8.2 OFFSITE POWER SYSTEM

DCD The information in this section of the referenced DCD is incorporated by reference with the following departure and supplements.

8.2.1 SYSTEM DESCRIPTION

BLN SUP The TVA system supplies the offsite ac power required for start-up, normal operation, and safe shutdown of the Bellefonte Nuclear Plant. The Bellefonte Nuclear Plant is connected to an existing network supplying large load centers. Each generating unit is tied into TVA's 500 kV transmission system via two 500 kV transmission connections. The 161 kV switchyard is supplied by two physically independent 161 kV transmission lines.

The 500 kV connections consist of two lines 29.71 and 21.31 miles long to the Widows Creek Steam Plant, one line 40.82 miles long to the Madison 500 kV Substation, and one system interconnection 117.6 miles long to the Alabama Power Company's Miller Steam Plant. The Miller Steam Plant is connected to the Alabama Power Company's 500 kV grid and to the TVA system with a second 500 kV interconnection to the West Point 500 kV Substation. Unit 1 is connected via the Widows Creek No. 1 and the Madison 500 kV lines. Unit 2 is connected to Widows Creek No. 2 and the Miller 500 kV lines. There is no direct connection between the 500 kV buses associated with the two units. A 500 kV breaker is provided as a spare for any line or transformer breaker. Connections to the switchyard buses are shown in Figure 8.2-201.

The 161 kV switchyard is supplied by two physically separate lines. One of these lines is 17.2 miles long and connects to the Widows Creek Steam Plant, and the other is 7.47 miles long and connects to the Scottsboro, Alabama 161 kV Substation. The Scottsboro 161 kV Substation is, in turn, connected to the Goose Pond 161 kV Substation which in turn has direct connections to the Guntersville Hydro Plant, and the Widows Creek Steam Plant and the Madison 500 kV Substation.

The Bellefonte-Widows Creek No. 1 and the Bellefonte-Madison 500 kV lines are common on the right of way for approximately the first 12.5 miles from the plant. In the first 1.5 miles adjacent to Bellefonte, the Widows Creek 161 kV line is underbuilt on the Widows Creek No. 1 500 kV line and the Scottsboro 1161 kV line is underbuilt on the Madison 500 kV line. The lines in these sections are separated sufficiently to ensure that the failure of any tower in one line will not endanger the other 500 kV or 161 kV circuits.

Short terminal sections (approximately 0.3 miles each) of single circuit 161 kV line are used to extend the Widows Creek and Scottsboro 161 kV lines from the underbuilt sections into the plant 161 kV switchyard. The terminal sections of the Widows Creek and the Scottsboro 161 kV lines both cross the Miller and Widows Creek No. 2 500 kV lines. The crossing points are separated sufficiently to preclude the likelihood that a line breaking or a tower falling will cause simultaneous failure of both circuits. The Widows Creek 161 kV line also crosses the Madison and Widows Creek No. 1 500 kV Lines at the entry to the underbuilt section.

The 500 kV and 161 kV transmission line structures are designed to withstand medium loading conditions as specified in ANSI C2.2-1976. Designing to these

requirements ensures the adequacy of lines to wind and icing conditions in excess of those that would be expected in this area. The phase conductor and shields wire design tensions are selected to avoid vibration problems. No galloping conductor conditions have been observed in the south central portion of the TVA system.

Transmission lines in the 500 kV and 161 kV voltage class have two overhead ground wires provided for lightening protection. This shielding has been effective for an area isokeraunic level of 60 and is reflected in the average operating record of only 0.8 and 2.8 flashover interruptions annually as a result of lightening per 100 miles of 500 kV and 161 kV lines respectively. The use of circuit breakers with automatic reclosing circuits results in the majority of these interruptions being momentary.

Two 250V batteries are provided to supply switchyard requirements. Each transmission line is protected with primary and backup relaying systems. Each power circuit breaker is equipped with two separate trip coils. Each of the two 250V batteries supplies portions of the protective devices, and for loss of one battery a manual transfer to the other battery is provided. The 500 kV and 161 kV breakers are normally controlled by the remote dispatchers located in an area dispatch control center but can be controlled locally.

BLN CDI

The location of the unit auxiliary transformers, the step-up transformers and the reserve transformer is shown on Figures 8.2-202 and 8.2-203.

8.2.1.1 Transmission Switchyard

BLN CDI

The 500 kV Bellefonte switchyard consists of circuit breakers, disconnect switches, busses, transformers and associated equipment. The switchyard is arranged in a modified breaker-and-a-half configuration as shown in Figure 8.2-204.

A 500/13.8 kV Support Transformer is connected directly to each 500 kV bus through a disconnect switch which is capable of interrupting magnetizing current. The Support Transformers are three-winding transformers rated at 60/80/100 MVA. Each transformer has two low side breakers connected so that either transformer may supply via underground duct a 13.8/6.9 kV Unit Auxiliary Transformer in the Transformer Area.

Another offsite supply consists of a 13.8 kV maintenance supply through the switchyard to the Reserve Auxiliary Transformer in the Transformer Area. The connections from the Unit Auxiliary Transformers and Reserve Auxiliary Transformer to station busses is discussed in Section 8.3.

The switchyard has been designed in accordance with the following industry standards:

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
2. American National Standards Institute (ANSI)
3. National Electrical Manufacturers Association (NEMA)
4. American Society for Testing and Materials (ASTM)
5. National Electric Safety Code (NESC)

As discussed in the AP1000 DCD, Subsection 8.1.4.1, offsite power has no safety-related function. Offsite power redundancy is provided to assure a reliable offsite system for delivery of power generated at the station and to minimize challenges to passive safety systems.

BLN DEP 8.2.1-1

The 500 kV and 161 kV transmission line structures associated with the plant are designed to withstand medium ~~standard~~ loading conditions for the specific-site as provided in Reference 1.

8.2.1.2 Transformer Area

BLN DEP 8.2.1-2

~~Protective relaying and metering required for this equipment is located in the turbine building.~~ Metering required for this equipment is located in the turbine building. Protective relaying required for this equipment is located in the turbine building and the transformer area control building.

8.2.2 Grid Stability

BLN COL 8.2.5

Although an exemption to 10 CFR 50, Appendix A, GDC 17 is justified as discussed in the generic DCD, Section 8.2.3, system reliability considerations result in many of the same system characteristics of a system designed to meet that criterion. Some of those characteristics are:

1. Any one of the 500 kV transmission circuits is capable of carrying the auxiliary load.
2. The 500 kV system is protected from lightning and switching surges by lightning-protective equipment and by overhead static lines.
3. The design of the 125V dc system for the switchyard provides for two independent dc systems. Each of the two systems consists of a separate 125V dc battery, a battery charger, and a distribution system. Cable separation is maintained between the two systems from the batteries to the distribution cabinets. A single failure caused by a malfunction of either of the two 125V dc systems will not affect the performance of the other system. The ability of the switchyard to supply offsite power to the plant will not be affected by the complete loss of either of the two 125V dc systems. The 125V systems are continuously monitored in the control room.
4. Alarm windows are provided in the control room for ac or dc supply trouble, switchyard annunciator trouble, loss of carrier signal on either 500 kV circuit, unit auxiliary transformer trouble, 500 kV breaker opening, and 500 kV bus protection trips. Remote indication of 500 kV bus voltage and frequency is also provided in the load dispatch control room of OUC.
5. For reliability and operating flexibility, the substation design (Widows Creek, Scottsboro and Bellefonte) is a breaker-and-a-half arrangement, with breaker failure backup protection. This design permits the following:
   - Any transmission line can be cleared under normal or fault conditions without affecting any other transmission line
   - Any circuit breaker can be isolated for maintenance without interrupting the power or protection to any circuit, and

- Short circuits on a section of bus will be isolated without interrupting service to any items of equipment other than those connected to the faulted bus section.

Steady state and transient stability analyses demonstrate the ability of the grid to provide uninterrupted synchronous alternating current to the 500-kV Plant Site Switchyard for the following conditions:

1. With any one of the 500 kV transmission circuits out of service, a sustained three-phase fault on any other 500 kV circuit cleared in primary clearing time of 0.05 seconds,
2. A sustained three-phase fault occurring simultaneously on both circuits of a double-circuit 500 kV transmission line between the plant switchyard and the TVA system cleared in primary time of 0.05 seconds,
3. A sustained three-phase fault on any one of the 345-kV transmission circuits between the plant switchyard and the OUC grid cleared in the breaker failure back up clearing time of 0.175 seconds.

The preliminary steady state and transient stability studies performed show that the offsite power sources remain intact as reliable sources to supply the onsite electrical power system for the loss of either nuclear unit, the loss of a single 500 kV line connecting these units into the transmission system, the loss of one unit and two 500 kV transmission lines, the loss of the next largest generating unit on the system, or the loss of the most critical 500 kV transmission line. Steady state studies show these offsite sources to be reliable sources for the onsite power system when both nuclear units are simultaneously removed from service.

Transient stability studies included conditions of three phase faults on transmission lines connecting the nuclear units into the transmission system. Studies of the faults included stuck breaker conditions in which one nuclear unit and two 500 kV lines were disconnected automatically from the transmission system as a result of these disturbances. These cases were considered to be the most serious conditions of postulated transmission disturbances. They showed that the transmission system remains stable with negligible disturbance for the offsite power supplies. Steady state studies show the 500 kV and 161 kV networks are capable of supplying the offsite power requirements for normal, safe shutdown or accident conditions.

Results of the preliminary analysis are shown in Table 8.2-201. Final grid stability calculations will be performed prior to fuel load. A criterion of the AP1000 design is that the grid will remain stable and the reactor coolant pump bus voltage will remain above the voltage required to maintain the reactor coolant flow assumed in the Chapter 15 analyses for a minimum 3 seconds following a turbine trip. Instrument setpoint criteria for breaker protective devices are based on this criterion. The DCD criterion is shown to be met in the preliminary analysis.

Interconnection of the two 500 kV supplies to the grid is shown on Figure 8.2-201. The interconnected system is operated in accordance with reliability criteria specified by the interconnected system operator. Any changes to operation of the system are communicated to TVA and plant management. Changes are reviewed for compliance with the management agreement discussed above. Based on historical operation of the systems, the criteria for reliability identified in this section will be met.

8.2.5 Combined License Information for Offsite Electrical Power

BLN COL This COL Item is addressed in Subsection 8.2.2.

8.2.6 References

BLN DEP 8.2.6-1 1. ANSI ~~C2-1997~~ C2.2-1976, National Electrical Safety Code."

TABLES

BLN SUP Table 8.2-201

FIGURES

BLN SUP Figure 8.2-201

BLN SUP Figure 8.2-202

BLN SUP Figure 8.2-203

BLN SUP Figure 8.2-204