8.3 Onsite Power Systems

The information in this section of the reference ABWR DCD including all subsections, tables, and figures is incorporated by reference with the following departures and supplements.

STD DEP T1 2.4-2 (Figure 8.3-1)

STD DEP T1 2.12-2

STD DEP T1 2.14-1 (Tables 8.3-1, 8.3-3, and 8.3-4)

STP DEP 1.1-2

STD DEP 6.2-2

STD DEP 8.3-1 (Figure 8.3-1)

STP DEP 8.3-3 (Table 8.3-1, Table 8.3-3, Figure 8.3-1, and Figure 8.3-2)

STD DEP 9.5-1

STP DEP 10.2-1 (Figure 8.3-1)

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STD DEP Admin

8.3.1 AC Power Systems

STD DEP 8.3-1

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The onsite power system interfaces with the offsite power system at the input terminals to the supply breakers for the normal, alternate, and combustion turbine generator power feeds to the medium voltage (~~6.9 kV~~ 13.8 kV and 4.16 kV*) switchgear. ~~It is a three load group system with each load group consisting of a non-Class 1E and a Class 1E portion.~~* The system consists of four load groups on non-Class 1E 13.8 kV Power Generation (PG) buses, three load groups on non-Class 1E 4.16 kV Plant Investment Protection (PIP) buses, and three load groups on Class 1E 4.16 kV buses. *The three load groups of the Class 1E power system (i.e., the three divisions) are independent of each other. The principal elements of the auxiliary AC electric power systems are shown on the single line diagrams (SLD) in Figures 8.3-1 through 8.3-3.*

Each Class 1E division has a dedicated safety-related, Class 1E diesel generator, which automatically starts on high drywell pressure, low reactor vessel level or loss of voltage on the division's ~~6.9~~ 4.16 *kV bus. The signals generated from high drywell pressure and low reactor vessel level are arranged in two-out-of-four logic combinations, and are utilized to sense the presence of a LOCA condition and* *subsequently start the diesel. These signals also initiate the emergency core cooling systems.*

The loss of voltage condition and the degraded voltage condition are sensed by independent sets of three undervoltage relays (one on each phase of the ~~*6.9*~~ 4.16 *kV bus) which are configured such that two-out-of-three trip states will initiate circuitry for transferring power from offsite power to the onsite diesel generator (after a time delay for the degraded voltage condition). The primary side of each of the instrument potential transformers (PTs) is connected phase-to-phase (i.e., a "delta" configuration) such that a loss of a single phase will cause two of the three undervoltage relays to trip, thus satisfying the two-out-of-three logic. (For more information on the degraded voltage condition and associated time delays, etc., see Subsection (8) of 8.3.1.1.7.)*

NRC Bulletin 2012-01 discusses the possibility that an open phase condition, with or without accompanying ground faults, located on the high-voltage side of a transformer connecting a GDC 17 offsite power circuit to the plant electrical system could, result in a degraded condition in the onsite power system (see Reference 8.2-7). To address this issue, monitoring of the normal and alternate preferred power supply feeds through the MPT and RATs is provided as described in subsection 8.2.1.2.4 and the Class 1E busses are provided with negative sequence voltage relays to ensure that the motors on the 1E busses are not subjected to unbalanced currents and voltages as described below.

Each of the Divisional Class 1E 4.16kV busses, has 3 negative sequence voltage relays configured such that a two-out-of-three trip state will initiate circuitry for transferring power from the offsite power supply to the onsite diesel generator after a time delay. Each negative sequence relay monitors all three bus phases using the bus instrument potential transformers. Should negative sequence voltage that would adversely affect the motors be present on a 4.16kV bus, the two-out-of-three logic will automatically actuate (see Subsection (10) of 8.3.1.1.7). Upon actuation, the negative sequence relays annunciate in the Main Control Room.

Each ~~*6.9*~~ 4.16 *kV Class 1E bus feeds its associated 480V unit* ~~*substation*~~ power center *through a* ~~*6.9*~~ 4.16 *kV/ 480/277V power center transformer.*

STP DEP 1.1-2

STD DEP 8.3-1

Standby power is provided to plant investment protection non-Class 1E loads in all three load groups by a combustion turbine generator located in the turbine building. CTG Bus 1 can be tied to CTG Bus 2 by the manual closing of the CTG bus tie breaker. When the plant conditions are beyond the design basis, the plant operators have the capability to cross-connect an alternate power source from the other unit. The cross-tie breakers can only be closed after complying with the shedding requirements and loads limitations in accordance with off-normal/emergency procedures.

STD DEP 8.3-1

AC power is supplied at ~~6.9~~ 13.8 kV or 4.16 *kV for motor loads larger than 300 kW and transformed to 480V for smaller loads. The 480V system is further transformed into lower voltages as required for instruments, lighting, and controls. In general, motors larger than 300 kW are supplied from the ~~6.9~~* 13.8 kV or 4.16 *kV buses. Motors 300 kW or smaller but larger than 100 kW are supplied power from 480V switchgear. Motors 100 kW or smaller are supplied power from 480V motor control centers.*

8.3.1.0.1 Non-Class 1E Medium Voltage Power Distribution System

STD DEP 8.3-1

The non-Class 1E medium voltage power distribution system consists of ~~nine 6.9 kV buses divided into three load groups~~ four 13.8 kV PG buses and three 4.16 kV PIP buses. *The ~~three load~~* four bus *~~group~~ configuration was chosen to* meet the requirement that the ten Reactor Internal Pumps (RIPs) be powered by four independent buses. This will minimize large core flow reduction events and *match the mechanical* power generation *systems which are mostly ~~three~~* four *trains (e.g. ~~three~~* four *feedwater pumps*, four condensate pumps, four condensate booster pumps, four heater drain pumps, and *~~three~~* four *circulating water pumps~~, three turbine building supply and exhaust fans~~)*. The three bus configuration was chosen to match the supported mechanical systems, which typically consist of two or three trains.

~~Within each load group there is one~~ The four *power generation ~~bus which supplies~~* buses supply *power production loads ~~which do not provide water to the pressure vessel~~. Each one of these buses has access to power from one winding of its assigned unit auxiliary transformer. ~~It~~* Each PG bus *also has access to ~~the~~* a *reserve auxiliary transformer* or CTG *as an alternate source, if its unit auxiliary transformer fails or during maintenance outages for the normal feed. Bus transfer between preferred power sources is manual dead bus transfer and not automatic.*

~~Another power generation bus within each load group supplies power to pumps which are capable of supplying water to the pressure vessel during normal power operation (i.e., the condensate and feedwater pumps). These buses normally receive power from the unit auxiliary transformer and supply power to the third bus [plant investment protection (PIP)] in the load group through a cross-tie. The cross-tie automatically opens on loss of power but may be manually re-closed if it is desired to operate a condensate and feedwater pump or a condensate pump from the reserve auxiliary transformer which is connectable to the PIP buses. In addition, the combustion turbine generator is capable of supplying power to any of the condensate pumps through the bus ties from the PIP buses. This provides three load groups of non-safety grade equipment, in addition to the divisional Class 1E load groups, which may be used to supply water to the reactor vessel in emergencies.~~

*~~A third~~ Plant Investment Protection (PIP) bus*es *suppl*y*~~ies~~ power to non-safety loads (e.g. the turbine building HVAC, the turbine building service water and the turbine building closed cooling water systems)* in three load groups. *On loss of normal* or alternate *preferred power ~~the cross-tie to the power generation bus is automatically~~*

~~*tripped open and the non-Class 1E PIP bus is automatically transferred (two out of the three buses in the load groups transfer)*~~, an automatic transfer of pre-selected buses occurs *via a dead bus transfer to the combustion turbine which automatically starts on loss of power. The PIP systems for each* selected *load group automatically restart to support their load*s ~~*groups*~~*.*

~~*The non-Class 1E buses are comprised of metal clad switchgear rated for 7.2 kV 500 MV.A with a bus full load rating of 2000A. Maximum calculated full load short time current is 1700A. Bus ratings of 3000A are available for the switchgear as insurance against future load growth, if necessary. The circuit breaker interrupting capacity is 41,000 amperes*~~ The non-Class 1E switchgear interruption ratings are chosen to be capable of clearing the maximum expected fault current. The continuous ratings are chosen to carry the maximum expected normal currents. The 13.8 kV/4.16 kV switchgear is rated at 15 kV/4.76 kV, respectively. *Instrument and control power is from the non-Class 1E, 125VDC power system.*

The ~~*6.9*~~ 13.8 *kV buses supply power to adjustable speed drives for the feedwater and reactor internal pumps. These adjustable speed drives are designed to the requirements of IEEE-519. Voltage distortion limits are as stated in Table 4 of the IEEE Std.*

~~*Each 6.9 kV bus has a safety grounding circuit breaker designed to protect personnel during maintenance operations (see Figure 8.3-1). During periods when the buses are energized, these breakers are racked out (i.e., in the disconnect position). A control room annunciator sounds whenever any of these breakers are racked for service. The interlocks for the bus grounding devices are as follows:*~~

~~*(1) Under-voltage relays must be actuated.*~~

~~*(2) Bus Feeder breakers must be in the disconnect position.*~~

~~*(3) Voltage for bus instrumentation must be available.*~~

~~*Conversely, the bus feeder breakers are interlocked such that they cannot close unless their associated grounding breakers are in their disconnect positions*~~ Each medium voltage 13.8 kV and 4.16 kV bus has a spare space which can be used to insert a manual grounding circuit device for use during maintenance activities.

8.3.1.0.2.1 Power Centers

STD DEP 8.3-1

Power for the non-Class 1E 480V auxiliaries is supplied from power centers consisting of ~~*6.9 kV/*~~ 13.8 kV/480V or 4.16 kV/*480V transformers and associated metal-clad switchgear (see Figure 8.3-1).* ~~*There are six non-Class 1E, (two per load group), power centers. One power center per load group is supplied power from the non-Class 1E PIP bus in the load group*~~ There is at least one power center on each of the medium voltage PG and PIP buses.

8.3.1.0.6.2 Grounding Methods

STD DEP 8.3-1

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~~ devices.

8.3.1.0.6.3 Bus Protection

STD DEP 8.3-1

Bus protection is as follows:

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

(2) ~~6.9kV~~ Medium voltage *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 overcurrent and ground fault protection~~ Not Used.

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

8.3.1.1.1 Medium Voltage Class 1E Power Distribution System

STD DEP 8.3-1

Class 1E AC power loads are divided into three divisions (Divisions I, II, and III), each fed from an independent ~~6.9~~ 4.16 *kV Class 1E bus. During normal operation (which includes all modes of plant operation; i.e., shutdown, refueling, startup, and run), two of the three divisions are* normally *fed from an offsite normal preferred power supply. The remaining division is* normally *fed from the alternate preferred power source (Subsection 8.3.4.9).*

The Class 1E buses are comprised of metal clad switchgear ~~rated for 7.2kV 500MV-A with a bus full load rating of 2,000 amperes. Maximum calculated full load short time current is 1,700 amperes. Bus ratings of 3,000 amperes are available for the switchgear as insurance against further load growth, if necessary. The circuit breaker interrupting capacity is 41,000 amperes~~ with normal and interrupting ratings that are sized to carry normal loads and to clear expected faults. *~~Instrument and control power is from the Class 1E 125VDC power system in the same Class 1E division~~.* Control and instrument power for each Class 1E division are supplied by its associated Class 1E 125 VDC power system.

~~*Each 6.9 kV bus has a safety grounding circuit breaker designed to protect personnel during maintenance operations (see Figure 8.3-1). During periods when the buses are energized, these breakers are racked out (i.e., in the disconnect position). A control room annunciator sounds whenever any of these breakers are racked in for service.*~~

~~*The interlocks for the bus grounding devices are as follows:*~~

~~*(1) Under-voltage relays must be actuated.*~~

~~*(2) Bus Feeder breakers must be in the disconnect position.*~~

~~*(3) Voltage for bus instrumentation must be available.*~~

~~*Conversely, the bus feeder breakers are interlocked such that they cannot close unless their associated grounding breakers are in their disconnect positions.*~~ Each medium voltage 4.16 kV bus has a spare space which can be used to insert a manual grounding circuit device for use during maintenance activities. A main control room indication is provided when the bus grounding circuit device is installed.

Standby AC power for Class 1E buses is supplied by diesel generators at ~~6.9~~ 4.16 *kV and distributed by the Class 1E power distribution system. Division I, II and III buses are automatically transferred to the diesel generators when the preferred power supply to these buses is ≤70% bus voltage.*

STP DEP 8.3-3

The Division I Class 1E bus supplies power to three separate groups of non-Class 1E fine motion control rod drive (FMCRD) motors (see Figure 8.3-1, ~~sheet 3~~ sheet 4*). Although these motors are not Class 1E, the drives may be inserted as a backup to scram and are of special importance because of this. It is important that the first available standby power be available for the motors, therefore, a diesel supplied bus was chosen as the first source of standby AC power and a combustion turbine supplied PIP bus as the second backup source. Division I was chosen because it was the most lightly loaded diesel generator.*

STD DEP 8.3-1

~~*The load breakers in the Division I switchgear are part of the isolation scheme between the Class 1E power and the non-Class 1E load. In addition to the normal over-current tripping of these load breakers, Class 1E zone selective interlocking is provided between them and the upstream Class 1E bus feed breakers.*~~

The fault interrupt capability of all Class 1E breakers, fault interrupt coordination between the supply and load breakers for each Class 1E load and the Division I non-Class 1E load~~, and the zone selective interlock feature of the breaker for the non-Class 1E load~~ all have the capability of being tested (Subsection 8.3.4.29).~~ The zone selective interlock is a feature of the trip unit for the breaker and is tested when the other features such as current setting and long time delay are tested.~~

~~*If fault current flows in the non-Class 1E load, it is sensed by the Class 1E current device for the load breaker and a trip blocking signal is sent to the upstream Class 1E feed breakers. This blocking lasts for about 75 milliseconds. This allows the load breaker to trip in its normal instantaneous tripping time of 35 to 50 milliseconds, if the magnitude of the fault current is high enough. This assures that the fault current has been terminated before the Class 1E upstream breakers are free to trip. For fault currents of lesser magnitude, the blocking delay will time out without either bus feeder or load breakers tripping, but the load breaker will eventually trip and always before the upstream feeder breaker. This order of tripping is assured by the coordination between the breakers provided by long-time pickup, long-time delay and instantaneous pickup trip device characteristics.*~~ Class 1E microprocessor controlled protective relaying equipment senses fault current flowing in the non-Class 1E load. This equipment utilizes digital timers that can reproduce the timing requirements by sensing the number of cycles of the electrical waveform itself. Coordination of the definite time delay and the upstream bus feeder breakers allows termination of the fault current before the feeder breakers are free to trip. *Tripping of the Class 1E feed breaker is normal for faults which occur on the Class 1E bus it feeds.* ~~*Coordination is provided between the bus main feed breakers and the load breakers.*~~

Power is supplied to each FMCRD load group from either the Division I Class 1E bus or ~~*the*~~ a *non-Class 1E PIP bus through* a non-Class 1E automatic transfer switch located between the power sources and the 480V FMCRD power distribution panels. Switchover to the non-Class 1E PIP bus source is automatic on loss of power from the Class 1E diesel bus source.~~*a pair of interlocked transfer switches located between the power sources and the 6.9 kV/480V transformer feeding the FMCRD MCC. These transfer switches are classified as associated, and are treated as Class 1E. Switchover to the non-Class 1E PIP bus source is automatic on loss of power from the Class 1E diesel bus source.*~~ *Switching back to the Class 1E diesel bus power is by manual action only.* Per IEEE-384 and Regulatory Guide 1.75, isolation between the Class 1E bus and non-1E load is maintained.

STD DEP 8.3-1

STP DEP 8.3-3

The design minimizes the probability of a single failure affecting more than one FMCRD group by providing ~~*three*~~ six *independent* ~~*Class 1E*~~ *feeds (*~~*one*~~ two *for each group) directly from the Division I Class 1E* ~~*6.9 k*~~ and PIP 480*V bus*es *(see sheet 3* and 4 *of Figure 8.3-1).* The two Class 1E protective devices connected in series provide isolation between the Class 1E bus and non-Class 1E load. The transfer switches are non-Class 1E. The feeder circuits from the non-Class 1E PIP bus to the transfer switch, and circuits downstream of the transfer switch, are non-Class 1E. ~~*The Class 1E load breakers in conjunction with the zone selective interlocking feature (which is also Class 1E), provide the needed isolation between the Class 1E bus and the non-Class 1E loads. The feeder circuits on the upstream side of the Class 1E load breakers are Class 1E. The FMCRD circuits on the load side of the Class 1E load breakers down to and including the transfer switches are associated. Control power for the transfer switches is provided from Division I. The feeder circuits from the non-Class 1E PIP bus*~~

~~to the transfer switch, and circuits downstream of the transfer switch, are non-Class 1E.~~

STD DEP 8.3-1

~~*The Class 1E load breakers in conjunction with the zone selective interlocking feature (which is also Class 1E), provide the needed isolation between the Class 1E bus and the non-Class 1E loads. The feeder circuits on the upstream side of the Class 1E load breakers are Class 1E. The FMCRD circuits on the load side of the Class 1E load breakers down to and including the transfer switches are associated. Control power for the transfer switches is provided from Division I. The feeder circuits from the non-Class 1E PIP bus to the transfer switch, and circuits downstream of the transfer switch, are non-Class 1E.*~~

STD DEP T1 2.4-2

STD DEP 6.2-2

The Safety System Logic and Control (SSLC) initiates a trip of the condensate pumps when a feedwater line break is detected in the drywell. Although not credited in the FWLB analysis in Chapter 6.2, this trip provides added assurance of conservatism in the feedwater mass flow used in the analysis. This FWLB mitigation has been added to the STP 3&4 design, which adds safety related instrumentation to sense and confirm a FWLB based on high differential pressure between feedwater lines coincident with high drywell pressure to trip the condensate. In order to trip the condensate pumps, a provision of 13.8 kV medium voltage safety-related breaker in series with the non-safety 13.8 kV feeder breaker exists for each condensate pump. The trip circuit of each safety-related 13.8 kV breaker includes two independent trip coils. Each trip coil is powered from a separate division of Class 1E 125V DC system. Two separate divisions of safety-related control signals for feedwater line break are provided to initiate the trip of each breaker. This dual breaker in series arrangement ensures that the condensate pumps will trip on a feedwater line break.

The 13.8 kV breakers (both safety-related and nonsafety-related) are located in the Turbine Building. The procurement and design of the safety-related breakers are required to meet the criteria for performing the safety function of tripping the condensate pump breakers in case of the feedwater line break design basis event. The 125V DC control power and trip circuits of the safety-related breakers are also required to meet the independence criteria per RG 1.75. In addition, the safety-related breakers and its components are required to be seismically installed and missile protected at their location in the Turbine Building. Although the breaker control power and trip circuits will not fully meet the seismic Category I installation and RG 1.75 separation requirements, the following considerations provide reasonable assurance for tripping of condensate pumps during a feedwater line break in the drywell:

- The control power and SSLC circuits are provided with isolation devices.
- The control power cables are installed in dedicated raceways. Adequate separation exists between control circuit raceways and other non-safety raceways.

- The design of the raceway supports is performed considering seismic loads throughout their routing.
- The safety-related breakers are located in a separate electrical room.
- The design of the safety-related breaker supports is performed considering seismic loads.
- The probability of trip and control power circuit failure is very low. Even in case of failure of non-safety power cable, the breaker trip circuit is expected to perform the safety function of tripping the condensate pump feeder breakers due to redundancy of trip coils, trip signals and control power supply.
- The design does not impact or degrade any other safety-related equipment or function.
- A reliability assessment for this design has been performed.

8.3.1.1.2.1 Power Centers

STD DEP 8.3-1

Power for 480V auxiliaries is supplied from power centers consisting of ~~6.9~~ 4.16 *kV/480V transformers and associated metal clad switchgear (see Figure 8.3-1). There are* at least *two power centers in each Class 1E division.*

8.3.1.1.4.1 120 VAC Class 1E Instrument Power System

STD DEP T1 2.12-2

Individual regulating transformers supply 120 VAC to the four divisions of *instrument power (Figure 8.3-2). Each Class 1E divisional transformer is supplied from a 480V MCC in the same division*, except for the Division IV transformer, which is supplied from the 480V MCC of Division II*. There are three divisions* (I, II, and III)*, each backed up by its* associated *divisional diesel generator as the source when offsite source is lost.* Division IV is backed up by the Division II diesel generator, when the offsite source is lost*. Power is distributed to the individual loads from distribution panels, and to logic level circuits through the control room logic panels. Transformers are sized to supply their respective distribution panel instrumentation and control loads.*

8.3.1.1.5 Class 1E Electric Equipment Considerations

STD DEP Admin

(4) *Capacity of switchgear, power centers with their respective transformers, motor control centers, and distribution panels is equal to or greater than the maximum available fault current to which it is exposed under all design modes of operation until the fault is cleared.*

Interrupting capability of the Class 1E switchgear and MCC breakers is selected to interrupt the available short-circuit current at the circuit breaker load terminals. Short circuit analysis will be performed in accordance with IEEE 141 and/or other acceptable industry standards or practices to determine fault currents. ~~See Subsection 8.2.3(16) for interface requirement.~~

8.3.1.1.6.2 Grounding Methods

STD DEP 8.3-1

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~~ devices.

8.3.1.1.6.3 Bus Protection

STD DEP 8.3-1

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Bus protection is as follows:

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

(2) ~~*6.9 kV*~~ Medium voltage *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 overcurrent and ground fault protection.*~~ Not Used.

(4) ~~*6.9 kV*~~ Medium voltage *feeders used for motor starters have instantaneous, inverse time overcurrent, ground fault and motor protection.*

8.3.1.1.7 Load Shedding and Sequencing on Class 1E Buses

STD DEP 8.3-1

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This subsection addresses Class 1E Divisions I, II, and III. Load shedding, bus transfer and sequencing on a ~~6.9~~ 4.16 *kV Class 1E bus is initiated on loss of bus voltage.*

(1) ***Loss of Preferred Power (LOPP)***—*The ~~6.9~~* 4.16 *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~~ 4.16 kV) are tripped.

(2) ***Loss of Coolant Accident (LOCA)****—When a LOCA occurs, the standby diesel generator is started and remains in the standby mode (i.e. voltage and frequency are within normal limits and no lockout exists) unless a LOPP signal is also present as discussed in (3) and (4) below. In addition, with or without a LOPP, the load sequence timers are started if the ~~6.9~~ 4.16 kV emergency bus voltage is greater than 70%, and loads are applied to the bus at the end of preset times.*

Each load has an individual load sequence timer which will start if a LOCA occurs and the ~~6.9~~ 4.16 kV emergency bus voltage is greater than 70%, regardless of whether the bus voltage source is normal or alternate preferred power or the diesel generator.

(5) ***LOCA when diesel generator is parallel with preferred power source during test****—If a LOCA occurs when the diesel generator is paralleled with either the normal preferred power or the alternate preferred power source, the D/G will automatically be disconnected from the ~~6.9~~ 4.16 kV emergency bus regardless of whether the test is being conducted from the local control panel or the main control room.*

(8) ***Protection against degraded voltage****—For protection of the Division I, II and III electrical equipment against the effects of a sustained degraded voltage, the ~~6.9~~ 4.16 kV divisional bus voltages are monitored.*

(9) ***Station Blackout (SBO) considerations—****A station blackout event is defined as the total loss of all offsite (preferred) and onsite Class IE AC power supplies except Class IE AC power generated through inverters from the station batteries. In such an event, the combustion turbine generator (CTG) will automatically start and achieve rated speed and voltage ~~within two~~ in less than ten minutes. The CTG will then automatically assume pre-selected loads on the plant investment protection (PIP) buses. With the diesel generators unavailable, the reactor operator will manually shed PIP loads and connect the non-Class 1E CTG with the required shutdown loads within ten minutes of the event initiation. Specifically, the operator will energize one of the Class 1E distribution system buses by closing each of the ~~two~~ circuit breakers (via controls in the main control room) between the CTG unit and the Class 1E bus. The ~~circuit breaker closest to the CTG is non-Class 1E and the~~ circuit breaker closest to the Class 1E bus is Class 1E, and the other breakers are non-Class 1E. Later, the operator will energize other safety-related and non-safety-related loads, as appropriate, to complete the shutdown process. See Appendix 1C and Subsection 9.5.11 for further information on Station Blackout and the CTG, respectively.*

(10) **Negative Sequence Voltage**—For protection of the Division I, II and III electrical equipment against the effects of an unbalanced power supply, the Class 1E 4.16 kV divisional busses are monitored for negative sequence voltage. If the bus negative sequence voltage increases to the setpoint, and after a time delay (to prevent triggering by transients), the respective feeder breakers trip open. The opening of the feeder breakers de-energizes the bus causing the undervoltage relays to actuate. The actuation of the undervoltage relays results in a start signal being sent to the diesel generator before any of the Class 1E loads experience degraded conditions exceeding those for which the equipment is qualified. The expected nominal setpoint is 4.5% (design limit is 5%) and the expected nominal time delay is 2.5 seconds (design limit is 3 seconds). Final setpoints are determined in accordance with the Setpoint Control Program. The time delay setting is defined to provide appropriate motor protection. This assures such loads will restart when the diesel generator assumes the degraded bus and sequences its loads. If the bus voltage recovers within the time delay period, the protective timer will automatically reset. Should a LOCA occur during the time delay, the feeder breaker with the negative sequence voltage will be tripped instantly. Subsequent bus transfer will be as described above. The negative sequence voltage relay output circuitry is separate from the output circuitry for the degraded grid and undervoltage relays in each of the Class 1E 4.16kV switchgear. At the feeder breakers, the contacts for the negative sequence voltage, degraded voltage, and undervoltage are connected in parallel to the trip coils of each feeder breaker.

8.3.1.1.8 Standby AC Power System

STD DEP Admin

*See Subsection*s *9.5.13.8,* 8.1.4.1, and 8.3.4.2 *for COL license information.*

8.3.1.1.8.1 Redundant Standby AC Power Supplies

STD DEP 8.3-1

Each standby power system division, including the diesel generator, its auxiliary systems and the distribution of power to various Class 1E loads through the ~~6.9~~ 4.16 kV and 480V systems, is segregated and separated from the other divisions.

8.3.1.1.8.2 Ratings and Capability

STD DEP 8.3-1

(5) Each diesel generator is sized to supply its post accident (LOCA) load requirements, and has a continuous load rating of ~~6.25~~ 9MV·A @ 0.8 power factor (Figure 8.3-1). The overload rating is 110% of the rated output for a two-hour period out of a 24-hour period. A load profile analysis for each diesel generator will be performed in accordance with acceptable industry standards and/or practices.

STP DEP 8.3-3

(12) *The maximum loads expected to occur for each division (according to nameplate ratings) do not exceed ~~90%~~* 95% *of the continuous power output rating of the diesel generator.* See Table 8.3-1 for diesel generator loads applicable to each division.

STD DEP 8.3-1

(17) *Bus voltage and frequency will recover to ~~6.9~~* 4.16 *kV±10% at 60±2% Hz within 10 seconds following trip and restart of the largest load.*

8.3.1.2 Analysis

STP DEP 1.1-2

STD DEP 8.3-1

STD DEP 9.5-1

(1) *General Design Criteria (GDC):*

(a) *Criteria: GDCs 2, 4,* 5, *17, 18 and 50.*

(2) *Regulatory Guides (RGs):*

(f) *RG 1.75—Physical Independence of Electric Systems*

Regarding Position C-1 of Regulatory Guide 1.75 (Subsection 8.3.1.1.1), the non-Class 1E FMCRD motors are supplied power from the Division 1 Class 1E bus ~~through three dedicated power center transformers~~. The Class 1E load breakers or protective devices connected in series *for the bus* are~~is~~ *tripped by fault current for faults in the non-Class 1E load* prior to initiation of a trip of upstream breakers. ~~There is also a zone selective interlock provided from the load breaker to the Class 1E bus supply breaker so that the supply breaker is delayed from tripping while fault current is flowing in the non-Class 1E load feeder.~~ *This meets the intent of the Regulatory Guide position* ~~in that the main supply breaker is prevented from tripping on faults in the non-safety-related loads. The transfer switch downstream of the load feeder is associated, and meets Class 1E requirements.~~

There are three ~~6.9~~ 4.16 *kV electrical divisions which are independent load groups backed by individual diesel-generator sets. The low voltage*

AC systems consists of four divisions which are backed by independent DC battery, charger and inverter systems.

(h) ~~*RG 1.108 - Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants*~~ Not Used

(I) RG 1.81 - Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

STP 3 & 4 is a dual-unit station. Units 3 & 4 do not share AC or DC onsite emergency and shutdown electric systems. The onsite electric power systems are independent, separate, and designed with the capability of supplying minimum Engineered Safety Feature loads and loads required for attaining a safe and orderly cold shutdown of each unit, assuming a single failure and loss of offsite power.

(4) *Other SRP Criteria:*

(b) *NRC Policy Issue On Alternate Power for Non-safety Loads*

~~*The ABWR reserve auxiliary transformer has the same rating as the three unit auxiliary transformers, and therefore can assume the full load of any one unit auxiliary transformer (Subsection 8.2.1.2). The interconnection capability for the ABWR is such that any plant loads can be manually connected to receive power from any of the six sources (i.e., the two switching stations, the combustion turbine, and the three diesel generators). Administrative controls are provided to prevent paralleling of sources (Subsection 8.3.4.15). The ABWR therefore exceeds the requirements of the policy issue.*~~ Normal plant operating loads can be supplied by either the reserve or unit auxiliary transformers. Any non-safety power generation loads can be manually connected to receive power from any of the two sources (i.e., the two switching stations represented by the UATs and RATs) due to the interconnection capability for the ABWR. Any Plant Investment Protection (PIP) load can be manually connected to receive power from three sources (i.e., two switching stations and the CTG). Any Class 1E safety bus can be manually connected to receive power from four sources (i.e., two switching stations, the CTG, and the EDGs). Either the UATs or either of the RATs can supply the three Class 1E safety buses. Administrative controls are provided to prevent paralleling of sources (Subsection 8.3.4.15). The ABWR therefore exceeds the requirements of the policy issue.

8.3.2.1.2 Class 1E DC Loads

STD DEP T1 3.4-1

STD DEP 8.3-1

The 125 VDC Class 1E power is required for emergency lighting, diesel-generator field flashing, control and switching functions such as the control of ~~6.9 kV~~ medium voltage *and 480V switchgear, control relays, meters and indicators, ~~multiplexers,~~ vital AC power supplies, as well as DC components used in the reactor core isolation cooling system.*

8.3.2.1.3.1.1 Class 1E Electric Equipment Considerations

STD DEP Admin

(6) Breaker coordination analyses will be performed in accordance with IEEE 141, 242, and/or other acceptable industry standards or practices.

~~See Subsection 8.3.4.6 for COL license information.~~

8.3.2.1.3.5 Station Blackout

STD DEP Admin

Station blackout performance is discussed in Subsection 8.3.1.1.7(9) and Appendix 1C. See Subsections 9.5.13.19, 9.5.13.20, ~~and~~ 9.5.13.21, and 1C.4.1 *for COL license information.*

8.3.2.2.2 Regulatory Requirements

STP DEP 1.1-2

(2) Regulatory Guides (RGs)

(l) RG 1.81 - Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

STP 3 & 4 is a dual-unit station. Units 3 & 4 do not share AC or DC onsite emergency and shutdown electric systems. The onsite electric power systems are independent, separate, and designed with the capability of supplying minimum Engineered Safety Feature loads and loads required for attaining a safe and orderly cold shutdown of each unit, assuming a single failure and loss of offsite power.

8.3.3.2.1S Testing of Power, Control, and Instrumentation Cables

Medium voltage power cables, 480 Vac, 120 Vac and 125/250 Vdc power cables, control cables, and instrumentation cables which are underground and which support equipment covered by the Maintenance Rule are monitored and the results trended using techniques and at a frequency determined appropriate for the application based on a review of industry best practices.

8.3.3.5.1 Power, Instrumentation and Control Systems

NOTE: Associated lighting circuits are described in Section 9.5.3~~ and associated Fine Motion Control Rod Drive (FMCRD) circuits are described in Section 8.3.1.1.1.~~ Any other associated circuits added beyond those described above must be specifically identified and justified. Associated circuits are defined in Section 5.5.1 of IEEE-384, with the clarification for Items (3) and (4) that non- Class 1E circuits being in an enclosed raceway without the required physical separation or barriers between the enclosed raceway and the Class 1E or associated cables makes the circuits (related to the non-Class 1E cable in the enclosed raceway) associated circuits.

8.3.3.5.1.3 Raceway Identification

STD DEP 8.3-1

All conduit is tagged with a unique conduit number, in addition to the marking characteristics shown below, at 4.57m intervals, at discontinuities, at pull boxes, at points of entrance and exit of rooms and at origin and destination of equipment. Conduits containing cables operating at above 600V ~~(i.e., 6.9 kV)~~ are also tagged to indicate the operating voltage. These markings are applied prior to the installation of the cables.

8.3.3.6.1.1 Class 1E Electric Equipment Arrangement

(4) *An independent raceway system is provided for each division of the Class 1E electric system. The raceways are arranged, physically, top to bottom, as follows (based on the function and the voltage class of the cables):*

Note: V5 = Medium voltage power, 13.8 kV (15 kV insulation class) for non-Class 1E systems only.

(a) *V4 = Medium voltage power, ~~6.9~~* 4.16 kV *(~~8~~* 5 *kV insulation class).*

(5) *Class 1E power system power supplies and distribution equipment (including diesel generators, batteries, battery chargers, CVCF power supplies, ~~6.9~~* 4.16 *kV switchgear, 480V load centers, and 480V motor control centers) are located in areas with access doors that are administratively controlled.*

8.3.3.6.2.2.4 Isolation Devices

STD DEP 8.3-1

Where electrical interfaces between Class 1E and non-Class 1E circuits or between Class 1E circuits of different divisions cannot be avoided, Class 1E isolation devices will be used. ~~AC isolation (the FMCRD drives on Division 1 is the only case) is provided~~

~~*by Class1E interlocked circuit breaker coordination as described in Subsection 8.3.1.1.1.*~~

8.3.3.9S Monitoring of Manholes

Manholes are provided with high water level alarms. Where appropriate, sump pumps are provided. Additionally, manholes are inspected every year to ensure water levels are below the lowest layer of cables, to confirm sump pump and alarm functionality, and to ensure proper seating of manhole covers. If warranted, manhole covers will be sealed to minimize water ingression.

8.3.4 COL License Information

8.3.4.1 Not Used

8.3.4.2 Diesel Generator Design Details

The following site-specific supplement addresses COL License Information Item 8.8.

Procurement documents for the emergency diesel generators will specify that the diesel generators will be capable of reaching full speed and voltage within 20 seconds after the signal to start and that the vendor's testing that demonstrates this capability will be witnessed by QA. Procedure(s) which implement the testing guidance provided in RG 1.9 and IEEE 387 will be developed before fuel load to test that each emergency diesel generator meets the requirement to reach full speed and voltage within 20 seconds after the start signal is initiated. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. In addition, the Technical Specifications (see Chapter 16) require periodic retesting and verification that each emergency diesel generator meets this requirement. (COM 8.3-1)

8.3.4.3 Not Used

8.3.4.4 Protective Devices for Electrical Penetration Assemblies

The following site-specific supplement addresses COL License Information Item 8.10.

Procedure(s) will be developed before fuel load that demonstrates the functional capability of the electrical penetration assembly protective devices to perform their required safety functions. These procedures include periodic testing and calibration of the protective devices (except for fuses which will be inspected) to demonstrate their functional capability for the circuits that pass through the containment electrical penetrations assemblies and require special consideration as defined by IEEE-741. A sample of each different type of over current device is selected for periodic testing during refueling outages. The testing includes verification of thermal and instantaneous trip characteristics of molded case circuit breakers; verification of long time, short time, and instantaneous trips of medium voltage air circuit breakers; and verification of long time, short time, and instantaneous trips of low voltage air circuit breakers. The procedures will be developed before fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-2)

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 following site-specific supplement addresses COL License Information Item 8.15.

Procedure(s) that require one of three divisional buses to be fed from an alternate source during normal operation to prevent the simultaneous de-energization of all divisional buses on the loss of one offsite power supply, will be developed prior to fuel load. Technical Specifications limit operation when both of the reserve auxiliary transformers or all three (3) unit auxiliary transformers are inoperable. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-3)

8.3.4.10 Not Used

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 following site-specific supplement addresses COL License Information Item 8.19.

The availability of adequate voltage (+/-10%) at the device load from Class 1E switchgear and motor control centers for different operating scenarios will be determined by analysis. The electrical model for the analysis will be validated by site testing prior to fuel load. The capability of critical electrical equipment to operate within +/- 10% of nominal voltage will also be confirmed by vendor testing of the system components before shipment. (COM 8.3- 4)

8.3.4.14 Administrative Controls for Bus Grounding Circuit Devices

This subsection of the ABWR DCD is replaced in its entirety with the following site-specific supplement which addresses COL License Information Item 8.20.

Plant operating procedures will provide appropriate administrative controls to assure that bus grounding circuit devices are removed whenever the corresponding buses are energized. Operation and maintenance procedures, that provide directions to energize or deenergize high voltage electrical equipment, will also include instructions regarding bus grounding circuit devices to assure that they are in the correct position. These procedures will be developed prior to fuel load and be consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-5)

8.3.4.15 Administrative Controls for Manual Interconnections

The following site-specific supplement addresses COL License Information Item 8.21.

Plant operating procedure(s) to prevent paralleling of redundant onsite Class 1E power supplies from different buses and sources to power plant loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-6)

8.3.4.16 Not Used

8.3.4.17 Common Industrial Standards Referenced in Purchase Specifications

The following site-specific supplement addresses COL License Information Item 8.23.

The appropriate industrial standards, such as those listed in Subsection 8.3.5, for the assurance of quality manufacturing of both Class 1E and non-Class 1E equipment, will be referenced in the purchase documents.

8.3.4.18 Administrative Controls for Switching 125 VDC Standby Charger

The following site-specific supplement addresses COL License Information Item 8.24.

Plant operating procedure(s) and administrative key controls will be developed prior to fuel load to assure that all input and output circuit breakers for the standby battery charger are in the open position when the charger is not in use, and at least two circuit breakers in series are verified to be open between redundant divisions when the standby charger is placed into service (Section 8.3.2.1.3). The interlocks are also addressed in the single line diagrams (Figures 8.3-1). These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-7)

8.3.4.19 Control of Access to Class 1E Power Equipment

The following site-specific supplement addresses COL License Information Item 8.25.

Procedure(s) that contain appropriate administrative controls to limit access to Class 1E power equipment areas and Class 1E distribution panels, will be developed prior to fuel load. Class 1E power system power supplies and distribution equipment (including diesel generators, batteries, battery chargers, CVCF power supplies, 4.16 kV switchgear, 480 V load centers, 480 V motor control centers) are all located within the Vital Area areas and access is controlled accordingly. In addition, AC and DC distribution panels are located in the same areas or similar areas as Class 1E power supplies and distribution equipment or the distribution panels are capable of being locked, so that access to circuit breakers can be administratively controlled. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-8)

8.3.4.20 Periodic Testing of Voltage Protection Equipment

The following site-specific supplement addresses COL License Information Item 8.26.

Procedure(s) which implement the testing requirements of RG 1.118 and IEEE 338 for the periodic testing of instruments, timers, and other electrical equipment designed to protect the distribution system from: (1) loss of offsite voltage, and (2) degradation of offsite voltage, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-9)

8.3.4.21 Diesel Generator Parallel Test Mode

The following site-specific supplement addresses COL License Information Item 8.27.

Procedure(s) will be developed prior to fuel load which provide for the periodic testing of the diesel generator interlocks which restore units to emergency standby in the event of a LOCA or LOPP. Such procedures shall require that each diesel generator set be operated independently of the other sets, and be connected to the utility power system only by manual control during testing or for bus transfer. Also, such procedures shall require that the duration of the connection between the preferred power supply and the standby power supply shall be minimized in accordance with Section 6.1.3 of IEEE-308. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5 (COM 8.3-10)

8.3.4.22 Periodic Testing of Diesel Generator Protective Relaying

The following site-specific supplement addresses COL License Information Item 8.28.

Procedure(s) which implement the testing requirements of RG 1.9 and IEEE 387 for periodic testing of diesel generator protective relaying, bypass circuitry, and annunciation will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-11)

8.3.4.23 Periodic Testing of Diesel Generator Synchronizing Interlocks

The following site-specific supplement addresses COL License Information Item 8.29.

Procedure(s) which implement the testing requirements of RG 1.9 and IEEE 387 for periodic testing of diesel generator synchronizing interlocks, and to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-12)

8.3.4.24 Periodic Testing of Thermal Overloads and Bypass Circuitry

The following site-specific supplement addresses COL License Information Item 8.30.

Procedure(s) for the periodic testing of thermal overloads and associated bypass circuitry for Class 1E MOVs to the requirements of RG 1.106 will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-13)

8.3.4.25 Periodic Inspection/Testing of Lighting Systems

The following site-specific supplement addresses COL License Information Item 8.31.

Procedure(s) for periodic inspection of all lighting systems installed in safety-related areas and in passageways leading to and from these areas and for periodic inspection of the lighting systems which are normally de-energized (e.g., DC-powered lamps), will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-14)

8.3.4.26 Controls for Limiting Potential Hazards into Cable Chases

The following site-specific supplement addresses COL License Information Item 8.32.

Procedure(s) to control and limit the introduction of potential hazards into cable chases and control room areas will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-15)

8.3.4.27 Periodic Testing of Class 1E Equipment Protective Relaying

The following site-specific supplement addresses COL License Information Item 8.33.

Procedure(s) for the periodic testing of all protective relaying and thermal overloads associated with Class 1E motors and switchgear will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-16)

8.3.4.28 Periodic Testing of CVCF Power Supplies and EPAs

The following site-specific supplement addresses COL License Information Item 8.34.

Procedure(s) for the periodic testing of CVCF power supplies (including alarms) and associated Electrical Protection Assemblies (EPAs) which provide power to the Reactor Protection System will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-17)

8.3.4.29 Periodic Testing of Class 1E Circuit Breakers

This subsection of the ABWR DCD is replaced in its entirety with the following site-specific supplement which addresses COL License Information Item 8.35.

Procedure(s) for the periodic calibration and functional testing of the fault interrupt capability of all Class 1E breakers; the fault interrupt coordination between supply and load breakers for each Class 1E load and each Division I non-Class 1E load will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-18)

8.3.4.30 Periodic Testing of Electrical Systems & Equipment

The following site-specific supplement addresses COL License Information Item 8.36.

Procedure(s) for the periodic testing of all Class 1E electrical systems and equipment in accordance with surveillance and test requirements of Section 7 of IEEE 308, will be developed prior to fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-19)

8.3.4.31 Not Used

8.3.4.32 Class 1E Battery Installation and Maintenance Requirements

The following site-specific supplement addresses COL License Information Item 8.38.

Procedure(s) for the installation, maintenance, testing and replacement of Class 1E station batteries which meet the requirements of IEEE 484 and Section 5 of IEEE 946, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-20)

8.3.4.33 Periodic Testing of Class 1E Batteries

The following site-specific supplement addresses COL License Information Item 8.39.

Procedure(s) for the periodic testing of Class 1E station batteries in accordance with the requirements of Section 7 of IEEE 308 to ensure sufficient capacity and capability to supply power to their connected loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-21)

8.3.4.34 Periodic Testing of Class 1E CVCF Power Supplies

The following site-specific supplement addresses COL License Information Item 8.40.

Procedure(s) for the periodic testing of Class 1E constant voltage constant frequency (CVCF) power supplies to ensure sufficient capacity to supply power to their connected loads, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-22)

8.3.4.35 Periodic Testing of Class 1E Battery Chargers

The following site-specific supplement addresses COL License Information Item 8.41.

Procedure(s) for the periodic testing of Class 1E battery chargers to ensure sufficient capacity to supply power to their connected loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-23)

8.3.4.36 Periodic Testing of Class 1E Diesel Generators

The following site-specific supplement addresses COL License Information Item 8.42.

Procedure(s) for the periodic testing and/or analysis of Class 1E diesel generators to demonstrate their capability to satisfy the criteria in Subsection 8.3.1.1.8.2, to supply the actual full design basis load current for each sequenced load step, and to manually start each diesel generator will be developed prior to fuel load. These procedures will be developed prior to fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-24)

8.3.5 References

STD DEP 8.3-1

~~*7.2 kV-rated*~~ Medium voltage *metal-clad Switchgear*

Table 8.3-1 from the reference ABWR DCD is replaced in its entirety with the following.

Table 8.3-1 D/G Load Table—LOCA + LOPP

Sys. No	Load Description	Rating (kW)	Generator Connected Loads (kW) A (Div I)	B (Div II)	C (Div III)	Note*
-----	Motor operated Valves	160x3	X	X	X	(2)
C12	FMCRD	432x1	432	–	–	
C41	SLC Pump	50x2	50	50	–	
E11	RHR Pump	589x3	589	589	589	
	Fill Pump	4x3	X	X	X	
E22	HPCF Pump	1689x2	–	1689	1689	
P21	RCW Pump (Div I, II)	389x4	778	778	–	
	(Div III)	300x2	–	–	600	
P25	HECW Pump	50x5	50	100	100	
	HECW Refrigerator	367x5	367	734	734	
P41	RSW Pump	530x6	1060	1060	1060	
R23	P/C Transformer Loss	30x6	60	60	60	
R42	DC 125V Charger (Div I,II,III)	98x3	98	98	98	
	(Div IV)	56x1	–	56	–	(3)
	125 VDC Standby Charger	98	98	–	98	
R46	Vital CVCF					
	(Div I,II,III)	28x3	28	28	28	
	(Div IV)	28	–	28	–	(3)
R47	Instrument and Control Power					
	(Div I,II,III)	40x3	40	40	40	
	(Div IV)	40	–	40	–	(3)
R52	Lighting	100x3	100	100	100	
T22	SGTS Fan	61x2	–	61	61	
	SGTS Heaters	26x2	–	26	26	
	SGTS Cooling Fan	4x2	–	4	4	
U41	CRHA Supply Fans	122x4	–	244	244	(5)
	CRHA HVAC Emergency Filter Unit Supply Fans	17x4	–	34	34	(5)
	CBSREA HVAC Supply Fans	61x6	122	122	122	(5)
	RBSREEHVAC Supply Fans	61x6	122	122	122	(5)
	RBSRDGHVAC Emergency Supply Fans	50x6	100	100	100	(5)

Table 8.3-1 D/G Load Table—LOCA + LOPP (Continued)

Sys. No	Load Description	Rating (kW)	Generator Connected Loads (kW) A (Div I)	B (Div II)	C (Div III)	Note*
	RBSREEHVAC Supply Electrical Heating Coil	101x6	X	X	X	
	Cooling Tower Fan	208x6	416	416	416	
	UHS HVAC Fan	41x3	41	41	41	
	UHS Unit Heater	180x3	180	180	180	
Other Loads			174	140	131	
Total Connected Loads			5271	7306	7043	
Total Standby Loads and Short Time Loads			538	677	677	
Total Operating Loads			4733	6629	6366	

* See Table 8.3-3 for Notes

Table 8.3-3 Notes for Tables 8.3-1 and 8.3-2

(3) *Div. IV ~~battery charger~~ is fed from Div. II motor control centers.*

(4) *Load description acronyms are interpreted as follows:*

CRHA	Control Room Habitability Area
CBSREA	Control Building Safety-Related Equipment Area
~~*FCS*~~	~~*Flammability Control System*~~
RBSREEHVAC	Reactor Building Safety-Related Electrical Equipment HVAC System
RBSRDGHVAC	Reactor Building Safety-Related Diesel Generator HVAC System
UHS	Ultimate Heat Sink

Table 8.3-4 D/G Load Sequence Diagram Major Loads

	Mode	Div. (Block Time)	Block 1 (20 s)	Block 2 (30 s)	Block 3 (35 s)	Block 4 (40 s)	Block 5 (45 s)	Block 6 (50 s)	Block 7 (55 s)	Block 8 (60 s)	Block 9 (After 65 s)
LOCA Loads	LOCA & LOPP	I	*MOV* *Inst. Tr Lighting* *FCMRD*[*]	*RHR Pump* *DG HVAC*	*RCW Pump* *HECW Pump*	*RCW Pump*	*RSW Pump* *R/B Emer. HVAC* *C/B Emer. HVAC*	*RSW Pump*	*SGTS*	*Chargers* *CVCFs*	*SLC Pump* ~~*FCS*~~ *HECW Refrig*
	LOCA & LOPP	II	*MOV* *HPCF Pump Inst. Tr Lighting*	*RHR Pump* *DG HVAC*	*RCW Pump* *HECW Pump*	*RCW Pump* *MCR HVAC*	*RSW Pump* *R/B Emer. HVAC* *C/B Emer. HVAC*	*RSW Pump*	*SGTS*	*Chargers* *CVCFs*	*SLC Pump* ~~*FCS*~~ *HECW Refrig*
	LOCA & LOPP	III	*MOV* *HPCF Pump Inst. Tr Lighting*	*RHR Pump* *DG HVAC*	*RCW Pump* *HECW Pump*	*RCW Pump* *MCR HVAC*	*RSW Pump* *R/B Emer. HVAC* *C/B Emer. HVAC*	*RSW Pump*		*Chargers* *CVCFs*	*HECW Refrig*

** FMCRDs are the only Non-Class 1E loads on the DG buses.*

The following figures are located in Chapter 21:

Figure 8.3-1 Electrical Power Distribution System SLD (Sheets 1- ~~3~~ 4)

Figure 8.3-2 Instrument and Control Power Supply System SLD