



Information Security Reminder

Information Security Reminder: OpE COMMs contain preliminary information in the interest of timely internal communication of operating experience. OpE COMMs may be pre-decisional and may contain sensitive information.

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Jesse Robles (2/3/2012 10:27:24 am)

Revised on 6/19/2013 6:57:38 am

Augmented Inspection - Wolf Creek Generating Station Loss of Offsite Power and Notification of Unusual Event

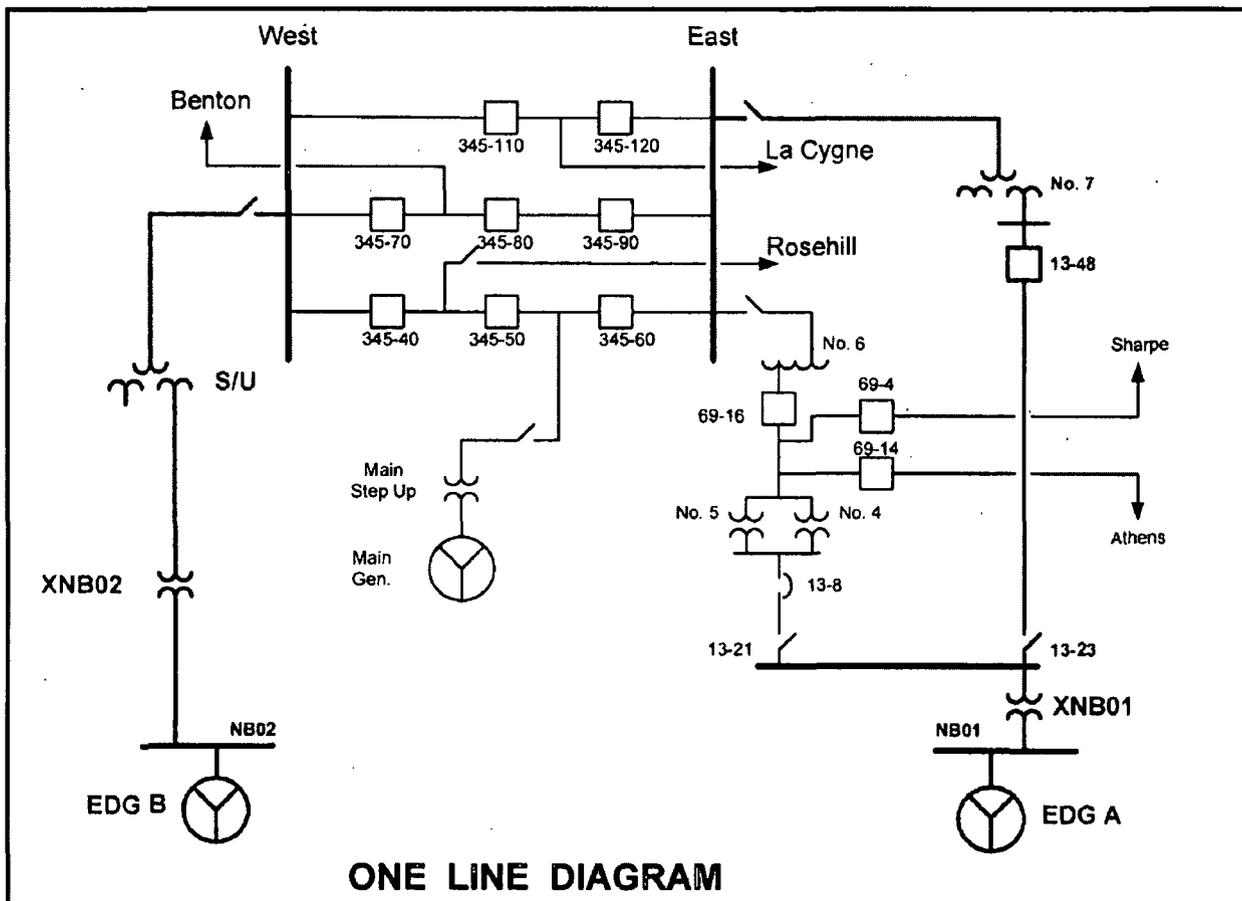
Note: The content of this OpE COMM will be updated periodically as new information becomes available from the AIT.

Summary

On January 13, 2012, Wolf Creek Generating Station experienced an automatic reactor trip and a loss of offsite power (LOOP). The site declared a Notification of Unusual Event (NOUE) (See [EN 47590](#), [PNO-IV-12-002](#), and [PNO-IV-002A](#)) as a result of the loss of offsite power. Several equipment issues were identified during the event, including ground alarms on an Emergency Diesel Generator (EDG), leaks on the Essential Service Water (ESW) system, an unexpected trip of the Turbine Driven Auxiliary Feedwater Pump (TDAFWP), and failure of a temporary diesel-driven fire pump (DFP). A Management Directive (MD) 8.3 evaluation was performed, and an Augmented Inspection Team (AIT) was sent to the site to gather additional information on the event.

Event Description

On January 13, 2012 at 2:03 p.m., the main generator output breaker 345-60 (see figure below) at Wolf Creek Generating Station failed and isolated the east switchyard bus, resulting in a turbine trip and subsequent reactor trip. A fast bus transfer did not occur as expected due to the actuation of the differential current relay for the startup transformer and the west bus was isolated. This resulted in both EDGs starting and loading. A Notification of Unusual Event (NOUE) was declared at 2:15 p.m. due to the loss of offsite power (LOOP).



Wolf Creek Electrical Distribution System

At 5:09 p.m. on January 13, Wolf Creek terminated the NOUE after offsite power was partially restored. The site started investigating the cause of the failure and determine necessary repairs. The plant was brought to the cold shutdown operating mode, with offsite power supplying safety-related loads and select non-vital loads and both emergency diesel generators were secured. The licensee restored power to most of the plant systems on January 17 after verifying that the non-vital switchboards were safe to energize.

During the event, the following unexpected issues occurred:

- A ground alarm was received for the field circuit on the B EDG. The EDG continued to run with normal output. The licensee initially believed that the cause of the ground alarm was failure of the varistor (non-linear resistor) on the generator field ground detection (DGF) relay. However, this cause was ruled after an actual ground was found to exist in the generator field circuit. The ground was found in one of the leads between the slip-rings and the pole pieces. This issue occurred on a similar EDG at Limerick (See Inspection Report). A similar issue occurred in a commercial EDG in 1980, and was the subject of a Part 21 and NRC Circular 80-23.
- The ESW piping associated with the C containment cooler developed a 5 gpm leak inside containment, necessitating a containment entry shortly after the trip to determine the unknown source of containment sump in-leakage. This leak may have been caused by a hydrodynamic transient (water hammer) that was the result of the ESW pumps shutting off during the LOOP and restarting during the EDG load sequencing. This phenomenon has been experienced at the site before. See SOER 09-01, SER 2-08, and LER

4822008004R01. The piping section where the leak occurred had never been inspected due to an oversight by licensee staff. Other portions of piping have since been discovered that have never been inspected. The licensee is inspecting those portions and repairing as necessary.

- A 780 gallon void formed in the reactor vessel head region during the natural circulation cooldown. Operators did not identify this condition when a step in the Emergency Operating Procedure ES-04, "Natural Circulation Cooldown" prompted them to check for a void. Operators continued through the procedure, and the void eventually collapsed itself as they continued to cool down. (See Operating Experience below).
- The turbine-driven auxiliary feedwater pump (TDAFWP) tripped while operators were shutting down the pump. The trip lever was found in the actuated position. The motor-driven auxiliary feedwater pumps' (MDAFWP) flow control valves had previously identified material issues that made controlling them difficult, which led the operators to rely on the TDAFW pumps for an extended period of time. This led to the pump being operated at steam pressures that were lower than those recommended by the vendor (see Callaway SIT Report on an event where the TDAFWP was run at low steam pressures). A possible cause for the overspeed mechanism actuation is vibration induced by operating at lower pressures, coupled with inadequate tolerances in the trip mechanism.
- The diesel-driven fire pump (DFP) had been out of service and a temporary DFP had been in service. The temporary DFP failed, causing the loss of fire water for a period of 9 hours. The loss of fire water was not identified for approximately 4 hours into the event. The loss of the DFP complicated efforts to provide makeup to the Condensate Storage Tank (CST). In addition, the licensee identified problems with priming and the possibility of ingesting mud from the lake bottom. A fire truck was staged as a standby for the DFP.
- One pressurizer power operated relief valve (PORV) cycled eighteen times during the event. The other PORV had previously experience seat leakage and had its associated block valve shut at the time of the event.
- A source range nuclear instrument channel (N-31) indicated higher than expected, which could have impacted the ability to verify adequate shutdown margin existed. This was a known issue, and the NI had been replaced several times. This phenomenon occurs when cavity cooling is lost. The licensee is still investigating the cause of the NI-31 deviation
- The switchyard events recorder did not function, complicating assessment of the event.
- An emergency modification was performed to cut a hole in the Chemistry Building bulkhead to supply temporary power to the chemistry lab. This was performed to facilitate shutdown margin calculations and boration for plant cooldown. Although this is the preferred method, there were alternate means of ensuring shutdown margin calculations during the event.
- Temporary power was supplied to the sump pumps associated with the TDAFW pump steam drains, which collected inside the auxiliary building.
- Temporary power was supplied to EDG starting air compressors to ensure the full capability to restart EDGs, if needed.
- Temporary power was supplied to the train A ESF transformer auxiliaries to ensure continued transformer operation (the only source of offsite power at the time).
- All three methods of Reactor Coolant System (RCS) leakage detection were lost as a result of the LOOP.

In response to the event, Region IV performed a MD 8.3 evaluation. The Incremental Conditional Core Damage Probability (ICCDP) was estimated to be $8E-5$, which is in the SIT/AIT overlap range. Additionally, deterministic criteria item D, "Led to the loss of a safety function or multiple failures in systems used to mitigate an actual event," and item G, "Involved repetitive failures or events involving safety-related equipment or deficiencies in operations," were met. After consulting with NRR, the Region dispatched an AIT to the site to obtain more information on the event (see AIT Charter).

Update on 9/25/2012

An AIT follow-up inspection was completed and the AIT report and supplemental inspection report are available. The thirteen unresolved items resulted in four green findings and one yellow finding. The yellow finding involved the licensee's failure to provide adequate oversight of contractors while they performed work that could affect safety-related equipment. The licensee failed to identify that electrical maintenance contractors had not installed insulating sleeves on wires affecting the differential current protection circuit. See Final Significance Determination Letter. The other findings were related to an inadequate procedure for the TDAFW overspeed mechanism, failure to take corrective actions to preclude ESW leaks (see IR 2012006), failure to have appropriate procedures for fire protection compensatory measures, and failure to identify and correct a condition adverse to fire protection.

Update on 6/19/2013

INPO issued IER 2-12-27 on April 5, 2012 describing the event and multiple causes and corrective actions.

Similar Events and Previous Operating Experience (OpE)

Recent Wolf Creek LOOP Events

LER 4822009002R00 - Loss of Offsite Power Due to Lightning Strike, event date: 8/19/2009

LER 4822008004R00 - Loss of Power Event When the Reactor was Defueled, event date: 4/7/2007

LER 4822008004R01 - Loss of Power Event When the Reactor was Defueled - Revision 1

Wolf Creek Inspection Report 2011004 - See Section 1R04 describing that On July 21, 2011, the inspectors identified a Green finding for degraded switchyard components that caused a loss of offsite power.

EDG Ground Detection OpE

DGF Information Sheet

IEEE Paper on Generator Field Ground Detection

Ground on EDG field at Limerick (See Inspection Report).

NRC Circular 80-23.

ESW Water Hammer Events and OpE

Wolf Creek Inspection Report 2009007 - See Section 1R2.3.c.2 (page 14) describing a Green non-cited violation involving the Wolf Creek August 19, 2009 loss of offsite power induced pressure transient on the essential service water system. The pressure transient resulted in significant leakage from the system and required immediate repair.

LER 3462003009 - Davis-Besse - Loss of Offsite Power Due to Degraded Regional Grid Voltage

LER 4401991024R01 - Perry - Loss of Emergency Service Water System Loop Due to Inadvertent Isolation of Keepfill System

LER 3871983066R01 - Susquehanna - Update on Emergency Service Water Check Valve Failure

NRC Generic Letter 96-06 - Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions

Review of Callaway Waterhammer and Two-Phase Flow Analysis - See Section 4 - Waterhammer Analysis

Head Voiding During Natural Circulation Cooldown OpE

St. Lucie Natural Circulation Cooldown Event:

[NRC IE Circular 80-15](#)

[NRC Generic Letter 81-21](#)

[Generic Safety Issue 31](#)

[INPO SOER 81-07](#)

[INPO SOER 81-06](#)

[INPO SOER 81-05](#)

[INPO SOER 81-04](#)

Other Head Void Issues, Events, and Information

[NRC IE Circular 81-10](#)

[Fort Calhoun Inspection Report 2008003](#) - See section 40A3.1

[Watts Bar Ops Guidance Report](#)

Turbine-Driven Auxiliary Feedwater Pump OpE

[Callaway SIT Report for TDAFW pump.](#)

For questions or concerns related to this OpE COMM, contact Jesse Robles (jesse.robles@nrc.gov), 301-415-2940.

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