups. UATs are separated from the

RAT(s). In addition, UATs are provided with their own oil pit, drain, fire deluge system, grounding, and lightning protection system.

The PMG, its output circuit breaker, and UAT power feeders are separated from the RAT(s) power feeders. The PMG, its output circuit breaker, and UAT instrumentation and control circuits, are separated from the RAT(s) instrumentation and control circuits.

The MPT and its switching station instrumentation and control circuits, from the switchyard(s) to the main control room (MCR), are separated from the RAT(s) and its switching station instrumentation and control circuits.

The medium voltage M/C switchgear and low voltage P/C switchgear, with their respective transformers, and the low voltage MCCs are sized to supply their load requirements. M/C and P/C switchgear, with their respective transformers, and MCCs are rated to withstand fault currents for the time required to clear the fault from the power source. The PMG output circuit breaker, and power feeder and load circuit breakers for the M/C and P/C switchgear, and MCCs are sized to supply their load requirements and are rated to interrupt fault currents.

Class 1E equipment is protected from degraded voltage conditions.

EPD System interrupting devices (circuit breakers and fuses) are coordinated so that the circuit interrupter closest to the fault opens before other devices.

Instrumentation and control power for the Class 1E divisional medium voltage M/C switchgear and low voltage P/C switchgear is supplied from the Class 1E DC power system in the same division.

The PMG output circuit breaker is equipped with redundant trip devices which are supplied from separate, non-Class 1E DC power systems.

EPD System cables and bus ducts are sized to supply their load requirements and are rated to withstand fault currents for the time required to clear the fault from its power source.

For the EPD System, Class 1E power is supplied by three independent Class 1E divisions. Independence is maintained between Class 1E divisions, and also between Class 1E divisions and non-Class 1E equipment.

The only non-Class 1E loads connected to the Class 1E EPD System are the Fine Motion Control Rod Drives (FMCRDs) and the associated AC standby lighting system.

External (to Reactor Building) connections are provided to all three 1E Reactor Building 480 VAC Power Centers for portable FLEX diesel generators. The connectors are isolated from the Power Centers by normally open 1E breakers.

There are no automatic connections between Class 1E divisions.

Class 1E medium voltage M/C switchgear and low voltage P/C switchgear and MCCs are identified according to their Class 1E division. Class 1E M/C and P/C switchgear and MCCs are located in Seismic Category I structures, and in their respective divisional areas.

Class 1E EPD System cables and raceways are identified according to their Class 1E division. Class 1E divisional cables are routed in Seismic Category I structures and in their respective divisional raceways.

Harmonic Distortion waveforms do not prevent Class 1E equipment from performing their safety functions.

The EPD System supplies an operating voltage at the terminals of the Class 1E utilization equipment that is within the utilization equipment's voltage tolerance limits.

An electrical grounding system is provided for (1) instrumentation, control, and computer systems, (2) electrical equipment (switchgear, distribution panels, transformers, and motors) and (3) mechanical equipment (fuel and chemical tanks). Lightning protection systems are provided for buildings and for structures and transformers located outside of the buildings. Each grounding system and lightning protection system is separately grounded to the plant grounding grid.

The EPD System has the following alarms, displays and controls in the MCR:

(1) Alarms for degraded voltage on Class 1E medium voltage M/C switchgear.

(2) Parameter displays for PMG output voltage, amperes, watts, vars, and frequency.

(3) Parameter displays for EPD System medium voltage M/C switchgear bus voltages and feeder and load amperes.

(4) Controls for the PMG output circuit breaker, medium voltage M/C switchgear feeder circuit breakers, load circuit breakers from the medium voltage M/C switchgear to their respective low voltage P/C switchgear, and low voltage feeder circuit breakers to the low voltage P/C switchgear.

(5) Status indication for the PMG output circuit breaker and the medium voltage M/C switchgear circuit breakers.

The EDP System has the following displays and controls at the Remote Shutdown System (RSS):

(1) Parameter displays for the bus voltages on the Class 1E Divisions I and II medium voltage M/C switchgear.

(2) Controls and status indication for the UAT, RAT(s), CTG and DG Class 1E feeder circuit breakers to the Division I and II medium voltage M/C switchgear, the load circuit breakers from the Class 1E Division I and II medium voltage M/C switchgear to their respective low voltage P/C switchgear, and the low voltage feeder circuit breakers to the Class 1E Division I and II low voltage P/C switchgear.

Class 1E equipment is classified as Seismic Category I.

Class 1E equipment which is located in areas designated as harsh environment areas is qualified for harsh environments.

Monitoring of the normal and alternate power feeds on the high voltage side of the UAT and RAT using the potential and current transformers of the protective relaying used for transformer protection is provided to detect open phase conditions, whether one, two, or three phases, with or without accompanying ground fault.

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All three phases of all the UAT or RAT shall be monitored for undervoltage, open phase, and ground faults by the specific transformer protective relay. When an undervoltage, open phase or ground fault is detected in any combination of one, two or three phases by the designated UAT or RAT protective relay, the protective relay shall send an alarm via the alarm system to the Main Control Room.

The UAT and RAT protective system relay automatically separates the Class 1E safety-related buses from the off-site power source and transfers safety-related loads to the unaffected offsite power source or the emergency diesel generators.

Interface Requirements

The portions of the EPD System which are not part of the Certified Design shall meet the following requirements:

The offsite system shall consist of a minimum of two independant offsite transmission circuits from the TN.

Voltage variations of the offsite TN during steady state operation shall not cause voltage variations at the loads of more than plus or minus 10% of the loads nominal ratings.

The normal steady state frequency of the offsite TN shall be within plus or minus 2 hertz of 60 hertz during recoverable periods of system instability.

The offsite transmission circuits from the TN through and including the main step-up power transformers and RAT(s) shall be sized to supply their load requirements, during all design operating modes, of their respective Class 1E divisions and non-Class 1E load groups.

The impedances of the main step-up power transformers and RAT(s) shall be compatible with the interrupting capability of the plant's circuit interrupting devices.

Insert for ABWR DCD Tier 1 Section 2.12.1 Electrical Power Distribution System

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All three phases of the nonsafety-related MPTs, UATs or RAT, on both the primary (high) and secondary (low) sides shall be monitored for under voltage, open phase, and ground faults by nonsafety-related micro-processor based protective relays. When an under voltage, open phase or ground fault is detected in any combination of one, two, or three phases by the designated MPT, UAT, or RAT protective relay, the protective relay shall send an alarm via the nonsafety-related alarm system to the Main Control Room.

Electric power to Class 1E safety-related busses is provided through a two feeder circuit breakers in series, one nonsafety-related and the other safety-related. This design ensures that the nonsafety-related protective relays shall, as appropriate, trip or fast transfer the plant nonsafety-related medium voltage busses and open the nonsafety-related circuit breaker feeds to the safety-related busses.

The Class 1E safety-related micro-processor based bus protective relay controlling the safety-related circuit breaker feeding nonsafety-related UAT Normal Preferred Power (NPP) power to the safety-related bus will automatically separate the safety-related bus from the nonsafety-related bus fed by the UAT NPP power source with detection of OPC or ground faults. The safety-related bus protective relay will then fast transfer the safety-related bus to the nonsafety-related RAT Alternative Preferred Power (APP) power source. The safety-related bus protective relay controlling the safety-related circuit breaker feeding nonsafety-related RAT APP power to the safety-related bus will automatically separate the safety-related bus from the nonsafety-related bus fed by the RAT power source with detection of OPC or ground faults. The safety-related bus protective relay will then fast transfer the safety-related bus to the UAT NPP power source.

If, as a result of either the nonsafety-related or safety-related micro-processor based protective relaying action, both UAT NPP and RAT APP power feeds have been separated from the safety-related bus, then the safety-related bus protective relays and safety-related sequencing logic will; 1) open the safety-related circuit breakers feeding the safety-related bus, 2) shed the safety-related loads on the safety-related bus, 3) start the safety-related emergency diesel generators, and 4) sequence on the safety-related loads.

There are three independent safety-related medium voltage busses which provide electric power to the safety-related equipment divisions. The safety-related protective relays and safety-related sequencing logic on each of the three safety-related busses are independent of those on the other safety-related busses. Therefore, the design conforms to the IEEE Std 603 single failure criterion.

The independence of offsite transmission power, instrumentation, and control circuits shall be compatible with the portion of the offsite transmission power, instrumentation, and control circuits within GE’s design scope.

Instrumentation and control system loads shall be compatible with the capacity and capability design requirements of DC systems within GE’s design scope.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.12.1 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria, which will be undertaken for the EPD System.

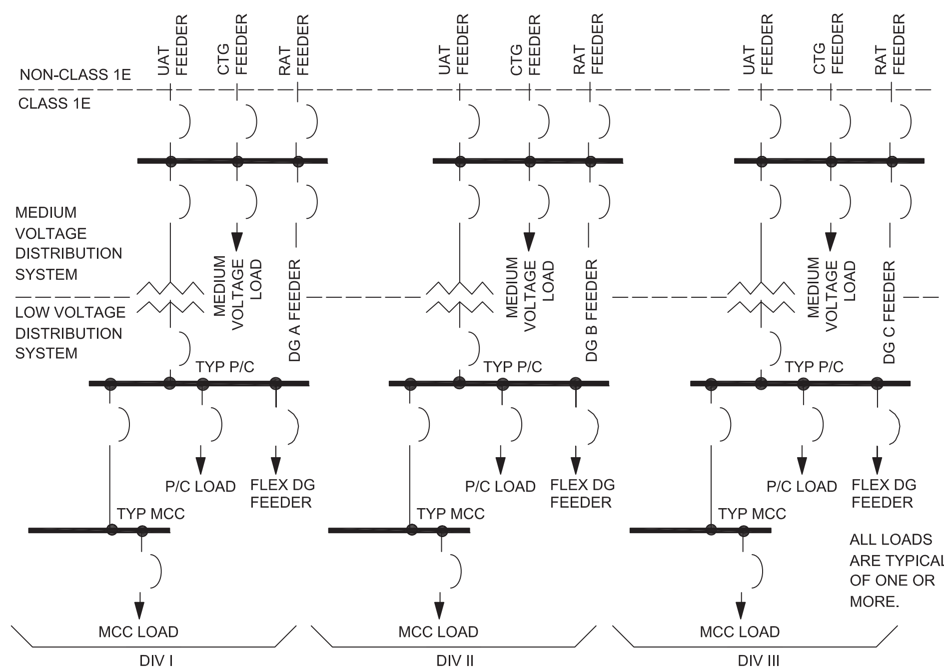

Figure 2.12.1 Class 1E Electrical Power Distribution System

Table 2.12.1 Electric Power Distribution System

Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The basic configuration for the EPD System is described in Section 2.12.1.	1. Inspection of the as-built system will be conducted.	1. The as-built EPD System conforms with the basic configuration described in Section 2.12.1.
2. UATs are sized to supply their load requirements, during design operating modes, of their respective Class 1E divisions and non-Class 1E load groups.	2. Analyses for the as-built UATs to determine their load requirements will be performed.	2. Analyses for as-built UATs exist and conclude that UAT capacity, as determined by its nameplate rating, exceeds its analyzed load requirements, during design operating modes, for its Class 1E division and non-Class 1E load group.
3. UATs are separated from the RAT(s).	3. Inspections of the as-built UATs will be conducted.	3. As-built UATs are separated from the RAT(s) by a minimum of 15.24m.
4. UATs are provided with their own oil pit, drain, fire deluge system, grounding, and lightning protection systems.	4. Inspections of the as-built UATs will be conducted.	4. As-built UATs are provided with their own oil pit, drain, fire deluge system, grounding, and lightning protection systems.
5. The PMG and its output circuit breaker is separated from the RAT(s) power feeders. The PMG and its output circuit breaker instrument and control circuits are separated from the RAT(s) instrumentation and control circuits.	5. Inspections for the as-built PMG, the PMG output circuit breaker, the RAT(s) and their respective instrumentation and control circuits will be conducted.	5. As-built PMG and its output circuit breaker is separated from the RAT(s) power feeders by a minimum of 15.24m, or by walls or floors. The PMG and its output circuit breaker instrument and control circuits are separated from the RAT(s) instrumentation and control circuits by a minimum of 15.24m, or by walls or floors outside the MCR, and are separated by routing the circuits in separate raceways inside the MCR.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
6. UATs power feeders, and instrumentation and control circuits are separated from the RAT(s) output power feeders, and instrumentation and control circuits.	6. Inspections for the as-built UATs and RAT(s) power feeders, and instrumentation and control circuits will be conducted.	6. As-built UAT power feeders are separated from the RAT(s) power feeders by a minimum of 15.24m, or by walls or floors, except at the switchgear, where they are routed to opposite ends of the medium voltage M/C switchgear. As-built UAT instrumentation and control circuits, are separated from the RAT(s) instrumentation and control circuits by a minimum of 15.24m, or by walls or floors, except as follows: a) at the non-Class 1E DC power sources, where they are routed in separate raceways, b) inside the MCR, where they are separated by routing the circuits in separate raceways, and c) at the switchgear, where they are routed to opposite ends of the medium voltage M/C switchgear and routed in separate raceways inside the switchgear.
7. The MPT and its switching station instrumentation and control circuits are separated from the RAT(s) and its switching station instrumentation and control circuits.	7. Inspections for the as-built MPT and RAT(s) and their respective switching station instrumentation and control circuits will be conducted.	7. As-built MPT and its switching station instrumentation and control circuits, from the switchyard(s) to the MCR, are separated from the RAT(s) and its switching station instrumentation and control circuits by a minimum of 15.24m, or by walls or floors. MPT and its switching station instrumentation and control circuits, inside the MCR, are separated from the RAT(s) and its switching station instrumentation and control circuits by routing the circuits in separate raceways.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
8. Medium voltage M/C switchgear, low voltage P/C switchgear, with their respective transformers, and MCCs, and their respective switchgear and MCC feeder and load circuit breakers are sized to supply their load requirements.	8. Analyses for the as-built EPD System to determine load requirements will be performed.	8. Analyses for the as-built EPD System exist and conclude that the capacities of the Class 1E switchgear, P/C transformers, MCCs, and their respective feeder and load circuit breakers, as determined by their nameplate ratings, exceed their analyzed load requirements.
9.	9.	9.
a. Medium voltage M/C switchgear, low voltage P/C switchgear, with their respective transformers, and MCCs, are rated to withstand fault currents for the time required to clear the fault from its power source.	a. Analyses for the as-built EPD System to determine fault currents will be performed.	a. Analyses for the as-built EPD System exist and conclude that the Class 1E switchgear, with their respective transformers, and MCC, current capacities exceed their analyzed fault currents for the time required, as determined by the circuit interrupting device coordination analyses, to clear the fault from its power source.
b. The PMG output circuit breaker, medium voltage M/C switchgear, low voltage P/C switchgear and MCC feeder and load circuit breakers are rated to interrupt fault currents	b. Analyses for the as-built EPD System to determine fault currents will be performed.	b. Analyses for the as-built EPD System exist and conclude that the analyzed fault currents do not exceed the PMG output circuit breaker, and M/C, P/C switchgear, and MCC feeder and load circuit breakers interrupt capacities, as determined by their nameplating ratings.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
10. Class 1E equipment is protected from degraded voltage conditions.	10. a. Analyses for the as-built EPD System to determine the trip conditions for degraded voltage conditions will be performed. b. Tests for each as-built Class 1E M/C switchgear will be conducted by providing a simulated degraded voltage signal.	10. a. Analyses for the as-built EPD System exist and conclude that the Class 1E preferred offsite power feeder breakers to the Class 1E M/C switchgear will trip before Class 1E loads experience degraded voltage conditions exceeding those voltage conditions for which the Class 1E equipment is qualified. b. As-built Class 1E feeder breakers from preferred offsite power to the Class 1E M/C switchgear trip when a degraded voltage condition exists.
11. EPD System interrupting devices (circuit breakers and fuses) are coordinated so that the circuit interrupter closest to the fault opens before other devices.	11. Analyses for the as-built EPD System to determine circuit interrupting device coordination will be performed.	11. Analyses for the as-built EPD System exist and conclude that the analyzed circuit interrupter closest to the fault will open before other devices.
12. Instrumentation and control power for Class 1E divisional medium voltage M/C switchgear and low voltage P/C switchgear is supplied from the Class 1E DC power system in the same division.	12. Tests of the as-built Class 1E medium and low voltage switchgear will be conducted by providing a test signal in only one Class 1E division at a time.	12. A test signal exists in only the Class 1E division under test.
13. The PMG output circuit breaker is equipped with redundant trip devices which are supplied from separate non-Class 1E DC power systems.	13. Tests of the as-built PMG output circuit breaker will be conducted by providing a test signal in only one trip circuit at a time.	13. A test signal exists in only the circuit under test.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14. EPD System cables and bus ducts are sized to supply their load requirements.	14. Analyses for the as-built EPD System cables and bus ducts will be performed.	14. Analyses for the as-built EPD System exist and conclude that cable and bus duct capacities, as determined by cable and bus duct ratings, exceed their analyzed load requirements.
15. EPD System cables and bus ducts are rated to withstand fault currents for the time required to clear its fault from its power source.	15. Analyses for the as-built EPD System to determine fault currents will be performed.	15. Analyses for the as-built EPD System exist and conclude that cables and bus ducts will withstand the analyzed fault currents for the time required, as determined by the circuit interrupting device coordination analyses, to clear the analyzed faults from their power sources.
16. For the EPD System, Class 1E power is supplied by three independent Class 1E divisions. Independence is maintained between Class 1E divisions, and between Class 1E divisions and non-Class 1E equipment.	16. a. Tests on the as-built EPD System will be conducted by providing a test signal in only one Class 1E division at a time. b. Inspections of the as-built EPD System Class 1E divisions will be conducted.	16. a. A test signal exists in only the Class 1E division under test in the EPD System. b. In the EPD System, physical separation or electrical isolation exists between Class 1E divisions. Physical separation or electrical isolation exists between these Class 1E divisions and non-Class 1E equipment.
17. Class 1E medium voltage M/C switchgear and low voltage P/C switchgear and MCCs are identified according to their Class 1E division.	17. Inspections of the as-built EPD System Class 1E M/C and P/C switchgear and MCCs will be conducted.	17. As-built Class 1E M/C and P/C switchgear, and MCCs are identified according to their Class 1E division.
18. Class 1E M/C and P/C switchgear and MCCs are located in Seismic Category I structures and in their respective divisional areas.	18. Inspections of the as-built Class 1E M/C and P/C switchgear and MCCs will be conducted.	18. As-built Class 1E M/C and P/C switchgear, and MCCs are located in Seismic Category I structures and in their respective divisional areas.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
19. Class 1E EPD System cables and raceways are identified according to their Class 1E division.	19. Inspections of the as-built Class 1E EPD System cables and raceways will be conducted.	19. As-built Class 1E EPD System cables and raceways are identified according to their Class 1E division.
20. Class 1E divisional cables are routed in Seismic Category I structures and in their respective divisional raceways.	20. Inspection of the as-built Class 1E EPD System divisional cables and raceways will be conducted.	20. As-built Class 1E divisional cables are routed in Seismic Category I structures and in their respective divisional raceways.
21. Harmonic Distortion waveforms do not prevent Class 1E equipment from performing their safety functions.	21. Analyses for the as-built EPD System to determine harmonic distortions will be performed.	21. Analyses for the as-built EPD System exist and conclude that harmonic distortion waveforms do not exceed 5% voltage distortion on the Class 1E EPD System.
22. The EPD System supplies an operating voltage at the terminals of the Class 1E utilization equipment that is within the utilization equipment's voltage tolerance limits.	22. a. Analyses for the as-built EPD System to determine voltage drops will be performed.	22. a. Analyses for the as-built EPD System exist and conclude that the analyzed operating voltage supplied at the terminals of the Class 1E utilization equipment is within the utilization equipment's voltage tolerance limits, as determined by their nameplate ratings.
	b. Tests of the as-built Class 1E EPD System will be conducted by operating connected Class 1E loads at their analyzed minimum voltage.	b. Connected Class 1E loads operate at their analyzed minmum voltage, as determined by the voltage drop analyses.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
23. An electrical grounding system is provided for (1) instrumentation, control, and computer systems, (2) electrical equipment (switchgear, distribution panels, transformers, and motors) and (3) mechanical equipment (fuel and chemical tanks). Lightning protection systems are provided for buildings and for structures and transformers located outside of the buildings. Each grounding system and lightning protection system is separately grounded to the plant grounding grid.	23. Inspections of the as-built EPD System plant Grounding and Lightning Protection Systems will be conducted.	23. The as-built EDP System instrumentation, control, and computer grounding system, electrical equipment and mechanical equipment grounding system, and lightning protection systems provided for buildings and for structures and transformers located outside of the buildings are separately grounded to the plant grounding grid.
24. MCR alarms, displays and controls provided for the EPD System are as defined in Section 2.12.1.	24. Inspections will be conducted on the MCR alarms, displays and controls for the EPD System.	24. Displays and controls exist or can be retrieved in the MCR as defined in Section 2.12.1.
25. RSS displays and controls provided for the EPD System are as defined in Section 2.12.1.	25. Inspections will be conducted on the as-built RSS displays and controls for the EPD System.	25. Displays and controls exist or can be retrieved on the RSS as defined in Section 2.12.1.

See Insert below for ITAAC 26 through 30 replacement.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
26. Monitoring of the high voltage side of the normal power feed (attached to the UATs) and the alternate power feed (attached to the RAT) using the potential and current transformers of the protective relaying used for transformer protection is provided to detect open phase conditions, whether one, two, or three phases, with or without accompanying ground fault.	26. An analysis of the transformer protection scheme will be performed to verify the following: a. Protective relay current and potential transformers have been correctly located. b. Relay set points can provide adequate detection.	26. An analysis demonstrates: a. The correct location of the current and potential transformers for each UAT and RAT transformer protection relay. b. Protective relay set points ensure that the monitoring systems can adequately detect open phase conditions in any combination of the three phases, with or without accompanying ground faults, on the high-voltage side of the UAT and RAT transformers. c. The trip setpoint is sufficient to provide detection of open phase conditions while minimizing spurious indications under conditions which may be normally expected in the transmission system.
27. All three phases of all the UATs or RAT shall be monitored for undervoltage, open phase, and ground faults by the specific transformer protective relay. When an undervoltage, open phase or ground fault is detected in any combination of one, two or three phases by the designated UATs or RAT protective relay, the protective relay shall send an alarm via the alarm system to the Main Control Room.	27. A test will be performed on the as-built monitoring system, using simulated signals, to demonstrate that, at the designated protective relay set points, each UAT and RAT monitoring system alarms in the Main Control Room.	27. Using simulated signals, at the designated protective relay set points in any combination of the three phases, the as-built UAT and RAT monitoring systems initiate an alarm in the Main Control Room.
28. Each UAT and RAT protective system relay automatically separates the Class 1E safety-related buses from the offsite power source and transfers safety-related loads to the unaffected offsite power source or the emergency diesel generators.	28. A test will be performed on each as-built UAT and RAT protective system relay, using simulated signals, to demonstrate that, at the designated protective relay set points, each UAT and RAT monitoring system transfers loads.	28. Using simulated signals, at the designated protective relay set points in any combination of the three phases, the as-built UAT and RAT monitoring systems initiate a transfer of loads.

See Insert below for ITAAC 26 through 30 replacement.

Table 2.12.1 Electric Power Distribution System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
29. Each safety bus shall be monitored for an unbalanced phase condition, the source of which is provided by offsite power source. When an unbalanced phase condition (UPC) is detected a protective relay shall send an alarm via the alarm system to the Main Control Room, and send a trip signal to the offsite power feeder breaker.	29. A test will be performed on the as-built monitoring system, using simulated signals, to demonstrate that, at the designated protective relay set points, each UPC is detected and opens the UAT and RAT feeder breakers to the safety bus.	29. Using simulated signals, at the designated protective relay set points: a. Each UPC is detected and b. UAT and RAT feeder breakers to the safety bus open.
30. Protective relaying used for protection of the 6.9 kV safety related buses is provided to detect open phase conditions, whether one, two, or three phases, with or without accompanying ground fault.	30. An analysis of the safety related bus protection scheme will be performed to verify the following: a. Protective relay current and potential transformers have been correctly located. b. Relay set points can provide adequate detection and protection of safety related loads.	30. An analysis demonstrates: a. The correct location of the current and potential transformers for each of the safety related buses. b. Protective relay set points ensure adequate detection and protection of safety related loads in the event of an open phase conditions in any combination of the three phases, with or without accompanying ground faults, on the high-voltage side of the UAT and RAT transformers.

INSERT FOR REPLACING ITAAC 26 THROUGH 30 [3 PAGES TOTAL]

Table 2.12.1 Electric Power Distribution System, Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	**Inspection, Tests, Analyses**	**Acceptance Criteria**
26. DELETED	**26.** DELETED	**26.** DELETED
27. DELETED	**27.** DELETED	**27.** DELETED

Design Commitment	**Inspection, Tests, Analyses**	**Acceptance Criteria**
28. Each MPT, UAT and RAT nonsafety-related micro-processor based protective relay(s), upon detecting: • open phase conditions (OPC) • phase to phase faults • ground faults • ground to phase faults in any combination of the three phases on the primary [high] or secondary [low] side of the transformer will: a. alarm to the Main Control Room and, as appropriate, b. either trip or fast transfer the nonsafety-related electrical busses to an alternate electric power source.	**28.** A test will be performed on each as-built MPT, UAT and RAT nonsafety-related protective relay(s), using simulated fault or phase loss signals in any combination of the three phases, to demonstrate that, at the designated protective relay setpoints: a. alarms will be sent to the Main Control Room and, as appropriate, b. either trip or fast transfer the nonsafety-related electrical busses to an alternate power source.	**28.** Using simulated signals in any combination of the three phases, at the designated nonsafety-related protective relay setpoints in any combination of phase fault or loss, the as-built MPT, UAT and RAT protective relay(s) will initiate: a. alarms in the Main Control Room and, as appropriate, b. either trip or fast transfer the nonsafety-related electrical busses to an alternate power source.

INSERT FOR REPLACING ITAAC 26 THROUGH 30 [3 PAGES TOTAL]

Table 2.12.1 Electric Power Distribution System, Inspections, Tests, Analyses and Acceptance Criteria

Design Commitment	Inspection, Tests, Analyses	Acceptance Criteria
29. The nonsafety-related electric power feeder circuit breakers to each safety-related bus shall be monitored for an unbalanced phase condition (UPC), the source of which is provided by nonsafety-related offsite electric power source. The monitoring nonsafety-related micro-processor based protective relays shall: a. detect the UPC, b. send an alarm via the alarm system to the Main Control Room and c. send a trip signal to open the nonsafety-related offsite electric power feeder circuit breakers to the Class 1E safety-related bus.	**29.** A test will be performed on the as-built nonsafety-related protective relays, using simulated signals, to demonstrate that, at the designated protective relay setpoints, each UPC is: a. detected, b. an alarm is sent to the Main Control Room and c. a trip signal is sent to open the nonsafety-related UAT NPP and RAT APP power feeder breakers to the Class 1E safety-related bus.	**29.** Using simulated signals, at the designated nonsafety-related protective relay setpoints, each UPC is: a. detected, b. an alarm is sent to the Main Control Room and c. a trip signal is sent to open the nonsafety-related UAT NPP and RAT APP power feeder breakers to the Class 1 E safety-related bus.
30. Class 1E safety-related micro-processor based protective relays located on the medium voltage safety-related electric power busses control the safety-related normal and alternative electric power feeder circuit breakers to ensure that the safety-related busses are protected against any combination or fault or phase loss conditions. Safety-related protective relays will perform the following functions: a. If an alternate nonsafety-related power source is available, then the safety-related protective relays controlling the safety-related feeder circuit breakers will appropriately trip or fast transfer power	**30.** A test will be performed on each as-built Class 1E safety-related protective relay, using simulated signals in any combination of fault or phase loss conditions, to demonstrate that, at the designated safety-related protective relay setpoints, the appropriate safety-related protective relays will perform the following functions: a. If an alternate nonsafety-related power source is available, then the safety-related protective relays controlling the safety-related feeder circuit breakers	**30.** Using simulated signals, at the designated Class 1E safety-related protective relay setpoints, in any combination of phase fault or loss conditions, the as-built safety-related protective relays will perform the following functions: a. If an alternate nonsafety-related power source is available, then the safety-related protective relays controlling the safety-related feeder circuit breakers will appropriately trip or fast transfer power between incoming alternate nonsafety-related power sources or b. If no alternate nonsafety-related power source is available, then the safety-related

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Table 2.12.1 Electric Power Distribution System, Inspections, Tests, Analyses and Acceptance Criteria

<u>Design Commitment</u>	<u>Inspection, Tests, Analyses</u>	<u>Acceptance Criteria</u>
between incoming alternate nonsafety-related power sources or b. If no alternate nonsafety-related power source is available, then the safety-related logic and safety-related protective relays controlling the appropriate safety-related circuit breakers will: 1) isolate the safety-related bus, 2) shed safety-related loads to protect the safety-related equipment, 3) start the safety-related emergency diesel generator and 4) sequence on the safety-related loads.	will appropriately trip or fast transfer power between incoming alternate nonsafety-related power sources or b. If no alternate nonsafety-related power source is available, then the safety-related logic and safety-related protective relays controlling the appropriate safety-related circuit breakers will; 1) isolate the safety-related bus, 2) shed the safety-related loads to protect the safety-related equipment, 3) start the safety-related emergency diesel generator, 4) sequence on the safety-related loads.	protective relays controlling the appropriate safety-related circuit breakers will: 1) isolate the safety-related bus, 2) shed the safety-related loads to protect the safety-related equipment, 3) start the safety-related emergency diesel generator and 4) sequence on the safety-related loads.
31. There is no data communication from the nonsafety-related to the Class 1E safety-related micro-processor based protective relays.	**31.** An inspection will be performed on each as-built safety-related and nonsafety-related protective relay(s) to verify that there is no data communication from the nonsafety-related to the safety-related protective relays.	**31.** An inspection demonstrates that there is no data communication from the nonsafety-related to the safety-related protective relays.

Table 1.8-19 Standard Review Plans and Branch Technical Positions Applicable to ABWR (Continued)

SRP No.	SRP Title	Appl. Rev.	Issued Date	ABWR Appli-cable?	Comments
	BTP ICSB 8 (PSB)	2	7/81	Yes	
	BTP ICSB 11 (PSB)	2	7/81	Yes	
	BTP ICSB 15 (PSB) (Deleted)				
	BTP ICSB 17 (PSB) (Superseded by Reg. Guide 1.9)				
	BTP ICSB 18 (PSB)	2	7/81	Yes	
	BTP ICSB 21 (PSB)	2	7/81	Yes	
	BTP PSB 1	0	7/81	Yes	
	BTP PSB 2	0	7/81	Yes	
	Appendix 8 — B General Agenda, Station Site Visits	0	7/81	Yes	
Add:	BTP 8-9	0	7/15	Yes	
Chapter 9 Auxiliary Systems					
9.1.1	New Fuel Storage	2	7/81	Yes	
9.1.2	Spent Fuel Storage	3	7/81	Yes	
9.1.3	Spent Fuel Pool Cooling and Cleanup System	1	7/81	Yes	
9.1.4	Light Load Handling System (Related to Refueling)	2	7/81	Yes	
	BTP ASB 9-1 (Superseded by NUREG-0554)				
9.1.5	Overhead Heavy Load Handling Systems	1	3/07	Yes	ABWR and COL Applicant
9.2.1	Station Service Water System	4	6/85	Yes	ABWR and COL Applicant
9.2.2	Reactor Auxiliary Cooling Water Systems	3	6/86	Yes	ABWR and COL Applicant
9.2.3	Demineralized Water Makeup System	2	7/81	Yes	ABWR and COL Applicant
9.2.4	Potable and Sanitary Water Systems	2	7/81	Yes	ABWR and COL Applicant
9.2.5	Ultimate Heat Sink	2	7/81	—	COL Applicant
	BTP ASB 9-2	2	7/81	Yes	

Table 1.9-1 Summary of ABWR Standard Plant COL License Information (Continued)

Item No.	Subject	Subsection
8.4	Offsite Power Systems Design Bases	8.2.4.3
8.5	Offsite Power Systems Scope Split	8.2.4.4
8.6	Capacity of Auxiliary Transformers	8.2.4.5
8.7	Monitoring and Protection Against Design Vulnerabilities	8.2.4.6
8.8	Diesel Generator Design Details	8.3.4.2
8.9	Not Used	8.3.4.3
8.10	Protective Devices for Electrical Penetration Assemblies	8.3.4.4
8.11	Not Used	8.3.4.5
8.12	Not Used	8.3.4.6
8.13	Not Used	8.3.4.7
8.14	Not Used	8.3.4.8
8.15	Offsite Power Supply Arrangements	8.3.4.9
8.16	~~Not Used~~ Mitigation of Open Phase Condition on RAT and UATs	8.3.4.10
8.17	~~Not Used~~ Mitigation of Open Phase Condition on Main Power Transformer (MPT)	8.3.4.11
8.18	Not Used	8.3.4.12
8.19	Load Testing of Class 1E Switchgear and Motor Control Centers	8.3.4.13
8.20	Administrative Controls for Bus Grounding Circuit Breakers	8.3.4.14
8.21	Administrative Controls for Manual Interconnections	8.3.4.15
8.22	Not Used	8.3.4.16
8.23	Common Industrial Standards Referenced in Purchase Specifications	8.3.4.17
8.24	Administrative Control for Switching 125Vdc Standby Charger	8.3.4.18
8.25	Control of Access to Class 1E Power Equipment	8.3.4.19
8.26	Periodic Testing of Voltage Protection Equipment	8.3.4.20
8.27	Diesel Generator Parallel Test Mode	8.3.4.21
8.28	Periodic Testing of Diesel Generator Protective Relaying	8.3.4.22
8.29	Periodic Testing of Diesel Generator Synchronizing Interlocks	8.3.4.23
8.30	Periodic Testing of Thermal Overloads and Bypass Circuitry	8.3.4.24
8.31	Periodic Inspection/Testing of Lighting System	8.3.4.25
8.32	Controls for Limiting Potential Hazards Into Cable Chases	8.3.4.26
8.33	Periodic Testing of Class 1E Equipment Protective Relaying	8.3.4.27

be utilized as a power source for the unit auxiliary transformers and their loads, both Class 1E and non-Class 1E. This is also the startup power source for the unit.

There are three unit auxiliary transformers, connected to supply power to three approximately equal load groups of equipment. The “Normal Preferred” power feed is from the unit auxiliary transformers so that there normally are no bus transfers required when the unit is tripped off the line.

One, three-winding 37.5 MV·A unit reserve auxiliary transformer (RAT) provides power via one secondary winding for the Class 1E buses as an alternate to the “Normal Preferred” power. The other secondary winding supplies reserve power to the non-Class 1E buses. This is truly a reserve transformer because unit startup is accomplished from the normal preferred power, which is backfed from the offsite transmission network over the main power circuit to the unit auxiliary transformers. The two low voltage windings of the reserve transformer are rated 18.75 MV·A each.

A 9mW combustion turbine generator is provided as an alternate AC power source. The unit is capable of providing power to non-Class 1E plant investment protection buses and Class 1E buses. The combustion turbine generator is non-safety-related.

8.1.2.2 Description of Onsite AC Power Distribution System

Three non-Class 1E buses and one Class 1E division receive power from the single unit auxiliary transformer assigned to each load group. Load groups A, B and C line up with Divisions I, II and III, respectively. One winding of the reserve auxiliary transformer may be utilized to supply reserve power to the non-Class 1E buses either directly or indirectly through bus tie breakers. The three Class 1E buses may be supplied power from the other winding of the reserve auxiliary transformer.

A combustion turbine generator (CTG) supplies automatic standby power to plant investment protection non-Class 1E loads. These loads are grouped on the three plant investment protection (PIP) buses as shown in Figure 8.3-1. The CTG also has the capability to be manually connected to any of the three Class 1E buses, for mitigation of the station blackout (SBO) event (see Subsection (9) of 8.3.1.1.7).

In general, motors larger than 300 kW are supplied from the 6.9 kV metal-clad (M/C) bus. Motors 300 kW or smaller but larger than 100 kW are supplied power from 480V power center (P/C) switchgear. Motors 100 kW or smaller are supplied power from 480V motor control centers (MCC). The 6.9 kV and 480V single line diagrams are shown in Figure 8.3-1.

During normal plant operation all of the non-Class 1E buses and two of the Class 1E buses are supplied with power from the main turbine generator through the unit auxiliary transformers. The remaining Class 1E bus is supplied from the reserve auxiliary transformer. This division is immediately available, without a bus transfer, if the normal preferred power is lost to the other two divisions.

Three safety related, Class 1E diesel generator standby AC power supplies provide a separate onsite source of power for each Class 1E division when normal or alternate preferred power supplies are not available. The transfer from the normal preferred or alternate preferred power supplies to the diesel generator is automatic. The transfer back to the normal preferred or the alternate preferred power source is a manual transfer.

The Division I, II, and III standby AC power supplies consist of an independent 6.9 kV Class 1E diesel generator (D/G), one for each division. Each D/G may be connected to its respective 6.9 kV Class 1E switchgear bus through a circuit breaker located in the switchgear.

The standby AC power system is capable of providing the required power to safely shut down the reactor after loss of preferred power (LOPP) and/or loss of coolant accident (LOCA) and to maintain the safe shutdown condition and operate the Class 1E auxiliaries necessary for plant safety after shutdown.

The plant 480 VAC power system distributes sufficient power for normal auxiliary and Class 1E 480 volt plant loads. All Class 1E elements of the 480V power distribution system are supplied via the 6.9 kV Class 1E switchgear and, therefore, are capable of being fed by the normal preferred, alternate preferred, standby diesel generator, or combustion turbine generator power supplies.

The 120 VAC non-Class 1E instrumentation power system, Figure 8.3-2, provides power for non-Class 1E control and instrumentation loads.

The Class 1E 120 VAC instrument power system, Figure 8.3-2, provides for Class 1E plant controls and instrumentation. The system is separated into Divisions I, II and III with distribution panels and local control panels fed from their respective divisional sources.

The 125 VDC power distribution system provides four independent and redundant onsite battery sources of power for operation of Class 1E DC power, control, and instrument loads. The 125 VDC non-Class 1E power control and instrument loads are supplied from three 125 VDC batteries located in the turbine building. A separate non-Class 1E 250V battery is provided to supply uninterruptible power to the plant computers and non-Class 1E DC motors (Figure 8.3-4).

The safety system and logic control (SSLC) for the Reactor Protection System (RPS) and Main Steamline Isolation Valves (MSIV) derives its power from four uninterruptible 120 VAC divisional buses (See Figure 8.3-3). The SSLC for the Emergency Core Cooling System (ECCS) derives its power from the four divisions of 125 VDC buses. The four buses provide the redundancy for various instrumentation, logic and trip circuits and solenoid valves. The SSLC power supply is further described in Subsection 8.1.3.1.1.2.

Add Insert #1 for Section 8.1.2.2.1 here (see next page for Insert #1).

Insert #1 for Section 8.1.2.2.1

8.1.2.2.1 Monitoring and Protection Against Design Vulnerabilities

The ABWR standard plant design incorporates requirements for mitigation of Open Phase Condition (OPC) as identified in NRC Bulletin 2012-01, “Design Vulnerability In Electric Power System” (Reference 8.2-3) and satisfies the criteria described in BTP 8-9. Refer to sub-sections 8.3.1.0.6.3 and 8.3.1.1.6.3 for detail descriptions.

(6) The batteries and chargers associated with the preferred power system can meet the requirements of their design loads.

(7) The generator breaker can open on demand. (Note: The breaker's actual opening and closing mechanisms are inherently confirmed during the shutdown and synchronizing processes. Trip circuits shall be periodically verified during shutdown periods while the breaker is open.)

(8) Isolated and non-segregated phase bus ducts are inspected and maintained such that they are clear of debris, fluids, and other undesirable materials. Also, terminals and insulators are inspected, cleaned and tightened, as necessary.

The test and inspection intervals will be established and maintained according to the guidelines of IEEE-338, Section 6.5, as appropriate for non-Class 1E systems (i.e., Items (4) and (7) of Section 6.5.1 are not applicable).

8.2.4.2 Procedures when a Reserve or Unit Auxiliary Transformer is Out of Service

Appropriate plant operating procedures will be imposed whenever the reserve auxiliary transformer or a unit auxiliary transformer is out of service.

8.2.4.3 Offsite Power Systems Design Bases

Interface requirements for the COL applicant offsite power systems design bases are provided in Subsection 8.2.3.

8.2.4.4 Offsite Power Systems Scope Split

Interface requirements for the COL applicant pertaining to offsite power systems scope split are provided in Subsection 8.2.3.

8.2.4.5 Capacity of Auxiliary Transformers

Appropriate plant procedures shall be provided to assure FOA ratings of the reserve auxiliary transformer, or any unit auxiliary transformer, will not be exceeded under any operating mode (Subsection 8.2.1.2).

8.2.4.6 Monitoring and Protection Against Design Vulnerabilities

The COL applicant shall describe the monitoring and protection scheme for the high voltage side of the UATs and RAT to protect against the concerns raised by NRC Bulletin 2012-01, Design Vulnerability In Electric Power System (Reference 8.2-3).

Delete Section 8.2.4.6.

8.3.1.0.6 Circuit Protection

8.3.1.0.6.1 Philosophy of Protection

Simplicity of load grouping facilitates the use of conventional, protective relaying practices for isolation of faults. Emphasis has been placed in preserving function and limiting loss of equipment function in situations of power loss or equipment failure.

Breaker coordinates analysis will be performed in accordance with IEEE 141, 242 and/or other acceptable industry standards or practices.

Circuit protection of the non-Class 1E buses is interfaced with the design of the overall protection system.

8.3.1.0.6.2 Grounding Methods

Station grounding and surge protection is discussed in Section 8A.1. The medium voltage (6.9kV) system is low resistance grounded except that the combustion turbine generator is high resistance grounded to maximize availability.

See Subsection 8.3.4.14 for COL license information pertaining to administrative control for bus grounding circuit breakers.

8.3.1.0.6.3 Bus Protection

Bus protection is as follows:

(1) 6.9kV bus incoming circuits have inverse time over-current, ground fault, bus differential and under-voltage protection.

(2) 6.9kV feeders for power centers have instantaneous, inverse time over-current and ground fault protection.

(3) 6.9kV feeders for heat exchanger building substations have inverse time over-current and ground fault protection.

(4) 6.9kV feeders used for motor starters have instantaneous, inverse time over-current, ground fault protection.

(5) 480V bus incoming line and feeder circuits have inverse time over-current and ground fault protection.

Add Item (6) as shown on Insert #1 for Section 8.3.1.0.6.3.

8.3.1.1 Class 1E AC Power Distribution System

8.3.1.1.1 Medium Voltage Class 1E Power Distribution System

Class 1E AC power loads are divided into three divisions (Divisions I, II, and III), each fed from an independent 6.9 kV Class 1E bus. During normal operation (which includes all modes of

Insert #1 for Section 8.3.1.0.6.3

(6) The Main Power Transformer (MPT), RAT and the UATs are monitored using micro-processor based protective relays on the primary (high) and secondary (low) sides for OPC, over current, ground fault, under voltage and unbalance phase conditions in any combination on all three phases. Alarms in the Main Control Room (MCR) alert the operator to an abnormal condition. Additionally, the protective relays appropriately trip or fast transfer the nonsafety-related medium voltage busses and the nonsafety-related feeder circuit breakers to the Class 1E safety-related busses. The COL applicant will develop procedures and train operators on how to respond to MCR alarms and protective actions indicating abnormal conditions including OPC on the MPT, RAT, and UATs as stated in Sections 8.3.4.10 and 8.3.4.11.

8.3.1.1.6.2 Grounding Methods

Station grounding and surge protection is discussed in Section 8A.1. The medium voltage (6.9 kV) system is low resistance grounded except that each diesel generator is high resistance grounded to maximize availability.

See Subsection 8.3.4.14 for COL license information pertaining to administrative control for bus grounding circuit breakers.

8.3.1.1.6.3 Bus Protection

Bus protection is as follows:

(1) 6.9 kV bus incoming circuits have inverse time over-current, ground fault, bus differential, unbalanced phase condition and under-voltage protection. The undervoltage and unbalanced phase monitoring is responsive to all three phases. The monitoring is effective for both load shedding and emergency diesel start and protection of the safety-related bus loads for grounds and loss of one or more phases.

Add Insert No. 1 for Section 8.3.1.1.6.3, Item 1 as a new paragraph for Item (1) here.

(2) 6.9 kV feeders for power centers have instantaneous, inverse time over-current and ground fault protection.

(3) 6.9 kV feeders for heat exchanger building substations have inverse time over-current and ground fault protection.

(4) 6.9 kV feeders used for motor starters have instantaneous, inverse time over-current, ground fault and motor protection.

(5) 480V bus incoming line and feeder circuits have inverse time over-current and ground fault protection.

(6) Nonsafety-related buses A4, B4, C4, and the new H bus are monitored by their own protective relays and will trip power to the safety-related buses on detection of abnormal voltages and frequency, including loss of one or more phases and ground conditions.

8.3.1.1.6.4 Protection Requirements for Diesel Generators

Replace the content of Section 8.3.1.1.6.4 with Insert #1 for Section 8.3.1.1.6.4. See insert further below.

~~Protective devices of the diesel generators meet all requirements of IEEE-603. When the diesel generators are called upon to operate during LOCA conditions, the only protective devices [...]e diesel are the generator differential relays, and the engine over-speed trip. [...]vices are retained under accident conditions to protect against possible, [...] Other protective relays, such as loss of excitation, anti-motoring (reverse [...]t voltage restraint, low jacket water pressure, high jacket water temperature, and low-lube oil pressure, are used to protect the machine when operating in parallel with the offsite power system, during periodic tests. The relays are automatically isolated from the~~

Insert #1 for Section 8.3.1.1.6.3, Item 1

[Add the following as a new paragraph in Item (1) of Section 8.3.1.1.6.3:]

Micro-processor based protective relays which are a part of the bus protection scheme automatically sense loss of a single, or multiple phases, and loss of phase with ground during all plant operating scenarios and loading conditions. In addition to detecting open phase condition (OPC), alarm function in the Main Control Room (MCR) are provided. The protective relay schemes include specific algorithms that are utilized via the micro-processor based protective relays to detect and isolate circuit breaker(s) on downstream busses thereby protecting safety-related equipment.

Replace the content of Section 8.3.1.1.6.4 with Insert #1 for Section 8.3.1.1.6.4. See insert further below.

tripping circuits during LOCA conditions when there is a concurrent LOPP signal. However, all of these bypassed parameters are annunciated in the main control room (Subsection 8.3.1.1.8.5). The bypasses and protective relays are testable and meet all IEEE-603 requirements, and are manually reset as required by Position 1.8 of Regulatory Guide 1.9. No trips are bypassed during LOPP or testing. See Subsection 8.3.4.22 for COL license information.

Synchronizing interlocks are provided to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply (see Section 5.1.4.2 of IEEE-741). Such interlocks are capable of being tested, and shall be periodically tested per Section 8.3.4.23).

8.3.1.1.7 Load Shedding and Sequencing on Class 1E Buses

This subsection addresses Class 1E Divisions I, II, and III. Load shedding, bus transfer and sequencing on a 6.9 kV Class 1E bus is initiated on loss of bus voltage. Only LOPP signals (≤70% bus voltage) or degraded voltage signals are used to trip the loads. However, the presence of a LOCA during LOPP reduces the time delay for initiation of bus transfer from 3 seconds to 0.4 seconds. The Class 1E equipment is designed to sustain operation for this 3-second period without damage to the equipment. The load sequencing for the diesels is given on Table 8.3-4.

Load shedding and bus ready-to-load signals are generated by the under-voltage relays monitoring the Class 1E medium voltage switchgear buses. Individual timer start and reset signals for the LOPP condition are generated, for each major LOPP load, by the bus under-voltage relays. Individual timer start and reset signals for the LOCA condition are generated, for each major LOCA load, by the Safety System Logic and Control (SSLC) system. Table 8.3-4 defines which loads are sequenced onto the diesel generator for the LOPP and LOPP + LOCA conditions. (i.e. if a LOCA signal is not present, only LOPP loads are sequenced).

(1) **Loss of Preferred Power (LOPP)**—The 6.9 kV Class 1E buses are normally energized from the normal or alternate preferred power supplies. Should the bus voltage decay to ≤ 70% of its nominal rated value, a bus transfer is initiated and the signal will trip the supply breaker, and start the diesel generator. When the bus voltage decays to 30%, large pump motor breakers (6.9 kV) are tripped. The transfer then proceeds to the diesel generator. If the standby diesel generator is ready to accept load (i.e., voltage and frequency are within normal limits and no lockout exists, and the normal and alternate preferred supply breakers are open), the diesel-generator breaker is signalled to close, following the tripping of the large motors. This accomplishes automatic transfer of the Class 1E bus to the diesel generator. Motor loads will be sequence started as required and shown on Table 8.3-4.

Insert #1 for Section 8.3.1.1.6.4

Protective devices of the emergency diesel generators meet all requirements of IEEE-603. When the emergency diesel generators are called upon to operate during LOCA conditions coincident with a LOPP, the only protective actions which shut down the diesel generators are an electric power differential condition, any detected faults that could damage the loads, and the diesel engine over-speed trip. These protection devices and their actions are retained under accident conditions to protect against possible significant damage. Other protective relays, such as loss of excitation, anti-motoring (reverse power), over-current voltage restraint, low jacket water pressure, high jacket water temperature, and low-lube oil pressure, are used to protect the machine when operating in parallel with the offsite power system, during periodic tests. The relays are automatically isolated from the tripping circuits during LOCA conditions when there is a concurrent LOPP signal. However, all of these bypassed parameters are annunciated in the main control room (Subsection 8.3.1.1.8.5). The bypasses and protective relays are testable and meet all IEEE-603 requirements, and are manually reset as required by Position 1.8 of Regulatory Guide 1.9. No trips are by passed during LOPP or testing. See Subsection 8.3.4.22 for COL license information.

Synchronizing interlocks, including protective actions resulting from any detected faults that could damage the emergency safety-related busses and their loads, are provided to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply (see Sections 5.1.4.2 of IEEE-741). Such interlocks are capable of being tested, and shall be periodically tested per Section 8.3.4.23).

Mitigation of Open Phase Condition on RAT and UATs
The COL applicant shall develop procedures and train operators on how to detect, respond and mitigate MCR alarms indicating Open Phase Conditions (OPC) and other abnormal conditions on the RAT and the UATs.

8.3.4.5 Not Used

8.3.4.6 Not Used

8.3.4.7 Not Used

8.3.4.8 Not Used

8.3.4.9 Offsite Power Supply Arrangement

The COL applicant operating procedures shall require one of the three divisional buses of Figure 8.3-1 be fed by the alternate power source during normal operation; in order to prevent simultaneous de-energization of all divisional buses on the loss of only one of the offsite power supplies. The selection of that division should be based on the Class 1E bus loads, the reliability/stability of the offsite circuits, and on the separation of the offsite feeds as they pass through the divisional areas.

Continued plant operation will be appropriately limited when the reserve auxiliary transformer is inoperable. See 8.2.4 for COL license information requirements.

8.3.4.10 ~~Not Used~~

Mitigation of Open Phase Condition on Main Power Transformer (MPT)
The COL applicant shall describe instrumentation, develop procedures and train operators on how to detect and respond to MCR alarms indicating Open Phase Conditions (OPC) and other abnormal conditions on the high voltage side of the MPT.

8.3.4.11 ~~Not Used~~

8.3.4.12 Not Used

8.3.4.13 Load Testing of Class 1E Switchgear and Motor Control Centers

The COL applicant will provide procedures for load testing the Class 1E switchgear and motor control centers by operating connected Class 1E loads at 9% to 10% above, and 9% to 10% below design voltage.

8.3.4.14 Administrative Controls for Bus Grounding Circuit Breakers

Figure 8.3-1 shows bus grounding circuit breakers, which are intended to provide safety grounds during maintenance operations. Administrative controls shall be provided by the COL applicant to keep these circuit breakers racked out (i.e., in the disconnect position) whenever corresponding buses are energized (Subsection 8.3.1.1.6.2).

8.3.4.15 Administrative Controls for Manual Interconnections

As indicated in Subsection 8.3.1.2(4)(b), the ABWR has capability for manually connecting any plant loads to receive power from any of the six sources. Appropriate plant operating procedures shall prevent paralleling of the redundant onsite Class 1E power supplies.