

**Palo Verde Nuclear Generating Station  
Sequence of Events  
on Monday, June 14, 2004**

- 07:41:03.966 493.1 cycles after fault #1 inception  
SC562 opened (McMicken 69kV Line)
- 07:41:04 (EMS) PSX832 closed auto  
(Perkins Cap-Bank Bypass)
  
- 07:41:05.373 577.6 cycles after fault #1 inception  
MQ562 opened (McMicken 69kV Line)
  
- 07:41:07.851 12.104 seconds after fault #1 inception  
PLX972 & PLX975 opened (Hassayampa 525kV Line #2)  
(Time stamp provided by SRP)
- 07:41:07.875 12.128 seconds after fault #1 inception  
PLX982 & PLX985 opened (Hassayampa 525kV Line #3)  
(Time stamp provided by SRP)
- 07:41:07.880 12.133 seconds after fault #1 inception  
PLX942 & PLX945 opened (Hassayampa 525kV Line #1)  
(Time stamp provided by SRP)
  
- 07:41:08.104 Fault #1 type changed = A-B-C-N
  
- 07:41:10.445 14.698 seconds after fault #1 inception  
NV1052 & NV1156 opened (Westwing 525kV Line)
  
- 07:41:10.456 14.709 seconds after fault #1 inception  
WW556 & WW652 opened (Navajo 525kV Line)
  
- 07:41:12 (EMS) WW424J opened (Westwing 230kV West Bus Reactor)
- 07:41:13 (EMS) HAAX912 & HAAX915 opened (Palo Verde 525kV Line #3)
- 07:41:13 (EMS) HAAX922 & HAAX925 opened (Palo Verde 525kV Line #2)
- 07:41:13 (EMS) HAAX932 opened (Palo Verde 525kV Line #1)
  
- 07:41:20.005 24.258 seconds after fault #1 inception  
PLX992 opened (Devers 525kV Line) (PLX995 out-of-service at  
this time)  
(Time stamp provided by SRP)
  
- 07:41:20.113 24.366 seconds after fault #1 inception  
PLX932 & PLX935 opened (Rudd 525kV Line)  
(Time stamp provided by SRP)

*Before  
Synchro  
Line*

*⇒ Open  
Conductor  
Sensing*

*⇒ Phase  
Differential  
Relay*

*20%  
Negative  
Sequence  
for 5sec*

*Other  
END  
of  
Hassayampa*

*B/20*

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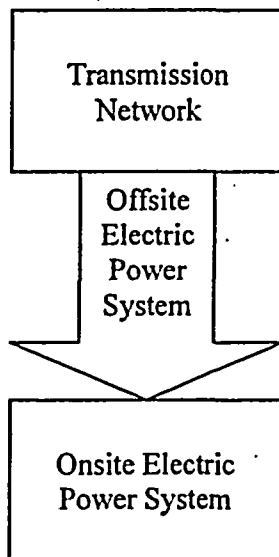
- 07:41:20.864 25.117 seconds after fault #1 inception  
PLX912 & PLX915 opened (Westwing 525kV Line #1)  
(Time stamp provided by SRP)
  
- 07:41:20.873 25.126 seconds after fault #1 inception  
WW1456 & WW1552 opened (Palo Verde 525kV Line #2)
  
- 07:41:20.874 25.127 seconds after fault #1 inception  
WW1156 & WW1252 opened (Palo Verde 525kV Line #1)
  
- 07:41:20.895 25.148 seconds after fault #1 inception  
PLX922 & PLX925 opened (Westwing 525kV Line #2)  
(Time stamp provided by SRP)
  
- 07:41:21 (EMS) RUX912 & RUX915 opened (Palo Verde 525kV Line)
  
- 07:41:23.848 28.101 seconds after fault #1 inception  
PLX988 opened (Palo Verde Unit-3)  
(Time stamp provided by SRP)
  
- 07:41:24.280 System Frequency = 59.514 Hz  
(Measured at APS Reach Substation)
  
- 07:41:24.641 28.894 seconds after fault #1 inception  
PLX918 opened (Palo Verde Unit-1)  
(Time stamp provided by SRP)
  
- 07:41:24.652 28.905 seconds after fault #1 inception  
PLX938 opened (Palo Verde Unit-2)  
(Time stamp provided by SRP)
  
- 07:41:34.615 38.868 seconds after fault #1 inception  
Fault #1 cleared
  
- 07:42:22.773 System Frequency = 59.770 Hz  
(Measured at APS Reach Substation)

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## Palo Verde Offsite Power Supply Compliance with GDC 17

The loss of offsite power event that occurred at Palo Verde on June 14, 2004 is classified as an "anticipated operational occurrence" as defined in 10CFR50 Appendix A: "...those conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit and include... loss of all offsite power." This is an analyzed design basis event as discussed in UFSAR section 15.2.6: LOSS OF NONEMERGENCY AC POWER TO THE STATION AUXILIARIES. A frequency of five loss of offsite power events in the life of a unit was assumed in the Palo Verde design (UFSAR Table 3.9-1.I.F.3.a).

General Design Criterion 17 discusses three elements of the power system: the transmission network, the offsite electric power system, and the onsite electric power system. These can be depicted as follows:



The offsite electric power system delivers power from the transmission network to the onsite electric power system. GDC 17 imposes certain design conditions on the offsite electric power supply as follows:

Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions.

The design of Palo Verde's offsite electric power system conforms to these conditions as discussed in UFSAR section 8.2.1.3.1. These design conditions specifically apply to the "two physically independent circuits" that deliver power from the transmission network to the onsite electric power system, and not to the transmission network, itself. Palo

Verde concurs with the NRC staff interpretation that there is no "requirement for meeting single failure, and in the absolute sense single failure cannot be met because there is only one power source, the grid."

There are many possible initiators for loss of offsite power events besides those that are prevented by proper design of the "two physically independent circuits". Certain other initiators are addressed in the Standard Review Plan (NUREG 0800). These are discussed in UFSAR section 8.2.2. This involves verification that:

...the system can withstand the following disturbances without loss of system stability or loss of load:

- A. A permanent 3-phase fault on the switchyard 525 kV bus with subsequent loss of the critical 525 kV line.
- B. A sudden loss of one of the three PVNGS units with no underfrequency load shedding measures in effect.
- C. The sudden loss of the largest single load on the Arizona-New Mexico-California-Southern Nevada system.

Implicit in this review is the recognition that there are other disturbances not discussed in NUREG 0800 that are more severe (but less likely) that could cause a loss of system stability resulting in a loss of offsite power event. One such disturbance, among many others, is a major fault in combination with failure of an electrical protective device to actuate as occurred on June 14.

Palo Verde recognizes the importance of minimizing the frequency of loss of offsite power events and is taking steps to eliminate the vulnerabilities disclosed by the June 14 event.

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2004-06-14 07:40

Westwing - Liberty 230kV Line (faulted line)

Elements affected:

525kV:

Westwing - Yavapai 525kV Line  
Westwing - Navajo 525kV Line  
Westwing - Palo Verde 525kV Line #1  
Westwing - Palo Verde 525kV Line #2  
Westwing - Perkins - Mead 525kV Line  
Palo Verde - Hassayampa 525kV Line #1  
Palo Verde - Hassayampa 525kV Line #2  
Palo Verde - Hassayampa 525kV Line #3  
Palo Verde - Rudd 525kV Line  
Palo Verde - Devers 525kV Line  
Hassayampa - Arlington 525kV Line

345kV:

Westwing - South 345kV Line

230kV:

Westwing - Agua Fria 230kV Line  
Westwing - Deer Valley 230kV Line  
Westwing - Pinnacle Peak 230kV Line  
Westwing - Surprise 230kV Line  
Westwing - Raceway 230kV Line  
Raceway - Waddell 230kV Line

69kV:

Westwing - Hedgepeth 69kV Line  
Westwing - Rio Vista 69kV Line  
Westwing - Westbrook 69kV Line  
Westwing - McMicken 69kV Line  
McMicken - Surprise 69kV Line  
McMicken - Morristown 69kV Line

Transformers:

Westwing 230/69kV Transformer #11  
Westwing 230/69kV Transformer #14  
Surprise 230/69kV Transformer #4  
Raceway 230/69kV Transformer #8  
McMicken 69/12.47kV Transformer #3

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Generation:

Palo Verde Unit-1  
Palo Verde Unit-2  
Palo Verde Unit-3  
Redhawk Steam Turbine 1  
Redhawk Combustion Turbine 1A  
Redhawk Combustion Turbine 2A

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- 07:40:55.747 Fault #1 inception  
    Fault #1 type = C-N  
    Fault #1 cause/location = Phase down reported near 115th Ave. &  
Union Hills (WW-LBX Line)
- 07:40:55.814 4.0 cycles after fault #1 inception  
    WW1126 opened (LBX / PPX 230kV crossover breaker)
- 07:40:55.822 8.5 cycles after fault #1 inception  
    LBX1282 opened (Westwing 230kV Line)
- 07:40:56.115 22.1 cycles after fault #1 inception  
    AFX732 & AFX735 opened (Westwing 230kV Line)
- 07:40:56.122 22.5 cycles after fault #1 inception  
    YP452 & YP852 opened (Westwing 525kV Line)
- 07:40:56.136 23.3 cycles after fault #1 inception  
    WW1426 & WW1522 opened (Agua Fria 230kV Line)
- 07:40:56.142 23.7 cycles after fault #1 inception  
    WW856 & WW952 opened (Yavapai 525kV Line)
- 07:40:56.165 25.1 cycles after fault #1 inception  
    DV322 & DV722 & DV962 opened (Westwing 230kV Line)
- 07:40:56.172 25.5 cycles after fault #1 inception  
    WW1726 & WW1822 opened (Deer Valley 230kV Line)
- 07:40:56.196 26.9 cycles after fault #1 inception  
    RWYX482 & RWYX582 & RWYX782 opened  
    (Westwing 230kV Line)  
    (Waddell 230kV Line)  
    (230/69kV Transformer #8)

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- 07:40:56.515 46.1 cycles after fault #1 inception  
WW1222 opened (Pinnacle Peak 230kV Line)
- 07:40:56.548 48.1 cycles after fault #1 inception  
SC622 & SC922 & SC262 opened (Surprise 230/69kV  
Transformer #4)
- 07:40:57.549 108.1 cycles after fault #1 inception  
SC1322 opened (Westwing 230kV Line)
- 07:40:58.339 155.5 cycles after fault #1 inception  
RIV762 opened (Westwing 69kV Line)
- 07:40:58.372 157.5 cycles after fault #1 inception  
HH762 opened (Westwing 69kV Line)
- 07:40:59 (EMS) WW2026 & WW2122 opened  
(Westwing 230/69kV Transformer #11 - High Side)
- 07:40:59.272 211.5 cycles after fault #1 inception  
WK362 opened (Westwing 69kV Line)
- 07:40:59.489 224.5 cycles after fault #1 inception  
HAAX935 & HAAX938 opened (Hassayampa - Arlington 525kV  
Line)  
(Time stamp provided by SRP)
- 07:41:00 (EMS) WW862 & WW962 & WW1362 opened  
(Westwing 230/69kV Transformer #11 - Low Side)
- 07:41:00.392 278.7 cycles after fault #1 inception  
WW752 opened (South 345kV Line)
- 07:41:01 (EMS) RWP-CT1A opened (Redhawk Combustion Turbine 1A)
- 07:41:01 (EMS) RWP-ST1 opened (Redhawk Steam Turbine 1) *Confirmed Next Sequence.*
- 07:41:01 (EMS) RWP-CT2A opened (Redhawk Combustion Turbine 2A)
- 07:41:01.982 Fault #1 type changed = B-C-N
- 07:41:02.154 Fault #1 type changed = C-N
- 07:41:02.799 Fault #1 type changed = B-C-N

} 500KV