UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 12, 2017

Mr. Adam C. Heflin
President, Chief Executive Officer,
and Chief Nuclear Officer
Wolf Creek Nuclear Operating Corporation
Post Office Box 411
Burlington, KS 66839

SUBJECT: WOLF CREEK GENERATING STATION – ACCIDENT SEQUENCE PRECURSOR ANALYSIS (LICENSEE EVENT REPORT 2016-001-01)

Dear Mr. Heflin:

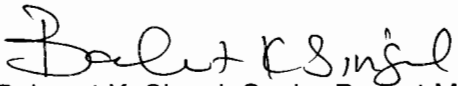
By letter dated March 28, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16095A207), as supplemented by letter dated November 10, 2016 (ADAMS Accession No. ML16326A175), Wolf Creek Nuclear Operating Corporation (WCNOC) submitted Licensee Event Report (LER) 2016-001-01, "Power Potential Transformer Overloading Results in Emergency Diesel Generator Inoperability," to the U.S. Nuclear Regulatory Commission (NRC) staff pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.73(a)(2)(i)(B) and 10 CFR 50.73(a)(2)(v)(B), (C), and (D). The LER describes the event of October 6, 2014, when a fire in one of the electrical cabinets resulted in an unexpected trip of one of the emergency diesel generators at Wolf Creek Generating Station (WCGS). The event also resulted in an unplanned entry into a 72-hour shutdown limiting condition for operation and an ALERT emergency classification.

As per the guidance in NRC Regulatory Issue Summary (RIS) 2006-24, "Revised Review and Transmittal Process for Accident Sequence Precursor Analyses" (ADAMS Accession No. ML060900007), the NRC staff reviewed the event at WCGS based on information provided in the LER to identify potential precursors and to determine the probability of an event leading to a core damage state resulting from the potential precursors.

The results of the NRC staff accident sequence precursor (ASP) analysis for the subject operational event on October 6, 2014, at WCGS, are provided in the enclosure to this letter for WCNOC's information. The NRC staff did not request a formal review by WCNOC since the results of the ASP analysis determined that the operational even had a best estimate increase in core damage probability (ΔCDP) of 2×10^{-6}, which is less than threshold of ΔCDP of 1×10^{-4} for a low risk event provided by RIS 2006-04.

If you have any questions, please contact me at 301-415-3016 or via e-mail at Balwant.Singal@nrc.gov.

Sincerely,



Balwant K. Singal, Senior Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure
WCGS Final ASP Program
Analysis - Precursor

cc w/encl: Distribution via Listserv

ENCLOSURE

FINAL ACCIDENT SEQUENCE PROGRAM ANALYSIS – PRECURSOR

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

Final ASP Program Analysis - Precursor

Accident Sequence Precursor Program – Office of Nuclear Regulatory Research			
Wolf Creek Generating Station	Power Potential Transformer Overloading Results in Emergency Diesel Generator Inoperability		
Event Date: 10/6/2014	**LER:** 482-2016-001-01 **IR(s):** 05000482/2016008		**ΔCDP=** 2×10^{-6}
Plant Type: Westinghouse PWR-4 with a Dry, Ambient Pressure Containment			
Plant Operating Mode (Reactor Power Level): Mode 1 (100% Reactor Power)			
Analyst: Keith Tetter	**Reviewer:** Chris Hunter	**Contributors:** David Aird	**BC Approved Date:** 04/12/2017

EXECUTIVE SUMMARY

On October 6, 2014, at 1:26 p.m. during a scheduled 24-hour run, the 'B' emergency diesel generator (EDG) unexpectedly tripped and a fire was observed in control cabinet NE106. Just prior to the trip, operations personnel observed vapor coming from NE106 and identified the source as the power potential transformer (PPT). The vapor was a deficiency first identified during a post maintenance test run on June 11, 2014. The PPT exhibited the same symptoms during the subsequent surveillances after June 11, 2014. The 'B' EDG was repaired and declared operable on October 9th at 5:17 p.m.

A failure investigation concluded that the smoking and eventual failure of the PPT on October 6th was most likely due to overloading caused from a failed diode that occurred during load transients on June 9, 2014. Therefore, the 'B' EDG would not have been able to fulfill its safety function for the complete mission time from June 9th until October 9th. Note that the 'B' EDG had run successfully in the previous three monthly surveillance tests (for a total of approximately 6 hours). During the June–October time period, the 'A' EDG was taken out of service for maintenance on July 21, 2014, creating a condition where both trains may have been inoperable. Therefore, an independent accident sequence precursor (ASP) analysis was performed given the windowed unavailability. When the 'A' and 'B' EDGs are inoperable, there are no remaining safety-related onsite standby alternating current (AC) sources.

According to the risk analysis modeling assumptions used in this ASP analysis, the most likely core damage scenario is weather-related loss of offsite power (LOOP) initiating event, successful reactor trip, emergency power system failure results in station blackout (SBO), auxiliary feedwater (AFW) succeeds, reactor coolant pump (RCP) seal integrity is maintained, operators fail to recover power prior to battery depletion (8 hours), operators successfully maintain AFW without direct current (DC) power, and operators fail to restore offsite power within 24 hours. This accident sequence accounts for approximately 27 percent of the increase in core damage probability (ΔCDP) for the event. The point estimate ΔCDP for this event is 2×10^{-6}, which is considered a precursor in the ASP Program.

EVENT DETAILS

Event Description. On October 6, 2014, at 1:26 p.m. during a scheduled 24-hour run, the 'B' EDG unexpectedly tripped and a fire was observed in control cabinet NE106. Just prior to the trip, operations personnel observed vapor coming from NE106 and identified the source as the PPT. The vapor was a deficiency first identified during a post maintenance test run on June 11, 2014. The PPT exhibited the same symptoms during the subsequent surveillances after June 11, 2014. The 'B' EDG was repaired and declared operable on October 9th at 5:17 p.m.

A failure investigation was performed using available site information as well as offsite hardware failure analysis, modeling, testing, and third party reviews. It was concluded that the smoking and eventual failure of the PPT on October 6th was most likely due to overloading. The overloading of the PPT resulted from failure of a diode in the power rectifier of the EDG excitation system. Failure of the diode occurred during load transients on June 9, 2014, resulting from a governor actuator malfunction. Therefore, the 'B' EDG would not have been able to fulfill its safety function for the completed mission time from June 9th until October 9th; however, note that the EDG had run successfully in the previous three monthly surveillance tests (for a total of approximately 6 hours).

During the June–October time period, the 'A' EDG was taken out of service for maintenance on July 21, 2014, creating a condition where both trains may have been inoperable. When the 'A' and 'B' EDGs are inoperable, there are no remaining safety-related onsite standby AC sources. Additional information is provided in licensee event report (LER) 482-2016-001-01 (Reference 1) and inspection reports (IRs) 05000482/2016004 (Reference 2) and 05000482/2016008 (Reference 3).

Cause. The direct cause of the event is identified as a single diode failure, induced by the governor actuator malfunction on June 9, 2014. The diode failure led to the thermal failure of the PPT.

Additional Event Information. This event occurred on October 6, 2014, but the LER was not available until 2016. There was a delay between the event and LER report because the licensee's evaluation of the issue and cause evaluation/conclusions initially determined that the failure was as a result of thermal degradation of the failed diode(s). Considering this failure mechanism, it was not initially clear that the station was in a reportable condition. The licensee completed additional hardware failure analyses on January 28, 2016, and revised its conclusions (specifically, the licensee determined that a diode had failed in June 2014) so the licensee submitted Revision 0 of LER 482-2016-001 on March 28, 2016. Revision 1 of LER 482-2016-001 was issued on November 10, 2016.

MODELING

Basis for ASP Analysis/Significant Determination Process Results. The ASP Program uses significant determination process results for degraded conditions when available and applicable. The ASP Program performs independent analyses for initiating events. ASP analyses of initiating events account for all failures/degraded conditions and unavailability (e.g., equipment out for test/maintenance) that occurred during the event, regardless of licensee

performance.[1] An independent ASP analysis was required because both safety-related EDGs were unavailable at the same time due to different causes.

NRC inspectors, in IR 05000482/2016004, re-characterized the preliminary *White* finding (as documented in IR 05000482/2016008) for failure to adequately develop and adjust preventative maintenance activities for EDG excitation system diodes to a *Green* finding due to new testing results that showed that over half of the excitation system diodes that were originally installed in the emergency diesel generators had manufacturing defect flaws that reduced their ability to withstand load transients such as the transients experienced on June 9, 2014, and for the lack of overlap in SBO diesel generators unavailability with EDG unavailability that was originally considered as concurrent SBO diesel generators and EDG unavailability, which resulted in the *White* finding. NRC inspectors discovered additional overpower transients that occurred on June 29, 1999, and December 20, 2007, which were in excess of the 1.4 megawatt threshold for damage as described by the licensee and that these previous overpower transients would have been expected to cause damage to excitation system diodes with pre-existing flaws, and determined that a transient-related aging mechanism caused degradation of the diodes and contributed to the failure of a diode on June 9, 2014, as predicted by the operating experience.

Analysis Type. A condition assessment was performed using the Wolf Creek Standardized Plant Analysis Risk (SPAR) model Revision 8.26, created in February 2015.

SPAR Model Modifications. The following SPAR model modifications were required for this condition assessment.[2]

- To prevent potential double counting of consequential LOOP events, the ACP-NB01-4 (*Loss of Offsite Power to Bus NB01 from 13.8kV*) and ACP-NB02-5 (*Loss of Offsite Power to Bus NB02 from 13.8kV*) gates were removed from the ACP-NB01 (*Wolf Creek Power from 4160V AC Bus NB01*) and ACP-NB02 (*Wolf Creek Power from 4160V AC Bus NB02*) faults trees, respectively.

Exposure Periods. In order to model this event, the analyst identified the following seven distinct exposure periods, determined with assistance from Table 1 of IR 05000482/2016008, which listed EDG run times on different dates, referred to as EP-1 through EP-7:

- EP-1 consists of the 3-day period from June 9, 2014, to June 11, 2014, when the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 16 hours.

- EP-2 consists of the 28-day period from June 11, 2014, to July 9, 2014, when the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 9 hours.

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1 ASP analyses also account for any degraded condition(s) that were identified after the initiating event occurred if the failure/degradation exposure period(s) overlapped the initiating event date.

2 In addition, basic events EPS-XHE-XL-NR01H (*Operator Fails to Recover Emergency Diesel in 1 Hour*), EPS-XHE-XL-NR02H (*Operator Fails to Recover Emergency Diesel in 2 Hours*), EPS-XHE-XL-NR03H (*Operator Fails to Recover Emergency Diesel in 3 Hour*), EPS-XHE-XL-NR04H (*Operator Fails to Recover Emergency Diesel in 4 Hour*), EPS-XHE-XL-NR6H (*Operator Fails to Recover Emergency Diesel in 6 Hours*), EPS-XHE-XL-NR8H (*Operator Fails to Recover Emergency Diesel in 8 Hours*), and EPS-XHE-XL-NR24H8 (*Operator Fails to Recover Emergency Diesel in 24 Hours (Given Failure at 8*) were set to TRUE in the base model. These basic events are set to TRUE for applicable ASP condition assessments and their use is limited to cases where event information supports credit for EDG recovery.

- EP-3 consists of the 27-day period from July 9, 2014, to August 6, 2014, (subtracting the day for EP-7) when the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 7 hours.

- EP-4 consists of the 33-day period from August 6, 2014, to September 8, 2014, when the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 5 hours.

- EP-5 consists of the 28-day period from September 8, 2014, to October 6, 2014, when the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 3 hours.

- EP-6 consists of the 3-day period from October 6, 2014, to October 9, 2014, when the 'B' EDG was failed and undergoing repairs.

- EP-7 consists of the one day period July 21, 2014, when the 'A' EDG was inoperable and the 'B' EDG would have failed to run for its full 24-hour mission time, but could have possibly run for 7 hours.

Key Modeling Assumptions. The following assumptions were determined to be significant to the modeling of this event:

For all exposure periods:

- The failure of 'B' EDG is modeled by setting basic event EPS-DGN-FR-NE02 (*Diesel Generator NE02 Fails to Run*) to TRUE because the 'B' EDG would have failed to run for its 24-hour mission during a postulated LOOP initiating event.

For EP-1:

- The 'B' EDG could potentially have run for 16 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 16 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	8.455E-3
OEP-XHE-XL-NR01HPC	3.309E-1	7.157E-3
OEP-XHE-XL-NR01HSC	4.015E-1	9.867E-3
OEP-XHE-XL-NR01HWR	6.868E-1	1.846E-1
OEP-XHE-XL-NR02HGR	3.915E-1	7.240E-3
OEP-XHE-XL-NR02HPC	1.763E-1	6.389E-3
OEP-XHE-XL-NR02HSC	2.240E-1	8.814E-3
OEP-XHE-XL-NR02HWR	5.589E-1	1.773E-1
OEP-XHE-XL-NR03HGR	2.496E-1	6.236E-3
OEP-XHE-XL-NR03HPC	1.117E-1	5.731E-3
OEP-XHE-XL-NR03HSC	1.453E-1	7.909E-3
OEP-XHE-XL-NR03HWR	4.800E-1	1.705E-1

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR04HGR	1.685E-1	5.399E-3
OEP-XHE-XL-NR04HPC	7.753E-2	5.163E-3
OEP-XHE-XL-NR04HSC	1.024E-1	7.127E-3
OEP-XHE-XL-NR04HWR	4.244E-1	1.642E-1
OEP-XHE-XL-NR06HGR	8.686E-2	4.106E-3
OEP-XHE-XL-NR06HPC	4.365E-2	4.240E-3
OEP-XHE-XL-NR06HSC	5.866E-2	5.854E-3
OEP-XHE-XL-NR06HWR	3.487E-1	1.529E-1
OEP-XHE-XL-NR08HGR	5.005E-2	3.175E-3
OEP-XHE-XL-NR08HPC	2.781E-2	3.528E-3
OEP-XHE-XL-NR08HSC	3.774E-2	4.873E-3
OEP-XHE-XL-NR08HWR	2.982E-1	1.431E-1

For EP-2:

- The 'B' EDG could potentially have run for 9 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 9 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	3.111E-2
OEP-XHE-XL-NR01HPC	3.309E-1	1.911E-2
OEP-XHE-XL-NR01HSC	4.015E-1	2.610E-2
OEP-XHE-XL-NR01HWR	6.868E-1	2.616E-1
OEP-XHE-XL-NR02HGR	3.915E-1	2.507E-2
OEP-XHE-XL-NR02HPC	1.763E-1	1.617E-2
OEP-XHE-XL-NR02HSC	2.240E-1	2.214E-2
OEP-XHE-XL-NR02HWR	5.589E-1	2.466E-1
OEP-XHE-XL-NR03HGR	2.496E-1	2.044E-2
OEP-XHE-XL-NR03HPC	1.117E-1	1.383E-2
OEP-XHE-XL-NR03HSC	1.453E-1	1.897E-2
OEP-XHE-XL-NR03HWR	4.800E-1	2.334E-1
OEP-XHE-XL-NR04HGR	1.685E-1	1.684E-2
OEP-XHE-XL-NR04HPC	7.753E-2	1.195E-2
OEP-XHE-XL-NR04HSC	1.024E-1	1.641E-2
OEP-XHE-XL-NR04HWR	4.244E-1	2.216E-1
OEP-XHE-XL-NR06HGR	8.686E-2	1.175E-2
OEP-XHE-XL-NR06HPC	4.365E-2	9.127E-3
OEP-XHE-XL-NR06HSC	5.866E-2	1.257E-2
OEP-XHE-XL-NR06HWR	3.487E-1	2.014E-1
OEP-XHE-XL-NR08HGR	5.005E-2	8.455E-3
OEP-XHE-XL-NR08HPC	2.781E-2	7.157E-3
OEP-XHE-XL-NR08HSC	3.774E-2	9.867E-3
OEP-XHE-XL-NR08HWR	2.982E-1	1.846E-1

For EP-3:

- The 'B' EDG could potentially have run for 7 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core

uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 7 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	5.005E-2
OEP-XHE-XL-NR01HPC	3.309E-1	2.781E-2
OEP-XHE-XL-NR01HSC	4.015E-1	3.774E-2
OEP-XHE-XL-NR01HWR	6.868E-1	2.982E-1
OEP-XHE-XL-NR02HGR	3.915E-1	3.915E-2
OEP-XHE-XL-NR02HPC	1.763E-1	2.287E-2
OEP-XHE-XL-NR02HSC	2.240E-1	3.116E-2
OEP-XHE-XL-NR02HWR	5.589E-1	2.786E-1
OEP-XHE-XL-NR03HGR	2.496E-1	3.111E-2
OEP-XHE-XL-NR03HPC	1.117E-1	1.911E-2
OEP-XHE-XL-NR03HSC	1.453E-1	2.610E-2
OEP-XHE-XL-NR03HWR	4.800E-1	2.616E-1
OEP-XHE-XL-NR04HGR	1.685E-1	2.507E-2
OEP-XHE-XL-NR04HPC	7.753E-2	1.617E-2
OEP-XHE-XL-NR04HSC	1.024E-1	2.214E-2
OEP-XHE-XL-NR04HWR	4.244E-1	2.466E-1
OEP-XHE-XL-NR06HGR	8.686E-2	1.684E-2
OEP-XHE-XL-NR06HPC	4.365E-2	1.195E-2
OEP-XHE-XL-NR06HSC	5.866E-2	1.641E-2
OEP-XHE-XL-NR06HWR	3.487E-1	2.216E-1
OEP-XHE-XL-NR08HGR	5.005E-2	1.175E-2
OEP-XHE-XL-NR08HPC	2.781E-2	9.127E-3
OEP-XHE-XL-NR08HSC	3.774E-2	1.257E-2
OEP-XHE-XL-NR08HWR	2.982E-1	2.014E-1

For EP-4:

- The 'B' EDG could potentially have run for 5 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 5 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	8.686E-2
OEP-XHE-XL-NR01HPC	3.309E-1	4.365E-2
OEP-XHE-XL-NR01HSC	4.015E-1	5.866E-2
OEP-XHE-XL-NR01HWR	6.868E-1	3.487E-1
OEP-XHE-XL-NR02HGR	3.915E-1	6.520E-2
OEP-XHE-XL-NR02HPC	1.763E-1	3.444E-2
OEP-XHE-XL-NR02HSC	2.240E-1	4.654E-2
OEP-XHE-XL-NR02HWR	5.589E-1	3.213E-1
OEP-XHE-XL-NR03HGR	2.496E-1	5.005E-2
OEP-XHE-XL-NR03HPC	1.117E-1	2.781E-2
OEP-XHE-XL-NR03HSC	1.453E-1	3.774E-2
OEP-XHE-XL-NR03HWR	4.800E-1	2.982E-1
OEP-XHE-XL-NR04HGR	1.685E-1	3.915E-2
OEP-XHE-XL-NR04HPC	7.753E-2	2.287E-2

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR04HSC	1.024E-1	3.116E-2
OEP-XHE-XL-NR04HWR	4.244E-1	2.786E-1
OEP-XHE-XL-NR06HGR	8.686E-2	2.507E-2
OEP-XHE-XL-NR06HPC	4.365E-2	1.617E-2
OEP-XHE-XL-NR06HSC	5.866E-2	2.214E-2
OEP-XHE-XL-NR06HWR	3.487E-1	2.466E-1
OEP-XHE-XL-NR08HGR	5.005E-2	1.684E-2
OEP-XHE-XL-NR08HPC	2.781E-2	1.195E-2
OEP-XHE-XL-NR08HSC	3.774E-2	1.641E-2
OEP-XHE-XL-NR08HWR	2.982E-1	2.216E-1

For EP-5:

- The 'B' EDG could potentially have run for 3 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 3 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	1.685E-1
OEP-XHE-XL-NR01HPC	3.309E-1	7.753E-2
OEP-XHE-XL-NR01HSC	4.015E-1	1.024E-1
OEP-XHE-XL-NR01HWR	6.868E-1	4.244E-1
OEP-XHE-XL-NR02HGR	3.915E-1	1.189E-1
OEP-XHE-XL-NR02HPC	1.763E-1	5.702E-2
OEP-XHE-XL-NR02HSC	2.240E-1	7.605E-2
OEP-XHE-XL-NR02HWR	5.589E-1	3.822E-1
OEP-XHE-XL-NR03HGR	2.496E-1	8.686E-2
OEP-XHE-XL-NR03HPC	1.117E-1	4.365E-2
OEP-XHE-XL-NR03HSC	1.453E-1	5.866E-2
OEP-XHE-XL-NR03HWR	4.800E-1	3.487E-1
OEP-XHE-XL-NR04HGR	1.685E-1	6.520E-2
OEP-XHE-XL-NR04HPC	7.753E-2	3.444E-2
OEP-XHE-XL-NR04HSC	1.024E-1	4.654E-2
OEP-XHE-XL-NR04HWR	4.244E-1	3.213E-1
OEP-XHE-XL-NR06HGR	8.686E-2	3.915E-2
OEP-XHE-XL-NR06HPC	4.365E-2	2.287E-2
OEP-XHE-XL-NR06HSC	5.866E-2	3.116E-2
OEP-XHE-XL-NR06HWR	3.487E-1	2.786E-1
OEP-XHE-XL-NR08HGR	5.005E-2	2.507E-2
OEP-XHE-XL-NR08HPC	2.781E-2	1.617E-2
OEP-XHE-XL-NR08HSC	3.774E-2	2.214E-2
OEP-XHE-XL-NR08HWR	2.982E-1	2.466E-1

For EP-6:

- While the 'B' EDG was undergoing repair, technical specifications would prevent test/maintenance activities that would render certain equipment unavailable. Therefore, basic events AFW-TDP-TM-PAL02 (*Feed Pump PAL02 is in Test or Maintenance*), EPS-DGN-TM-NE01 (*Diesel Generator NE01 Unavailable due to Test and*

Maintenance), ESW-MDP-TM-1A (*ESW Train A MDP 1A Unavailable due to Test or Maintenance*), and ESW-SYS-TM-TRAINA (*Service Water Train A Unavailable Due To Maintenance*) were set to FALSE.

For EP-7:

- The failure of 'A' EDG is modeled by setting basic event EPS-DGN-TM-NE01 to TRUE.
- The 'B' EDG could potentially have run for 7 hours during this exposure period; therefore additional time may be available to operators to recover offsite power (prior to either core uncovery or battery depletion) for postulated SBO scenarios. This credit is provided by setting the probability of basic events in the following table to probabilities equivalent to the offsite power non-recovery probabilities for those with 7 hours additional time.

Basic Event	Initial Probability	Revised Probability
OEP-XHE-XL-NR01HGR	6.587E-1	5.005E-2
OEP-XHE-XL-NR01HPC	3.309E-1	2.781E-2
OEP-XHE-XL-NR01HSC	4.015E-1	3.774E-2
OEP-XHE-XL-NR01HWR	6.868E-1	2.982E-1
OEP-XHE-XL-NR02HGR	3.915E-1	3.915E-2
OEP-XHE-XL-NR02HPC	1.763E-1	2.287E-2
OEP-XHE-XL-NR02HSC	2.240E-1	3.116E-2
OEP-XHE-XL-NR02HWR	5.589E-1	2.786E-1
OEP-XHE-XL-NR03HGR	2.496E-1	3.111E-2
OEP-XHE-XL-NR03HPC	1.117E-1	1.911E-2
OEP-XHE-XL-NR03HSC	1.453E-1	2.610E-2
OEP-XHE-XL-NR03HWR	4.800E-1	2.616E-1
OEP-XHE-XL-NR04HGR	1.685E-1	2.507E-2
OEP-XHE-XL-NR04HPC	7.753E-2	1.617E-2
OEP-XHE-XL-NR04HSC	1.024E-1	2.214E-2
OEP-XHE-XL-NR04HWR	4.244E-1	2.466E-1
OEP-XHE-XL-NR06HGR	8.686E-2	1.684E-2
OEP-XHE-XL-NR06HPC	4.365E-2	1.195E-2
OEP-XHE-XL-NR06HSC	5.866E-2	1.641E-2
OEP-XHE-XL-NR06HWR	3.487E-1	2.216E-1
OEP-XHE-XL-NR08HGR	5.005E-2	1.175E-2
OEP-XHE-XL-NR08HPC	2.781E-2	9.127E-3
OEP-XHE-XL-NR08HSC	3.774E-2	1.257E-2
OEP-XHE-XL-NR08HWR	2.982E-1	2.014E-1

ANALYSIS RESULTS

ΔCDP. The point estimate ΔCDP for this event is 1.9×10^{-6}. The ASP Program acceptance threshold is a ΔCDP of greater than 1×10^{-6}. Therefore, this event is a precursor. The following table provides the ΔCDP breakdown for each exposure period.

Exposure Period	ΔCDP
EP-1	3.0×10^{-8}
EP-2	3.3×10^{-7}
EP-3	3.4×10^{-7}
EP-4	4.7×10^{-7}
EP-5	4.8×10^{-7}
EP-6	3.9×10^{-8}
EP-7	2.2×10^{-7}
TOTAL	**1.9×10^{-6}**

Dominant Sequence. The dominant accident sequence is weather-related LOOP (LOOPWR) Sequence 16-06-4 (ΔCDP = 5.2×10^{-7}) that contributes 27 percent of the total internal events ΔCDP. Figures A-1 through A-3 in Appendix A illustrates this sequence. The dominant sequences that contribute at least 1 percent of the total internal events CCDP are provided in the following table.

Sequence	ΔCDP	Percentage	Description
LOOPWR 16-06-04	5.2E-07	27.2%	Weather-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP seal integrity is maintained; operators fail to recover power prior to battery depletion (8 hours); operators successfully maintain AFW without DC power; operators fail to restore offsite power within 24 hours
LOOPWR 16-09	2.2E-07	11.7%	Weather-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a loss-of-coolant accident (LOCA); operators fail to restore offsite power within 4 hours
LOOPGR 16-07-2	2.1E-07	10.8%	Grid-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators successfully restore offsite power within 4 hours, high-pressure injection (HPI) succeeds, secondary cooldown/depressurization succeeds, low-pressure recirculation fails
LOOPSC 16-07-2	1.8E-07	9.2%	Switchyard LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators successfully restore offsite power within 4 hours, HPI succeeds, secondary cooldown/depressurization succeeds, low-pressure recirculation fails

Sequence	ΔCDP	Percentage	Description
LOOPWR 16-48	1.5E-07	7.6%	Weather-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW fails; operators fail to restore offsite power within 1 hour
LOOPGR 16-48	7.8E-08	4.1%	Grid-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW fails; operators fail to restore offsite power within 1 hour
LOOPGR 16-09	7.1E-08	3.7%	Grid-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators fail to restore offsite power within 4 hours
LOOPWR 16-06-10	7.1E-08	3.8%	Weather-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP seal integrity is maintained; operators fail to recover power prior to battery depletion (8 hours); operators fail to maintain AFW without DC power
TRANS 21-16-07-2	6.3E-08	3.3%	Transient initiating event with consequential LOOP; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators successfully restore offsite power within 4 hours, HPI succeeds, secondary cooldown/depressurization succeeds, low-pressure recirculation fails
LOOPSC 16-48	4.5E-08	2.4%	Switchyard LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW fails; operators fail to restore offsite power within 1 hour
LOOPSC 16-09	5.1E-08	2.7%	Switchyard LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators fail to restore offsite power within 4 hours
LOOPWR 16-07-2	5.0E-08	2.6%	Weather-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators successfully restore offsite power within 4 hours, HPI succeeds, secondary cooldown/depressurization succeeds, low-pressure recirculation fails
LOOPSC 16-06-04	4.1E-08	2.1%	Switchyard LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP seal integrity is maintained; operators fail to recover power prior to battery depletion (8 hours); operators successfully maintain AFW without DC power; operators fail to restore offsite power within 24 hours

Sequence	ΔCDP	Percentage	Description
LOOPPC 16-07-2	3.3E-08	1.7%	Plant-centered LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP stage 2 seals fail resulting in a LOCA; operators successfully restore offsite power within 4 hours, HPI succeeds, secondary cooldown/depressurization succeeds, low-pressure recirculation fails
LOOPGR 16-06-04	3.0E-08	1.6%	Grid-related LOOP initiating event; successful reactor trip; emergency power system failure results in SBO; AFW succeeds; RCP seal integrity is maintained; operators fail to recover power prior to battery depletion (8 hours); operators successfully maintain AFW without DC power; operators fail to restore offsite power within 24 hours

REFERENCES

1. Wolf Creek Generating Station, "Power Potential Transformer Overloading Results in Emergency Diesel Generator Inoperability," LER 482-2016-001-01, dated November 10, 2016 (ADAMS Accession No. ML16326A175).

2. U.S. Nuclear Regulatory Commission, "Wolf Creek Generating Station – NRC Integrated Inspection Report 05000482/2016004," dated February 13, 2017 (ADAMS Accession No. ML17045A201).

3. U.S. Nuclear Regulatory Commission, "Wolf Creek Generating Station – NRC Inspection Report 05000482/2016008; Preliminary White Finding," dated August 19, 2016 (ADAMS Accession No. ML16235A132).

Appendix A: Key Event Trees

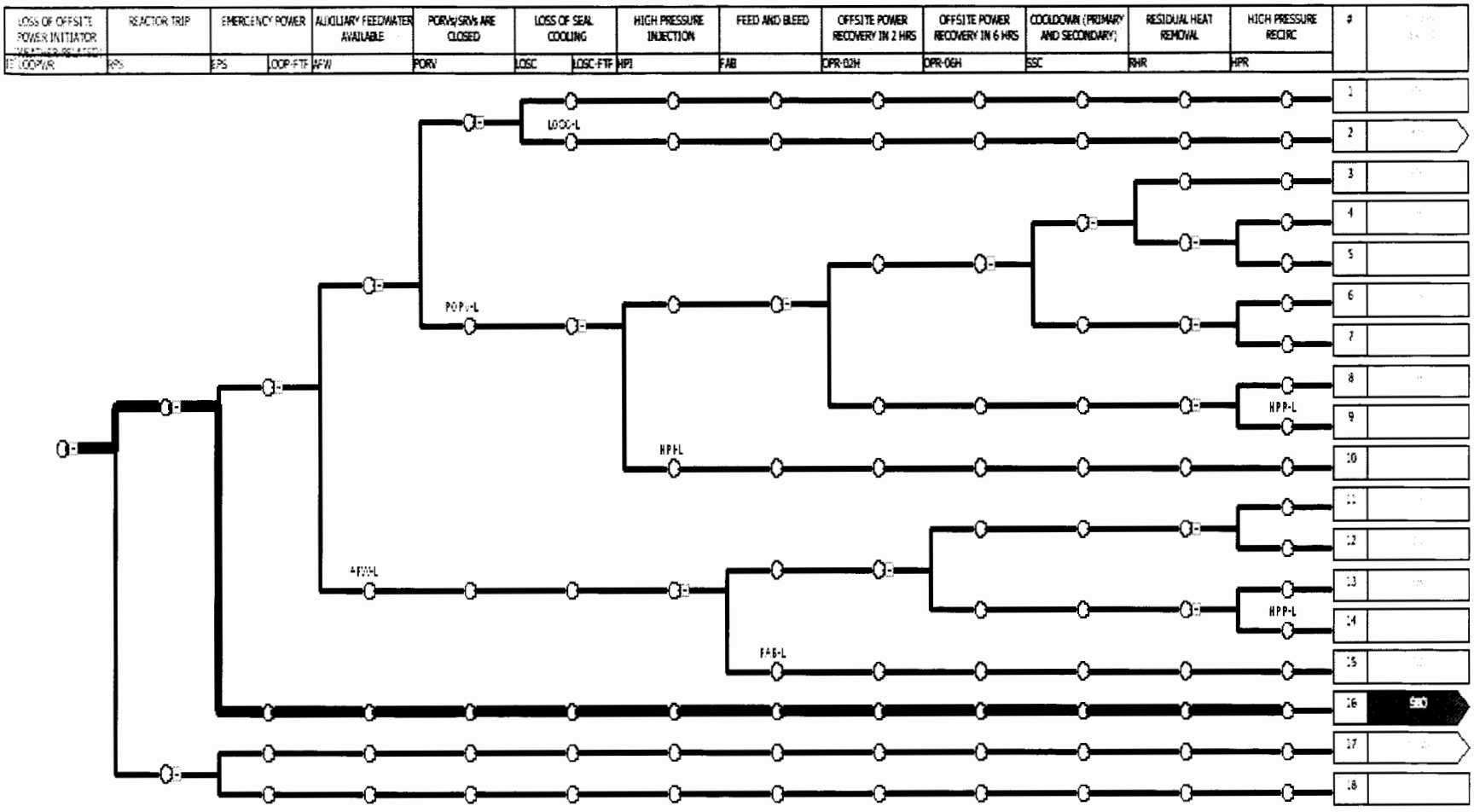

Figure A-1. Wolf Creek LOOP Event Tree (Weather-Related)

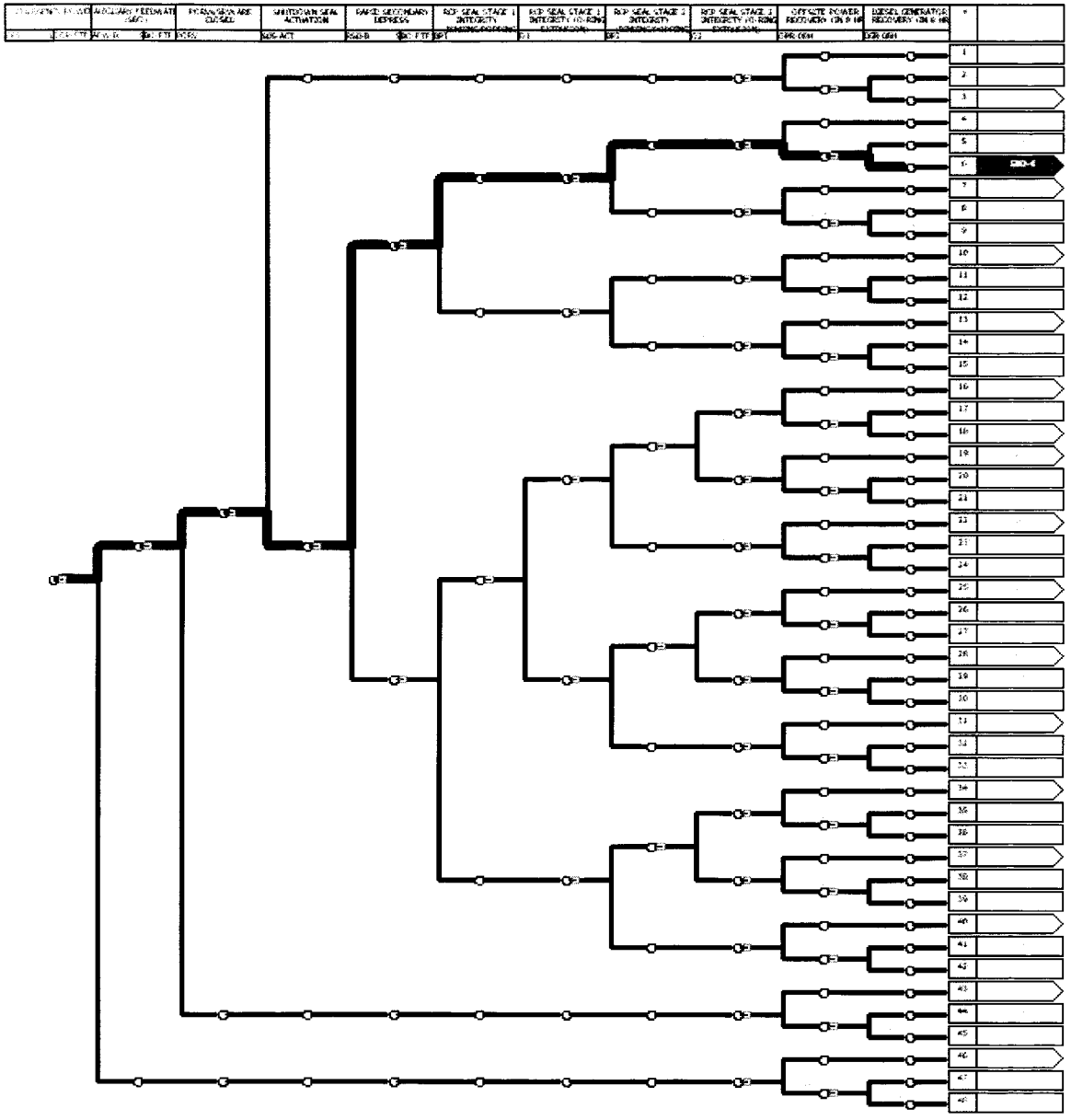

Figure A-2. Wolf Creek SBO Event Tree

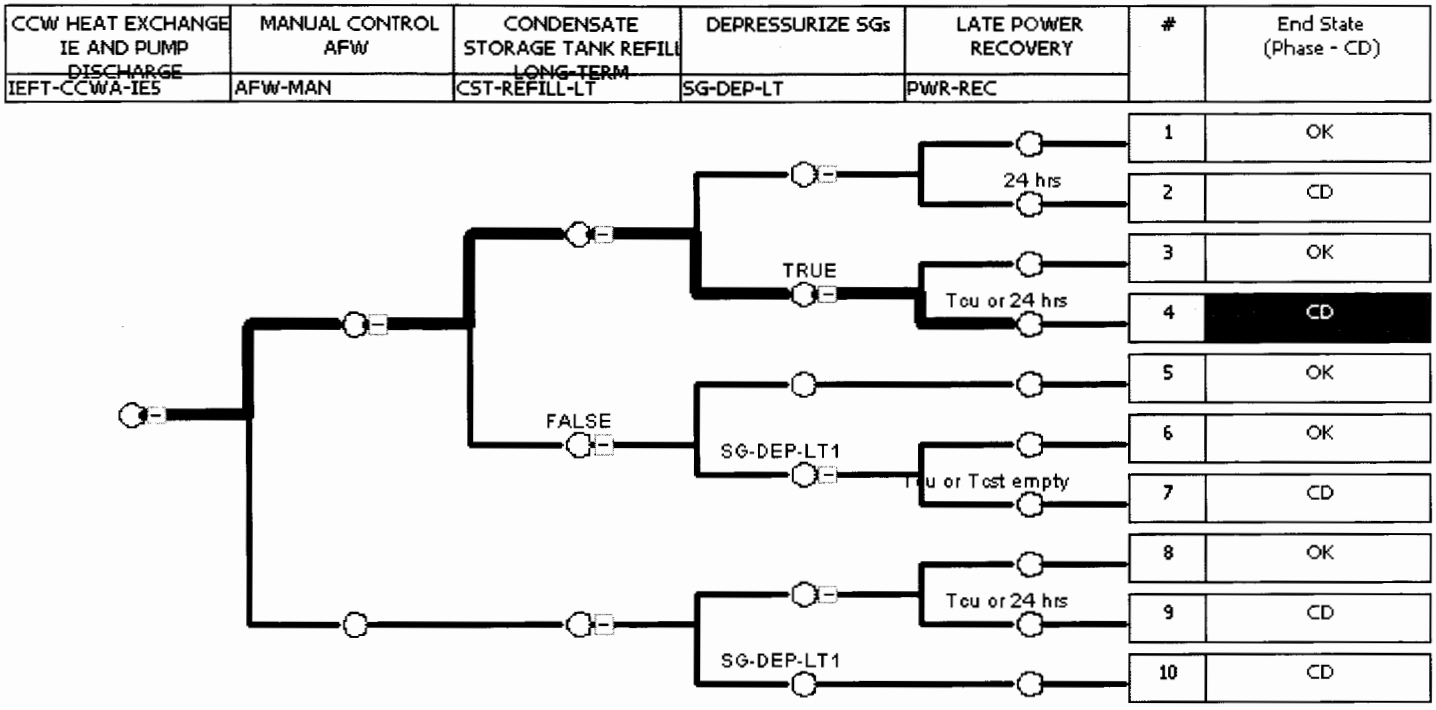

Figure A-3. Wolf Creek SBO-4 Event Tree

SUBJECT: WOLF CREEK GENERATING STATION – ACCIDENT SEQUENCE PRECURSOR ANALYSIS (LICENSEE EVENT REPORT 2016-001-01) DATED MAY 12, 2017

DISTRIBUTION:

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ADAMS Accession No.: ML17125A291 **via e-mail dated 5/8/17**

OFFICE	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA	RES/DRA/PRB/BC
NAME	BSingal	PBlechman	JLane*
DATE	05/08/2017	05/08/2017	05/08/2017
OFFICE	NRR/DORL/LPL4/BC	NRR/DORL/LPL4/PM	
NAME	RPascarelli	BSingal	
DATE	05/11/2017	05/12/2017	

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