

# WOLF CREEK

NUCLEAR OPERATING CORPORATION

Stephen L. Smith  
Plant Manager

WO 16-0053  
November 10, 2016

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555

Reference: Letter WO 16-0015, dated March 28, 2016, from S. L. Smith, WCNOG, to  
USNRC

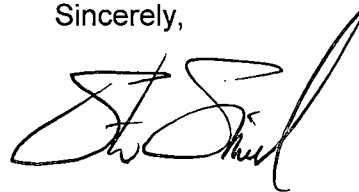
Subject: Docket No. 50-482: Licensee Event Report 2016-001-01, "Power Potential  
Transformer Overloading Results in Emergency Diesel Generator  
Inoperability"

Gentlemen:

The Reference submitted Licensee Event Report (LER) 2016-001-00, "Power Potential  
Transformer Overloading Results in Emergency Diesel Generator Inoperability." The enclosed  
supplement revises the root cause and adds reporting pursuant to 10 CFR 21.

This letter contains no commitments. If you have any questions concerning this matter, please  
contact me at (620) 364-4093, or Cynthia R. Hafenstine (620) 364-4204.

Sincerely,



Stephen L. Smith

SLS/rit

Enclosure: LER 2016-001-01

cc: K. M. Kennedy (NRC), w/e  
B. K. Singal (NRC), w/e  
N. H. Taylor (NRC), w/e  
Senior Resident Inspector (NRC), w/e

P.O. Box 411 / Burlington, KS 66839 / Phone: (620) 364-8831

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IEZZ  
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**LICENSEE EVENT REPORT (LER)**

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollects.Resource@nrc.gov](mailto:Infocollects.Resource@nrc.gov), and to the Desk Officer, Office of Information and Regulatory Affairs, NEOF-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

<b>1. FACILITY NAME</b> WOLF CREEK GENERATING STATION	<b>2. DOCKET NUMBER</b> 05000 482	<b>3. PAGE</b> 1 OF 4
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**4. TITLE**  
 Power Potential Transformer Overloading Results in Emergency Diesel Generator Inoperability

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	28	2016	2016 -	001 -	01	11	10	2016	FACILITY NAME	DOCKET NUMBER <b>05000</b>
									FACILITY NAME	DOCKET NUMBER <b>05000</b>

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)			
1	<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
10. POWER LEVEL	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
		<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input checked="" type="checkbox"/> OTHER	Specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER**

LICENSEE CONTACT Cynthia R. Hafenstine, Manager Regulatory Affairs	TELEPHONE NUMBER (Include Area Code) 620-364-4204
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**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
D	EK	DIODE	W351	Y					

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE			
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE)	<input checked="" type="checkbox"/> NO	MONTH	DAY	YEAR

**ABSTRACT** (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On October 6, 2014, at approximately 1326 Central Daylight Savings Time (CDT) during a scheduled 24-hour Run, the 'B' Emergency Diesel Generator (EDG) unexpectedly tripped and a fire was observed in the electrical cabinet (NE106). This resulted in an unplanned entry into a 72 hour shutdown Limiting Condition of Operation (LCO) and an ALERT emergency classification. The source of the fire was the Power Potential Transformer (PPT). On 1/28/16, a Hardware Failure Analysis concluded that the failure of the PPT was due to overloading which resulted from failure of a diode in the power rectifier of the EDG excitation system. Failure of the diode was induced by a governor actuator malfunction on June 9, 2014.

The PPT and associated cabling were replaced. All power diodes in each power rectifier were replaced. Further corrective actions are being tracked by Condition Report (CR) 88665.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
WOLF CREEK GENERATING STATION	05000-482	2016	- 001	- 01

**NARRATIVE**

**PLANT CONDITIONS PRIOR TO THE EVENT**

100 % reactor thermal power  
Mode 1

**DESCRIPTION**

On October 6, 2014, at approximately 1326 Central Daylight Savings Time (CDT) during a scheduled 24-hour Run, the 'B' Emergency Diesel Generator (EDG) [EIS: EK] unexpectedly tripped and a fire was observed in the electrical excitation control cabinet (NE106). Just prior to the trip, Operations personnel observed vapor coming from the cabinet and identified the source as the Power Potential Transformer (PPT) [EIS: XPT]. 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.

A failure investigation was performed using available site information as well as offsite hardware failure analysis (HFA), modeling, testing, and third party reviews. It was concluded that the smoking and eventual failure of the PPT on October 6, 2014 was due to overloading. The overloading of the PPT resulted from failure of a diode in the power rectifier [EIS: RECT] of the EDG excitation system. Failure of the diode occurred during load transients on June 09, 2014, resulting from a governor actuator [EIS: EK, 65] malfunction. The failed diode was susceptible to the governor malfunction transients due to a manufacturing defect near the edge of the silicon die. The failure of the diode was the only structure, component or system (SSC) that was inoperable at the start of the event and contributed to the event.

Upon failure of an exciter power rectifier diode, current boost to the generator field is reduced. The voltage regulator compensates by increasing the output of the power amplifier, supplied by the PPT, beyond the load capability of the PPT. The overloaded condition of the PPT led to increased temperatures which accelerated insulation breakdown and reduced service life. The degradation of the PPT insulation permitted a turn to turn fault on the middle phase of the primary windings. The generator fed the fault and the middle phase of the PPT observed the fault. This led to the failure of the companion diode, and introduced a short circuit in the field. The EDG then tripped due to protective relays, but not before the PPT catastrophically failed and emitted a fire.

The A-EDG was started within 24 hours of the inoperability of the B-EDG for Common Cause Failure, as required by Technical Specification (TS) 3.8.1 Condition B.3.1. The 'A' EDG was loaded and thermography was performed on the PPT to identify any overheating conditions. The thermography data determined that the 'A'-EDG had tested satisfactorily and remained operable on October 6, 2014.

The 'B' EDG was declared operable on October 9, 2014 at 1717 CDT.



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WOLF CREEK GENERATING STATION	05000-482	2016	- 001	- 01

**REPORTABILITY**

Technical Specification (TS) 3.8.1, 'AC Sources - Operating,' requires two diesel generators capable of supplying the onsite Class 1E power distribution subsystem(s) be operable in Modes 1, 2, 3 and 4. As a result of the HFA, the 'B' EDG was most likely inoperable from June 9, 2014 until October 9, 2014. This exceeded the allowed outage time for one EDG. This event is reportable in accordance with 10 CFR 50.73(a)(2)(i)(B) as a Condition prohibited by TS from June 9, 2014 until October 9, 2014.

The 'B' EDG was most likely inoperable from June 9, 2014 until October 9, 2014. During the 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. This event is reportable in accordance with 10 CFR 50.73(a)(2)(v)(B), (C) and (D) as an event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to: (B) Remove residual heat; (C) Control the release of radioactive material; or (D) mitigate the consequences of an accident.

The OTHER box in Section 11 of this form was marked to satisfy the reporting obligation pursuant to 10 CFR 21.

**ROOT CAUSE**

The station did not have the ability to assess the degradation of the PPT within the EDG's excitation system that led to the continual operation of a degraded component, resulting in significant equipment failure.

The station continued using the PPT after it was identified as degraded. When the smoking was first identified, the PPT was determined to be degraded, but could still perform its safety function due to the EDG satisfactorily performing its surveillances. The continual operation of a degraded component was primarily due to the limited knowledge of the excitation system and due to no available means to protect or detect an overloaded PPT.

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. One failed diode had an observable manufacturing defect consistent in appearance to the manufacturing defects found in the similar diodes. This manufacturing defect makes the diode more susceptible to failure during a transient that is lower than its voltage rating, but above its capability. The governor actuator malfunction is identified as a severely adverse and abnormal condition that stressed the excitation system more than normal system transients.



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**CORRECTIVE ACTIONS**

- The Power Potential Transformer and associated cabling have been replaced.
- The Current Transformers that feed the loss of fuse relay have been replaced.
- All power diodes in each Power Rectifier on both diesels have been replaced.
- Further corrective actions are being tracked by Condition Report (CR) 88665.

**SAFETY SIGNIFICANCE**

The 'B' EDG was most likely inoperable from June 9, 2014 until October 9, 2014. During that 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 on-site stand-by AC sources. However, in the event of a complete loss of AC electric power Wolf Creek Generating Station (WCGS) has three (3) non-safety related "Station Blackout" diesel generators that are capable of supplying power to the required engineered safety feature (ESF) functions following a station blackout event. There was no demand for on-site power during the time that both DGs were likely inoperable as power was available from the off-site power sources.

**OPERATING EXPERIENCE/PREVIOUS EVENTS**

On September 30, 1994, the 'A' EDG PPT caught fire while performing a maintenance run in accordance with procedure MGM KJ-006. Initial evaluation determined the cause to be a component failure of the PPT (Bravo phase to ground fault) which resulted in the transformer fire and fuse failure. The time delay portion of an Agastat relay did not work as designed. As a result, the diesel was shutdown locally (at the fuel racks) which left the exciter demanding high current and resulted in an open fuse.

On October 11, 1994, the 'B' EDG PPT caught fire while completing final inspections in accordance with procedure STS MT-016. The maintenance runs, performed under MGM KJ-006, were complete. An investigation into both events determined that preceding both transformer fires an abnormal engine shutdown occurred which resulted in the engine being shut down without de-energizing the excitation to the field. Three scenarios postulated to cause the event all involved a mechanical shutdown of the diesel without an electrical signal to de-energize the exciter.

Neither of these events contributed to the current event.

On December 20, 2007, a governor actuator on the 'B' EDG malfunctioned causing a power overload and high frequency once unloaded. The apparent cause evaluation determined the failure was the result of a manufacturing defect resulting in an internal wiring failure. This event was not applicable to the current event.