

## 8.0 Electric Power

### 8.1 Introduction

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

STD DEP T1 2.4-2

STD DEP T1 2.12-2

STP DEP 1.1-2 (Table 8.1-1)

STD DEP 1.8-1

STD DEP 8.3-1

STD DEP 9.5-1 (Table 8.1-1)

~~The plant medium voltage electrical system alternate design description was provided in ABWR Licensing Topical Report (LTR) NEDO 33335, "Advanced Boiling Water Reactor (ABWR) Plant Medium Voltage Electrical System Design," dated May 2007. Marked-up DCD pages 8.1-1 through 8.1-6 of this LTR are incorporated by reference.~~

#### 8.1.1 Offsite Transmission Network

*The description of the offsite transmission network is out of the ABWR Standard Plant scope, however there are interface requirements contained in Section 8.2.3 which must be complied with by the COL applicant.*

The following supplement provides site specific information on the interface between the offsite transmission network and STP 3 & 4.

The transmission service providers for STP 3 & 4 are CenterPoint Energy, AEP Texas Central Company (TCC), and City Public Service Board of San Antonio (CPS). The combined electrical grids of the three systems presently consist of interconnected fossil fuel plants which serve approximately 51,354 square miles with an overlaid 345/138/69 kV transmission system.

The three transmission service providers are members of the Electric Reliability Council of Texas (ERCOT). ERCOT consists of members engaged in generation, marketing, transmission, or distribution of electric energy within the State of Texas. ERCOT is the Independent System Operator (ISO), which oversees all generation and transmission functions.

The 345 kV switchyard at STP Units 3 & 4 has six 345 kV transmission circuits which connect it to the three transmission service providers' transmission system. Two of the 345 kV transmission circuits connect to CenterPoint Energy's Velasco substation and Hillje 345 kV switchyard. One of the 345 kV transmission circuits directly connects STPEGS and CPS's Elm Creek 345 kV switchyard near San Antonio, Texas. Two of

the 345 kV transmission circuits connect to TCC's White Point 345 kV substation and the Blessing 345 kV autotransformer. The remaining TCC 345 kV circuit connects to the STP 1 and 2 switchyard via a tieline (with a series reactor).

## **8.1.2 Electric Power Distribution System**

### **8.1.2.0 Definitions**

STD DEP 1.8-1

**Safety-related**—Any Class 1E power or protection system device included in the scope of IEEE-279603 or IEEE-308. (This term is explicitly defined in IEEE-100, though not in IEEE-308.) Note that “safety-related” includes both electrical and non-electrical equipment, whereas “Class 1E” pertains only to electrical equipment (i.e., any equipment which has an electrical interface).

### **8.1.2.1 Description of Offsite Electrical Power System**

STD DEP 8.3-1

The scope of the offsite electrical power system includes the entire offsite transmission network and the transmission lines coming into the switchyards to the termination of the bus duct and power cables at the input terminals of the circuit breakers for the ~~6.9 kV~~ medium voltage switchgear. The COL applicant has design responsibility for portions of the offsite power system. The scope split is as defined in the detailed description of the offsite power system in Subsection 8.2.1.1.

The ~~1500 MVA~~ main power transformer is a bank of three single phase transformers. One single phase installed spare transformer is provided.

~~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 backed 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.~~

There are two (2) three winding reserve auxiliary transformers (RATs), each with one 13.8 kV and one 4.16 kV secondary winding that provide alternate preferred power to connected loads.

~~A 9mW~~ A minimum of 20 MW 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**

STD DEP 8.3-1

~~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.~~

Unit auxiliary transformers (UATs) A & B each provide power to three non-Class 1E buses and one Class 1E bus. UAT C provides power to one non-Class 1E bus and one Class 1E bus. The 13.8 kV reserve auxiliary transformer (RAT) windings can be used to supply reserve power to non-Class 1E power generation buses. The 4.16 kV RAT windings can be used to supply reserve power to the plant investment protection (PIP) buses and also to the three (3) Class 1E buses.

In general, motors larger than 300 kW are supplied from the ~~6.9 kV~~ medium voltage 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~~ medium voltage 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~~ a reserve auxiliary transformer (RAT). This division is immediately available, without a bus transfer, if the normal preferred power is lost to the other two divisions.

The Division I, II, and III standby AC power supplies consist of an independent ~~6.94.16~~ kV Class 1E diesel generator (D/G), one for each division. Each D/G may be connected to its respective ~~6.94.16~~ kV Class 1E switchgear bus through a circuit breaker located in the switchgear.

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 ~~6.94.16~~ 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.

STD DEP T1 2.12-2

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,~~ and IV with distribution panels and local control panels fed from their respective divisional sources, except Division IV is fed from the Division II source.

### 8.1.2.3 Safety Loads

#### STD DEP 8.3-1

The safety loads utilize various Class 1E AC and/or DC sources for instrumentation and motive or control power or both for all systems required for safety. Combinations of power sources may be involved in performing a single safety function. For example, low voltage DC power in the control logic may provide an actuation signal to control a 6-94.16 kV circuit breaker to drive a large AC-powered pump motor. The systems required for safety are listed below:

- (3) ESF Support Systems
  - (d) Not Used Reactor Service Water System (RSW)
  - (i) Leak Detection and Isolation System (LDS)

#### 8.1.3.1.1.1 Onsite Power Systems - General

#### STD DEP 8.3-1

The unit's total Class 1E power load is divided into three divisions. Each division is fed by an independent 6-94.16 kV Class 1E bus, and each division has access to one onsite and two offsite power sources. An additional power source is provided by the combustion turbine generator (CTG). A description of the CTG is provided in Subsection 9.5.11.

Divisions I, II, and III standby AC power supplies have sufficient capacity to provide power to all their respective loads. Loss of the preferred power supply, as detected by 6-94.16 kV Class 1E bus under-voltage relays, will cause the standby power supplies to start and connect automatically, in sufficient time to safely shut down the reactor or limit the consequences of a design basis accident (DBA) to acceptable limits and maintain the reactor in a safe condition.

#### STD DEP T1 2.4-2

The Class 1E 6-94.16 kV Divisions I, II, and III switchgear buses, and associated 6-94.16 kV diesel generators, the safety-related 13.8 kV breakers (to trip condensate pumps in case of feedwater pipe break), 480 VAC distribution systems, and Divisions I, II, III and IV, 120 VAC and 125 VDC power and control systems conform to Seismic Category I requirements. This equipment is housed in Seismic Category I structures except for some control sensors associated with the Reactor Protection System [Subsection 9A.5.5.1], and the Leak Detection System [Subsection 9A.5.5.7], and the safety-related 13.8 kV breakers (Subsection 8.3.1.1.1). Seismic Qualification is in accordance with IEEE-344 (Section 3.10).

#### 8.1.3.1.2.1 General Design Criteria

#### STP DEP 1.1-2

- (3) GDC 5 - Sharing of Structures, Systems and Components

~~The ABWR is a single unit plant design. Therefore this GDC is not applicable.~~ STP 3 & 4 is a dual-unit station. ~~GE Licensing Topical Report (LTR) NEDO-33325, dated May 2007, titled "Common Equipment and Structures" addresses the sharing of structures, systems and components important to safety between the two units. The LTR demonstrates that GDC 5 is met for a standard dual unit configuration.~~ 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.

#### 8.1.3.1.2.2 NRC Regulatory Guides

STP DEP 1.1-2

STD DEP 9.5-1

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

~~The ABWR is designed as a single unit plant. Therefore, this Regulatory Guide is not applicable.~~ STP 3 & 4 is a dual-unit station. ~~GE Licensing Topical Report (LTR) NEDO-33325, dated May 2007, titled "Common Equipment and Structures" addresses the sharing of structures, systems, and components important to safety between the two units. The LTR demonstrates that RG-1.81 is met for a standard dual unit configuration.~~ 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.

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

#### 8.1.4 COL License Information

##### 8.1.4.1 Diesel Generator Reliability

The following standard supplement addresses COL License Information Item 8.1.

Procedure(s) to monitor onsite emergency diesel generator performance in accordance with the recommendations of NUREG/CR-0660 "Enhancement of On-site Emergency Diesel Generator Reliability," will be developed before fuel load to obtain improved performance and better reliability from the standby emergency diesel generators. Training will also be developed for maintenance personnel and other appropriate plant personnel in the proper operation and maintenance of the standby emergency diesel generators. These procedures will be developed consistent with the plant operating procedure development plan; ~~which was provided to the NRC in ABWR~~

~~Licensing Topical Report (LTR) NEDO 33297, dated January 2007, titled "Advanced Boiling Water Reactor (ABWR) Procedures Development Plan, in Section 13.5."~~  
(COM 8.1-1)

Table 8.1-1 Onsite Power System SRP Criteria Applicable Matrix

Applicable Criteria	Ref. IEEE Std	Offsite Power System	AC Power Systems (Onsite)	DC Power Systems (Onsite)
<del>GDC 5</del> * GDC 5			X	X
<del>RG 1.81</del> * RG 1.81			X	X
<del>RG 1.108</del>			X	

\*Multi-unit plants only; not applicable to single-unit ABWR

