8. ELECTRIC POWER

8.1 INTRODUCTION (ELECTRIC POWER SYSTEMS)

The San Onofre Nuclear Generating Station (SONGS) is permanently shutdown. In preparation for the transition to Decontamination and Dismantlement (D&D), the project has established "Cold and Dark" (C&D) conditions. C&D is the plant configuration that retains in-service only the minimum set of structures, systems, and components necessary for personnel safety and safe storage of spent fuel. Safety is enhanced by simplifying the on-site distribution busses, elimination of the 4kV buses, and general reductions in the number of energized circuits. C&D includes remaining, new, or legacy plant equipment. After relocation of all spent fuel from the pools to the Independent Spent Fuel Storage Installation (ISFSI) pad, additional changes can and will be made to various mechanical systems. This will further reduce the loads on the electric power system.

The electric power for the site is provided from the offsite transmission system via connections directly with the transmission system in the San Onofre Substation as well as from the San Diego Gas & Electric (SDG&E) Mesa 12kV distribution system. A new "Ring Bus" system powered from the transmission system connections is the primary source that powers C&D, the ISFSI, and D&D load centers. The SDG&E Mesa 12kV distribution system provides power for miscellaneous facilities located on SONGS property on the north and south end of the site.

Although systems and subsystems removed or partially removed from service no longer support operation, equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration. A summary of the legacy and new systems and their status is listed in the table below.

Legacy Systems	
System	Status
6.9kV	Removed from Service
4.16kV	Removed from Service
480 VAC	Removed from Service (See note 1)
120 VAC	Removed from Service (See note 1)
Emergency Diesel Generators	Removed from Service
DC Power	Removed from Service (See note 1)
Main Generators	Removed from Service
Iso-phase Buses	Removed from Service
Substation (renamed from Switchyard)	Available
Main, Auxiliary, and Reserve Auxiliary Transformers	Removed from Service

New Systems	
System	Status
12kV Ring Bus	New
480 VAC Load Centers	New (See note 1)
120 VAC	New (See note 1)
4kVAC Diesel Generator	New
480 VAC Diesel Generator	New

[1] Some components of the legacy system have been repurposed and repowered from the new ring bus as part of the C&D configuration.

8.2 UTILITY GRID AND ITS INTERCONNECTIONS (OFFSITE ELECTRIC SYSTEM)

SONGS is connected to the utility grid system for Southern California Edison (SCE) and SDG&E at the San Onofre Substation. The San Onofre Substation operates at 220kV and is the interconnection between the SDG&E and SCE electric systems. The offsite electric system is controlled by the California Independent System Operator Corporation and operated by SCE and SDG&E in their respective territories.

There are four transmission circuits that provide power to the SCE portion of the substation. In addition, there are five transmission circuits that provide power to the SDG&E portion of the substation. Site connections with the offsite power system are described in Section 8.3.

8.3 OFFSITE POWER SYSTEM

Offsite power is provided by the 220kV San Onofre Substation and connections with the SDG&E Mesa 12kV distribution system.

The San Onofre Substation is separated into two sections: The north section is the SCE section, and the south section is the SDG&E section. The two sections are connected by two bus-tie circuit breakers. Normal power to the SONGS Ring Bus is from two 220kV/12kV transformers located in the SCE section of the substation. These transformers can each separately supply the 12kV Ring Bus. Supply of the Ring Bus from the SDG&E Mesa 12kV distribution system can be made with SDG&E physical assistance. Miscellaneous facilities located on the south part of the SONGS property, (e.g., K-buildings and South Yard Facility) are powered by connections with the SDG&E Mesa 12kV distribution system.

The Ring Bus distribution system provides power to support the C&D shutdown plant configuration and the ISFSI.

8.4 ONSITE POWER SYSTEMS

The onsite power system consists of a 12kV Ring Bus system which supplies the site C&D systems and provides load drop centers for other loads. The distribution system consists of 480V

load centers and Motor Control Centers (MCC) as well as 480V and lower voltage distribution panels. See Controlled Drawing 38800 for a Simplified One Line Diagram of the 12kV Ring Bus.

8.4.1 AC POWER SYSTEMS

The 12kV Ring Bus is the source of AC power to SONGS in the C&D configuration. In the C&D plant configuration, there is a minimal set of loads that continue to require electrical power including security systems, radiation monitors, sump pumps, dilution pumps, HVAC, and the Independent Spent Fuel Pool Cooling System (ISFPCS).

The loads supplied by the C&D onsite power system are separated into "essential" and "non-essential" buses. Essential loads include selected AC and DC circuits judged to be of higher priority for maintaining safe plant conditions and are provided with backup diesel generators (DG).

The C&D electrical distribution system has two main functions:

1. To distribute power to all C&D loads during normal off-site power conditions.

2. To distribute power to selected essential loads under normal and loss-of-offsite-power (LOOP) conditions.

The configuration of the C&D onsite power systems consists of a Ring Bus with backup diesel generators. The Ring Bus operates at 12kV and supplies 480V buses. These buses supply 480V loads and 208V/120V buses. One 1500 kW backup diesel generator is provided to supply essential 480V buses in the event of a LOOP. The diesel generator is manually loaded and locally controlled. A second 500 kW backup diesel generator is provided to supply selected essential communications and emergency planning loads and is automatically loaded with an appropriate delay on LOOP.

The Ring Bus system includes the following:

- A substation tie-in with 220kV/12kV power through two 10/14 MVA transformers installed in positions three and six in the SCE portion of the San Onofre Substation.

- Underground power cable routing from the substation transformers to 12kV switchgear.

- A 12kV Ring Bus around the Unit 1 North Industrial Area and the Units 2 and 3 power block area. This system includes exposed above-ground cables.

- D&D 12kV power drops.

The electrical Ring Bus Distribution system consists of four main 480V load centers with power supplied by the new 12kV ring bus. The four 480V load centers (buses) are as follows:

- Bus 1: Non-essential loads, located inside on Elevation 37'-0" of the Units 2 and 3 Auxiliary Building (Radwaste Area). This is designated LDC01.
- Bus 2: Essential-only loads, located inside on Elevation 37'-0" of the Units 2 and 3 Auxiliary Building (Radwaste Area). This is designated LDC02.
- Bus 3: Non-essential loads in the North Industrial Area. This is designated LDC03.
- Bus 4: Non-essential loads on the west side of the plant, south of the Units 2 and 3 intake structure area. This is designated LDC04.

Each load center will step down the voltage from the ring bus via a 12kV/480V transformer to distribute power at the 480V level. Some loads, such as the ISFPCS, ISFSI, and HVAC, will be connected directly to the 480V load center. Other loads, such as the Control Room/Command Center and fire detection system, use transformers to step the voltage down from 480V to 208V/120V.

The quality class of all systems and components is provided in SCE Controlled Document 90034, “Q-List.”

8.4.2 BACKUP POWER SUPPLIES

There are two backup diesel generators that support the essential loads on the Ring Bus distribution system, a 1500 kW Backup Diesel Generator for loads including but not limited to ISFPCS, Spent Fuel Pool Make-up, Security systems, and associated instrumentation and controls; and a 500 kW Standby Diesel Generator for essential communications, emergency planning related equipment, and other related loads.

8.4.2.1 Backup 1500 kW Diesel Generator

The Ring Bus Distribution system includes one 1500 kW Backup DG which can be connected to essential power distribution bus LDC02. Although the normal power source is reliable, an outage of the 220kV San Onofre Substation is possible. The Backup DG is located at the south end of the station and is manually started and connected when needed.

The DG is sized at 4.16kV output and has a 1500 kW continuous rating. It connects to the essential bus LDC02 through a new 4.16kV/480V transformer. In order to prevent any back-feeding to the transmission grid, the output supply connection circuit breaker has a manual interlock with the normal supply circuit breaker so only one source can be closed onto the essential bus at a time.

A 15kVA, 480V-240V/120V single phase transformer powers the AC distribution panel located within the diesel generator set.

The DG is sized to power selected essential loads from LDC02. The loads to be powered are listed in a Motor and Electrical Load List. Alignment of the power sources and control of the loading on the source is controlled by procedure.

8.4.2.2 Standby 500 kW Diesel Generator

A second DG with a 500 kW continuous rating and 480V output is provided for certain essential communications, emergency planning related equipment, and other equipment. An automatic transfer switch with an appropriate delay signals the DG to start and switch power sources upon under-voltage from the normal source of power in the ring bus distribution system. Primary loads on the DG include the 800MHz radio system, site paging, and sirens.

The 500 kW Standby DG and the local automatic transfer switch is located just south of the legacy Unit 2 Main Transformer.

A 25kVA, 480V-240V/120V single phase transformer provides power to the AC distribution panel located within the diesel generator set.

8.4.3 DC POWER SYSTEMS

Two battery banks remain in service in the C&D configuration: Battery Bank 2B016 in the Unit 2 Turbine Building room 206, and 3B011 in the Control Building room 306K. Each room has gas detectors with local indication. The batteries with their associated chargers, inverters, and buses are listed below.

Battery	Inverter	Bus
2B016	2Y012	DC Bus 2D8
3B011	3Y005	DC Bus 3D5

The battery rooms are ventilated by a Battery Room Ventilation system which is designed to prevent combustible concentrations of hydrogen gas from accumulating. Chapter 9 contains a description of the Battery Room Ventilation systems.

Each battery charger is supplied with 480V-AC power from essential 480-volt buses.

8.4.4 SYSTEM OPERATION

During normal C&D operation, the 12kV system is powered by substation 220/12kV transformers. Each 480V load center is energized from its associated 12kV-480V stepdown transformer and low side 480V feed breaker. The 480V load centers are metal clad with compartments that are horizontally and vertically arranged.

The 480V load centers further distribute power to other 480V MCCs and to the 208V/120V distribution panels. Each MCC is energized from its associated 480V load center through feeder breakers. Operation of the breakers is provided locally at each breaker. The MCCs are metal-enclosed and are rated for indoor, 480V, 3 phase, 60 Hz applications. Each MCC contains vertically arranged rows of electrical compartments.

The molded-case circuit breakers are enclosed and supported by a housing of insulating material. The breakers are designed for manually closing and opening of the circuit, and to automatically open (trip) the circuit on current overload.

When the breaker is closed it powers a 480V / 120V control transformer. The control transformer provides power to the control circuit for operation of the starter contacts and light indication.

Most MCC buckets contain a motor starter for motor loads. Some MCC loads are equipped only with molded case circuit breakers and for non-motor loads. Examples of these loads are battery chargers, control panels, and room heaters. The circuits to these loads are energized and deenergized by manually opening or closing the MCC circuit breaker.

If off-site power is lost and cannot be restored quickly, the essential bus (LDC02) can be powered from the Backup DG which must be manually started and placed into service.

8.4.5 ANALYSIS

The electrical distribution system provides an essential support function for both the ISFPCS and the primary make-up capability. The design of the 12kV Ring Bus is safety class III (i.e., non-Class 1E electrical system), Quality Class III-AQ, and Seismic Category III consistent with the design of the ISFPCS and the primary make-up capability. The off-site power feed combined with the on-site diesel generator source provides redundancy of power sources consistent with the safety significance of the ISFPCS and primary make-up capability (see Reference 1).

8.5 REFERENCE

1. Letter, Marlayna Vaaler, NRC, to Mr. Thomas J. Palmisano, SCE, dated March 11, 2016, Re: San Onofre Nuclear Generating Station, Units 2 and 3 – Issuance of Amendments Modifying Licenses to Allow Changes to Specific Regulatory Guide Commitments.