

WOLF CREEK

NUCLEAR OPERATING CORPORATION

Donna Jacobs
Plant Manager

MAR 25 2002

WO 02-0017

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

Subject: Docket No. 50-482: Licensee Event Report 2002-001-00

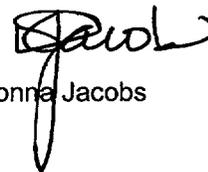
Gentlemen:

The enclosed Licensee Event Report (LER) 2002-001-00 is being submitted voluntarily. This report pertains to Emergency Diesel Generator (EDG) heat exchanger tube degradation at Wolf Creek Generating Station (WCGS). Specific information is included with respect to eddy current testing programs, including the identification and disposition of test data results containing absolute drift indication (ADI), suspected dealloying (SDA), and tube pitting indications in admiralty brass EDG heat exchanger tubes. Wolf Creek Nuclear Operating Corporation (WCNOC) believes this information may be of generic interest to the nuclear industry.

No commitments are identified in this correspondence.

If you should have any questions regarding this submittal, please contact me at (620) 364-4246 or Mr. Tony Harris at (620) 364-4038.

Very truly yours,



Donna Jacobs

DJ/clc

Enclosure

cc: J. N. Donohew (NRC), w/e
D. N. Graves (NRC), w/e
E. W. Merschoff (NRC), w/e
Senior Resident Inspector (NRC), w/e

IE22

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME WOLF CREEK GENERATING STATION	2. DOCKET NUMBER 05000482	3. PAGE 1 OF 4
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4. TITLE
Voluntary Report of Emergency Diesel Generator Heat Exchanger Tube Degradation

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	04	2002	2002	-- 001 --	00	03	25	2002	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE 1	11 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.73 (Check all that apply)									
	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)			
10. POWER LEVEL 100	20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)			
	20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)			
	20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)			
	20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		<input checked="" type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A			
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)					
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		Voluntary Report			
	20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vii)					
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)					
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)					

12. LICENSEE CONTACT FOR THIS LER

NAME Karl A. (Tony) Harris, Manager Regulatory Affairs	TELEPHONE NUMBER (Include Area Code) (620) 364-4038
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13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO					

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

This information is reported voluntarily appropriate to the guidance provided in NUREG 1022, "Event Reporting Guidelines 10 CFR 50.72 and 50.73," revision 2, section 2.7 "Voluntary Reporting."

Heat exchanger tube degradation was identified on both of Wolf Creeks Generating Station's (WCGS) Emergency Diesel Generators (EDGs). WCGS initiated an investigation team to examine this issue. Although the team concluded the EDGs were operable at the time of discovery, heat exchangers on both EDGs were found to be in a degraded condition. Suspect tubes were plugged. The team determined that the Preventive Maintenance (PM) program in place during the mid-1990s did not implement eddy current testing (ECT) to monitor structural integrity of EDG heat exchanger tubing. This condition monitoring is in addition to the thermal performance monitoring performed in response to NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment."

Specific information is included with respect to ECT programs, including the identification and disposition of test data containing absolute drift indication (ADI), suspected dealloying (SDA), and tube pitting indications in admiralty brass heat exchanger tubes.

Wolf Creek Nuclear Operating Corporation (WCNOC) believes this information may be of generic interest to the nuclear industry.

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17. NARRATIVE (If more space is required, use additional copies of NRC Form 366A)

Background:

The Emergency Diesel Generator (EDG) system at Wolf Creek Generating Station (WCGS) [EIS Code: EK] consists of a dedicated Colt-Pielstick, model type PC-2.5V EDG for each of the two 4160 volt Engineered Safeguards Features (ESF) buses [EIS Code: ED]. Each of the two EDGs serves the safety function of providing emergency electric power to mitigate accidents and events should the normal sources fail. Both EDGs are required to automatically start and run upon a Safety Injection Signal (SIS) or upon an undervoltage signal from the respective essential bus. The EDG automatically connects and supplies power to its associated ESF bus when power is lost to that bus.

Each EDG has three tube-and-shell heat exchangers in series (intercooler, lube oil, and jacket water), with the process fluid (EDG fluids) on the shell side and the lake water (Essential Service Water (ESW) [EIS Code: BI] or Service Water (SW) [EIS Code: KG]) on the tube side. The EDG heat exchanger set provides a support function to its respective EDG by removing heat from engine components and ultimate rejection of this heat to the lake water. These heat exchangers are safety related, ASME Section III, Class 3, seismically qualified Category I components mounted adjacent to each EDG.

The tubes in these heat exchangers are "straight through" tubes constructed from admiralty brass, and are contained in a removable tube bundle that is sealed at both ends to separate tube sheets.

The intercooler heat exchanger cools the engine turbocharger and the intercooler water system [EIS Code: LB] that removes heat from the engine intake air and generator bearings.

The lube oil heat exchanger cools the oil that provides lubrication to and removes heat from engine internal sliding components [EIS Code: LA].

The jacket water heat exchanger cools the engine cylinders and removes heat from other engine components.

Eddy current testing (ECT) is based on the principles of electromagnetic induction, and is used to detect and size defects in heat exchanger tubing. Testing is used to differentiate between tube defects and metallic deposits and to detect defects under the heat exchanger tube support plates. In addition to indications of tube pitting, ECT results may include absolute drift indication (ADI), denoting volumetric material loss in the tube, as well as suspected dealloying (SDA), indicating a depletion or removal of zinc from the heat exchanger tube material, and leaving a porous layer of copper inside the tube.

Plant Conditions Prior to the Event:

MODE -- 1
Power -- 100 percent
Normal Operating Temperature and Pressure

Event Description:

On December 13, 2001, the "A" EDG was removed from service to perform Preventive Maintenance (PM) inspection and ECT of the intercooler, lube oil, and jacket water heat exchangers. These activities were done in support of equipment condition trending efforts. Quality Control (QC) staff collected the ECT data and the EDG was returned to service. On January 2, 2002, the system engineer (SE) reviewed the ECT results and

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QC's recommended tube plugging list. At this time, the SE realized further evaluation was needed to disposition the results of the ECT exams. Further evaluation of the results raised concerns with the operability of the "A" EDG. At 1:47 P.M. Central Standard Time (CST) on January 4, 2002, WCGS declared the "A" EDG inoperable based upon ECT data that identified the need for plugging tubes in the intercooler, lube oil, and jacket water heat exchangers. This data identified not only characteristics of tube pitting, but also ADI in intercooler and lube oil heat exchanger tubes. Since these ADIs represented an indeterminate reading and did not provide specific results on the condition of the tubes, the actual remaining wall thickness could not be determined quantitatively.

The heat exchangers were opened, and the necessary tube plugging was performed on the "A" EDG. The heat exchangers were then closed, and the "A" EDG was declared operable and returned to service on January 5, 2002, at 11:34 A.M. CST.

On January 5, 2002 at 1:01 P.M. CST, the "B" EDG was removed from service to perform ECT on the intercooler, jacket water and lube oil heat exchangers. The results of this testing did not indicate any tubes that required plugging in the lube oil or jacket water heat exchangers. Wolf Creek Nuclear Operating Corporation (WCNOC) staff plugged 21 tubes in the intercooler heat exchanger due to various degrees of tube degradation (pitting greater than 66% through wall or where SDA or ADI was detected). Of those tubes, two were identified with ADIs, nine tubes had localized SDA, and ten tubes showed indication of pitting. The tubes were plugged, intercooler heat exchanger integrity was restored, and the "B" EDG was declared operable and returned to service on January 6, 2002, at 11:34 A.M. CST.

Because of the significance of the safety function served by the EDG system, WCNOC established an investigation team to examine the circumstances surrounding the EDG heat exchanger condition. This team focused on three areas:

- 1) Why the nonconforming condition (tube degradation) existed from December 13, 2001 to January 2, 2002, before actions were taken to correct the condition;
- 2) Why the heat exchanger PM program did not identify the degraded condition; and
- 3) The root cause of the material degradation.

Basis for Reportability:

This information is reported voluntarily appropriate to the guidance provided in NUREG 1022, "Event Reporting Guidelines 10 CFR 50.72 and 50.73", revision 2, section 2.7 "Voluntary Reporting."

Root Cause:

- 1) The primary cause of the failure to identify and resolve the nonconforming condition in a timely manner was due to wrong assumptions made by involved individuals. While visual examination of EDG heat exchanger tubes in August, 2000 identified some tube degradation, and prompted adding ET and wall thickness examinations for trending purposes to EDG heat exchanger PM tasks, the results were incorrectly interpreted that there was no concern with tube structural integrity.
- 2) The cause of the PM deficiencies has been attributed to past ineffective organizational interfaces. Wall thinning of these tubes began early in plant life due to a combination of dealloying and erosion

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caused by high flow velocities in the tubing. As a result, all of the tubes were replaced in each of the heat exchangers during refueling outages from 1987 through 1991. In addition, a design change was implemented in 1990 to reduce heat exchanger flow rates and mitigate tube erosion problems. Recommendations to monitor tube integrity (via ECT) following these tube replacements were not incorporated into the heat exchanger PM program. Since then, changes have been made to improve PM and monitoring programs for these and other important equipment. The incorporation of ECT testing for the EDG heat exchangers into the PM program was a result of these changes. It should be noted that the Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," program focuses on heat exchanger thermal performance, and does not specifically address tube structural integrity.

- 3) The apparent cause of the tubing degradation is dealloying of the admiralty brass heat exchanger tubing, exacerbated by erosion effects. This conclusion is based in part on results of the hardware failure analysis performed in 1990. WCNOG plans to pull and replace EDG heat exchanger tubes during Wolf Creek's upcoming refuel outage. The results of hardware failure analysis performed with the pulled tubes will be evaluated to validate and confirm this conclusion.

Corrective Actions:

Immediate Actions:

Degraded tubes in the "A" and "B" EDGs were plugged to ensure future structural integrity. Subsequent evaluation determined that both EDGs were fully available to perform their safety function, and were operable, prior to plugging the heat exchanger tubes.

The investigation of this issue has led to the development of numerous corrective action items tracked within WCNOG's Corrective Action program. Among these are:

- 1) On January 11, 2002, WCGS plant management conducted site-wide stand-down meetings for clarifying expectations regarding nonconformance identification and resolution. Additional actions to improve recognition and processing of nonconformances have been specified.
- 2) In addition to incorporating ECT into the EDG heat exchanger PM program, additional actions to improve aspects of the PM program pertinent to this issue have been specified. These include improving detail in procedures that govern heat exchanger inspection, testing, and trending activities as well as establishing standard protocols for reviewing and dispositioning test ECT results.
- 3) WCNOG plans to pull and replace specific degraded tubes. Laboratory analyses of these degraded tubes will include destructive testing of some tubes. The results of this analysis will again be reviewed to evaluate the effectiveness of the design change implemented in 1990 to reduce heat exchanger flow rates and mitigate tube erosion problems, and should confirm the apparent cause for the heat exchanger tube degradation.

Safety Significance:

The condition of the EDG heat exchanger tubes as described herein was of minimal actual safety significance. An evaluation performed for each heat exchanger indicates the safety function of the EDG system was not adversely impacted.