8.8 AUXILIARY DC POWER SUPPLY AND DISTRIBUTION

8.8.1 48-V DC Power System

8.8.1.1 Power Generation Objective

The objective of the 48-V DC Power System is to provide a reliable, continuous, independent, and conveniently utilized 48-V DC power supply for the plant communications and annunciator systems during all modes of plant operations.

8.8.1.2 Power Generation Design Basis

1. The 48-V DC Power System shall supply power for all 48-V DC requirements.

2. The system shall be provided with two annunciator batteries and one communication (telephone) battery capable of supplying the connected load when power from the chargers is lost.

8.8.1.3 Description

The 48-V DC Power System consists of three batteries, four battery chargers, and the associated buses, circuitry, and distribution panels required for the operation of the system. One battery and its charger is for the plant communications system. The other two batteries and their chargers are for the annunciator system. The fourth charger is a spare unit and may be switched to supply power to any one of the three 48-V DC buses. The battery chargers are not normally operated in parallel but are designed to operate in parallel. The annunciator battery system is arranged so that the total station annunciator load may be supplied from one battery.

During normal operations each battery charger provides the prime source of 48-V DC power, with the battery supplying peak demands, normally keeps its battery fully charged, and recharges its battery after a discharge. After a significant discharge the spare battery charger may be paralleled with another battery charger to assist in battery charging or load carrying. On loss of power to the charger, the battery supplies all the required loads.

Loss of 48-V DC annunciator power from one battery will be annunciated and an automatic transfer to the other 48-V annunciator battery accomplished. Thus, only a brief interruption in annunciation will result, and the low-voltage alarm will be actuated for Units 2 and 3 only. For Unit 1, the 48-V DC power sources are divided to supply either the A or B annunciator equipment; therefore, a loss of either 48-V DC source will not interrupt annunciation operation. The loss of 48-V DC will be indicated in the MCR by the extinguishing of the Blue Annunciator PLC A or B status lights located at the top of each panel.

The battery chargers are of the solid-state, rectifier type, capable of working independently and automatically regulating output voltage within 1.0 percent when the load is between 0 percent and 100 percent with the battery connected or disconnected. The chargers provide float and equalize charge, to recharge the batteries and maintain them in a fully charged condition.

The batteries are lead-acid, lead-calcium grid construction type with 24 cells (nominal 48-V DC), and rated to carry the maximum load required by any one battery. Each battery is designed to have an 8-hour rating of 840 ampere-hours.

The 48-V batteries are mounted on sturdy earthquake-type racks suitable for easy maintenance and housed in the battery rooms which are adequately ventilated to prevent a concentration of combustible gases from the charging operation. Racks and holddown bolts are designed as Class I equipment in accordance with Appendix C, "Structural Qualification of Subsystems and Components."

The relation of the 48-V DC Power System to other associated electrical systems is shown in Figure 8.6-1c of Subsection 8.6.

8.8.1.4 Inspection and Testing

Routine service and testing are based upon the recommendations of the manufacturer and sound maintenance practices. Typical inspections include visual examinations for leaks and corrosion, and checking all batteries for uniformity as well as values of cell voltage, specific gravity of electrolyte, and electrolyte level. Any one battery or battery charger may be removed from the system for testing or repair without interrupting service to the system.

8.8.2 24-V DC Power System

8.8.2.1 Power Generation Objective

The objective of the ± 24-V DC Power System is to assure a supply of 24-V DC power to various monitoring instrumentation during all modes of plant operation.

8.8.2.2 Power Generation Design Basis

1. The 24-V DC Power System shall supply power for all 24-V DC requirements through the use of two independent channels for each unit.

2. Each channel shall be provided with separate batteries capable of supplying the connected load when power from the chargers is lost.

8.8.2.3 Description

The ± 24-V DC Power System for each unit consists of two separate and independent 24-V DC channels. Each channel has a +24-V DC and a -24-V DC battery charger connected in series with a common ground. The two battery chargers are connected in parallel with two 24-V batteries having a common ground. The channels are designed for reliability and to minimize electrical noise. The circuits are designed so that the loads which are needed most will have the greatest probability of being served. The prime source of power is from the battery chargers, with the batteries serving as a backup source of power. Each channel has an independent local distribution panel. The voltage of the channel is indicated on the distribution panel.

Each channel is protected from high voltage by an overvoltage relay. The relay operates the charger output circuit breaker and actuates an alarm in the control room when the voltage exceeds approximately 29-V. The alarm in the control room is also actuated on low voltage.

The main circuit breakers on the feeder lines from the battery chargers and batteries break both the + and - sides of the system, while the ground connection remains uninterrupted. Loss of power from the battery chargers does not result in loss of ± 24-V DC supply.

The battery chargers are of the full-wave silicon rectifier type, capable of working independently. Each charger is capable of automatically regulating output voltage within ± 2 percent of its rated value under the following conditions:

1. The load is between 0 percent and 100 percent, with the AC power feeding the charger deviating from the rated voltage by 10 percent.

Each battery charger has the capacity to deliver the maximum charging rate required by the battery, as recommended by the battery manufacturer, while also supplying the normal steady-state DC load. It is possible to recharge each battery from a totally discharged condition, maintain full charge once achieved, and to periodically give the battery an equalizing charge if required. Lead-calcium batteries do not require an equalizing charge if floated between 2.20 and 2.25-V per cell.

The batteries are lead-acid, lead-calcium type with 12 cells (nominal 24-V DC) and rated to carry the maximum load required by any one battery.

The 24-V batteries for each unit are mounted on a sturdy rack suitable for easy maintenance and housed in the unit battery room, which is adequately ventilated to prevent a concentration of combustible gases from the charging operation.

The relation of the 24-V DC Power System to other associated electrical systems is shown in Figure 8.6-1d of Subsection 8.6.

The ± 24-V DC Power System is not a safety system and does not have a safety design basis. An evaluation of the total loss of ± 24-V power is shown in Table 8.8-3. As shown by this evaluation, the complete loss of ± 24-V DC power does not have unacceptable results nor does it prevent safe shutdown of the plant.

8.8.2.4 Inspection and Testing

Service and testing is performed on a routine basis in accordance with recommendations of the manufacturers and sound maintenance practices. Typical inspections include visual inspections for leaks and corrosion, and checking all batteries for voltage, specific gravity, and level of electrolyte. At the time of installation, a full load discharge test is made to prove that battery capacity is adequate.