

## **Persons Contacted**

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## **6.7 Coordination with Offsite Electrical Organizations**

### **a. Scope**

The team reviewed the design and maintenance practices off site electrical organization in order to assess factors that influenced electrical power Grid failure, the extend of the system failure and the corrective actions for preventing such failures.

### **b. Observations and Findings**

The loss of the Palo Verde 500kV grid, which disabled all the seven offsite power supplies for the nuclear stations, was due to the cascading effect of a wide area electrical isolation that originated from an electrical fault on a 230kV transmission line that remained un isolated for a period of 39 Sec., The selective tripping of the breakers to isolate problems at the West Wing 230Kv Substation, near the source of the fault, did not perform as required due to a relay failure and a design deficiency

The switchgear maintenance at the Palo Verde 500kV substation is performed by Salt River Project (SRP). The breakers undergo a yearly maintenance including a check of the SF6 tubing, pressure switches; a check of the air system for alarms and the operation of the compressor; breaker timing and operational check of the mechanisms.

The protective relaying is also inspected yearly. The relays' settings, software and firmware, operating characteristics, and communication circuits are verified for accuracy. The Palo Verde substation is manned by maintenance personnel during normal working hours for prompt identification of any evolving problems.

The licensee has calculated the onsite requirement for electrical voltage to be 512kV. They have directed the APS Energy Control Center (APS-ECC), the local transmission system operator, to provide voltage range of 525 to 535kV for the Palo Verde 500kV Substation. The Energy Control Center continued to provide voltage at the expected voltage band following the isolation of the fault.

The team concluded that the remedial measures taken and planned by the offsite electrical organizations would be an enhancement for preventing a cascading blackout in the Palo Verde 500kV substation.

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## **Design Improvement in West Wing Substation**

The primary cause for the cascading outage on the 500 kV Paloverde switch yard was the propagation of fault current from the 230kV to 500kV through the three lines that connected between 230kV and 500kV substations. The protection on these three lines was designed to detect only differential current within the line. In light of the recent event, the protection and metering department is considering adding an addition layer of protection on the three Palo Verde lines to prevent ground fault propagation between 230kV and 500 kV substations.

**Proprietary Information**

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