

Engineering White Paper

13.8kV Breaker Failures during Loss of Switchyard Event on 6/14/04

Prepared by: J. Holmes, x2950

Revision 1

Background

On 6/14/04, while recovering offsite power to the three PVNGS units, 13.8kV circuit breakers 1ENANS06K and 3ENANS05D failed to close on demand from the control room. Electrical Maintenance and Engineering were dispatched to investigate. The breakers were moved to the test position, cycled closed and open several times, racked into the operating position and closed normally to re-energize the system. Closure problems with 1ENANS06K delayed restoration of offsite power to the unit 1 Train B 4160V bus and problems with 3ENANS05D delayed restoration of offsite power to the unit 3 Train A 4160V bus. Both of these busses were powered from their respective EDGs during this period.

Both of these breakers tripped normally as expected in response to the event.

Evaluation

The ENANS05 and S06 switchgear are located outdoors in the startup yard near the 525kV switchyard. These busses are cooled by ventilating fans that circulate unfiltered outside ambient air through them. During the daylight hours of the summer months, these switchgear are exposed to high temperature conditions that lead to drying out of the breaker lubricating grease. In addition, the unfiltered air leads to dirt accumulation.

Because these breakers provide offsite power to the units, including the class 1E 4160 busses, they are cycled every 18 months during refueling outages. This static condition exacerbates the effects of the high temperatures because the lubrication is never exercised and it becomes hard.

~~This situation was recognized several years ago. Procedure 32MT-9ZZ37 implements periodic overhaul of 13.8kV breakers. Originally, testing and overhaul of these breakers was scheduled to be completed every 4 refueling cycles for breakers that cannot be done online, or every 8 years for those that can be done online. In 2000, this schedule was reduced so that these breakers are tested and overhauled every 2 cycles (3 years).~~

From a work history standpoint, breaker 1ENANS06K was rebuilt on 01/01/2002 and installed in the cubicle on 10/18/2002. Breaker 3ENANS05D was rebuilt on 11/14/2002 and installed in the cubicle on 12/16/2002. Breaker 1ENANS06K was operated during the last refueling outage during the clean/inspect PM for the switchgear.

In addition, modification WO 2508436 was initiated to add air conditioning to the switchgear to provide cooling and reduce dirt intrusion. This mod is scheduled for implementation per the 3-cycle plan in late 2005 or early 2006.

One function of these breakers is to open to provide electrical protection during electrical disturbances. They properly tripped in response to the event. The second function of these breakers is to provide offsite power to the units. For this latter function, they must be closed. These breakers are presently closed and are therefore in their desired position.

Apparent Cause

The apparent cause of the breakers' failure to close is improper operation of the close latching mechanism due to poor lubrication and contamination by dirt. This is based on past experience and the success that was achieved by exercising them. Because of the urgency of power restoration, detailed troubleshooting to confirm this cause was not conducted. An electrical problem is not

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believed to be part of the problem because the close coil could be heard clicking during each of the 2 or more attempts made to close the breaker from the control room. This leaves only a problem of a mechanical nature with the breakers.

how r they sure?

Conclusion

Continued use of these breakers is acceptable based on their ability to properly automatically trip, the fact that they are in the desired position thus obviating the need to close them. Additional preventative maintenance actions may be instituted during the evaluation of the associated CRDR 2716019.

Should look @ schematic for CB control - check for more than one relay reading to pick up for closure