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 FACIL: 50-315 Donald C. Cook Nuclear Power Plant, Unit 1, Indiana M 05000315
 AUTH. NAME AUTHOR AFFILIATION
 WEBER, G.A. Indiana Michigan Power Co. (formerly Indiana & Michigan Ele
 BLIND, A.A. Indiana Michigan Power Co. (formerly Indiana & Michigan Ele
 RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 94-015-01: on 941230, high vibration noted on outboard motor bearing, along w/ smell of smoke. Caused by worn outboard motor sleeve bearing. Motor returned to mfg for insp & repair. W/950531 ltr.

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 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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Indiana Michigan
Power Company
Cook Nuclear Plant
One Cook Place
Bridgman, MI 49106
616 465 5901



May 31, 1995

United States Nuclear Regulatory Commission
Document Control Desk
Rockville, Maryland 20852

Operating Licenses DPR-58
Docket No. 50-315

Document Control Manager:

In accordance with the criteria established by 10 CFR 50.73 entitled Licensee Event Report System, the following report is being submitted:

94-015-01

Sincerely,

A handwritten signature in cursive script, appearing to read 'A. A. Blind'.

A. A. Blind
Plant Manager

/pl

Attachment

c: J. B. Martin, Region III
E. E. Fitzpatrick
P. A. Bailey - Ft. Wayne
NRC Resident Inspector
J. B. Hickman - NRC
J. R. Padgett
G. Charnoff, Esq.
D. Hahn
INPO
S. J. Brewer

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11

LICENSEE EVENT REPORT (LER)

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

DONALD C. COOK NUCLEAR PLANT

DOCKET NUMBER (2)

05000 315

PAGE (3)

1 OF 5

TITLE (4)

CANCELLATION OF LER 94-015-00

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
12	30	94	94	015	01	05	31	95		05000
OPERATING MODE (9)		1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)		100	20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)	
			20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)		73.71(c)	
			20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)		OTHER	
			20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		(Specify in Abstract below and in Text, NRC Form 356A)	
			20.405(a)(1)(iv)		50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)			
			20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)			

LICENSEE CONTACT FOR THIS LER (12)

NAME

G.A. WEBER - PLANT ENGINEERING SUPERINTENDENT

TELEPHONE NUMBER (Include Area Code)

(616) 465-5901

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES

(If yes, complete EXPECTED SUBMISSION DATE)

X

NO

EXPECTED
SUBMISSION
DATE (15)

MONTH

DAY

YEAR

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

On December 30, 1994, with Unit 1 at 100 percent Rated Thermal Power and surveillance testing of the 1 East Motor Driven Auxiliary Feedwater Pump (1E MDAFP) in progress, high vibration was noted on the outboard motor bearing, along with the smell of smoke. The 1E MDAFP was removed from service and the motor was replaced. The equipment was tested and returned to service on December 31, 1994.

The degraded motor was returned to the manufacturer for inspection and repair. Upon disassembly it was noted that the outboard motor sleeve bearing was worn on the inboard shoulder area, indicating that the area had carried a thrust load for which it was not designed.

An Interim LER was submitted on April 13, 1995, in accordance with 10CFR50.73(a)(2)(i). LER 94-015-00 stated that the 1E MDAFP Motor was possibly in a degraded condition prior to December 30, 1994, and may not have been capable of extended operation. Additional investigation and evaluation were to be completed by the middle of May, 1995.

The Engineering Evaluation concluded that the 1E MDAFP Motor had a degraded bearing but would have been capable of continued pump operation. Based on this evaluation, this event has been determined to not be reportable. This submittal outlines the evaluation conclusions and serves to cancel LER 94-15-00.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1) DONALD C. COOK NUCLEAR PLANT	DOCKET NUMBER (2) 0 5 0 0 0 3 1 5	LER NUMBER (6)			PAGE (3)		
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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Event Description

On December 30, 1994, with Unit 1 at 100 percent Rated Thermal Power and surveillance testing of the 1 East Motor Driven Auxiliary Feedwater Pump (1E MDAFP) in progress, high vibration was noted on the outboard motor bearing, along with the smell of smoke. The E MDAFP was removed from service and the motor was replaced. The equipment was tested and returned to service on December 31, 1994.

The degraded motor was returned to the manufacturer for inspection and repair. Upon disassembly it was noted that the outboard motor sleeve bearing was worn on the inboard shoulder area, indicating that the area had carried a thrust load for which it was not designed. The vibration which prompted the equipment's removal from service in December was determined to have been caused by the bearing wear. The possibility existed that the pump motor was in a degraded condition prior to the December 30, 1994 event. The 1E MDAFP did not actually fail, but was conservatively removed from service, therefore, the ability of the 1E MDAFP to continue operating with a degraded motor bearing was being evaluated.

This event was reported as an Interim LER (94-14-00) under 10CFR 50.73(a)(2) potentially as a condition prohibited by the Technical Specifications as the 1E MDAFP motor may not have been capable of extended operation prior to the December 30, 1994 event.

Subsequent analysis showed that the 1E-MDAFP would have been capable of performing its design function. The following analysis outline provides the basis for this conclusion.

AnalysisMotor Design

The motor is manufactured by Reliance, rated 3600 RPM, 500 HP, 4160 Volt. The motor is designed with sleeve bearings, which are simply babbit-lined steel cylinders. The babbit is a soft lead based alloy. The bearings are designed so that oil will be brought up from a sump beneath the bearing, letting it then flow down onto the journal to spread out between the journal and shaft surfaces. During operations the shaft does not ride on the bearing but on a thin film of oil between it and the bearing. The bearings are designed to support the shaft radially, which is perpendicular to the shaft axis. Sleeve bearings are not designed to have a continuous thrust load capacity in the axial direction, a direction parallel to the motor shaft. This motor does have some ability to take very limited thrust, which is sometimes experienced during start-up and shutdown. An attachment shows the fit between the motor shaft and the bearing. As can be seen, there is a very small thrust face and limited babbit to support this thrust.

As can be seen by the attached sketch, there is also a second bearing face that has fiberglass insulation. This face is not designed to carry any thrust load. The fiberglass insulation is used on the bearing so that this end of the motor shaft will not be grounded. The fiberglass insulation is exposed to very low voltage levels which prevents circulating current in the shaft. Loss of the insulation is not critical in the short term and its only significance is in preventing long term damage by circulating current.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Bearing Review

Inspection of the motor bearing showed that it experienced thrust loading and consequently was damaged. The ability for this motor to be operable depends upon whether this damage would be a cascading failure or if it stabilized once sufficient material had worn away. The following analysis was undertaken to answer this question.

Inspection of the bearing indicated that the external thrust load caused the motor shaft to rub up against the babbitt in the bearing face B. It continued to wear away the babbitt reducing it as the motor shaft moved axially. After a period of time, the motor shaft also began to wear against the fiberglass on bearing face A. It was the heating of the fiberglass insulation that produced the smoke described in the December 1994 failure.

A key question is whether the motor shaft was continuing to press against the bearing face or had it worn away enough bearing material so that a gap was now open. Presence of this gap would mean that the fault would not be a cascading failure, but would have stabilized. If the motor shaft was continuing to press against either bearing faces, then that bearing face would be smooth and shiny due to the rubbing, polishing effect of the motor shaft. Inspection of both bearing faces indicated that there was a clearance that had developed between the bearing and motor shaft surfaces. Bearing inspection of the face with fiberglass showed that it was not smooth but that carbon marks had deposited on its face due to localized heating of the fiberglass and oil. These carbon marks were not being worn away by further contact from the motor shaft. Inspection of the babbitt also found very little shiny babbitt. The babbitt had originally worn away on face A but further signs of wear were not present.

This evidence also indicates that the motor could have run for considerably longer than 9 hours. The operational time requirements are based on the operability of the Condensate Storage Tank (CST). The CST's basis ensures that sufficient water is available with the minimum water volume needed to maintain the RCS at Hot Standby conditions for 9 hours with steam discharge to the atmosphere concurrent with total loss of off-site power. The damage to the bearing was localized and that the oil was cool enough to limit the temperature rise. Inspection of the babbitt shows that as the babbitt was worn away it flowed on face B where it was able to cool down and redistribute itself, or to the bearing under the shaft where it was worn smooth. If the temperature had continued to rise then the babbitt would have fallen into the oil and not remained on the bearing face. The oil samples contained small particles but no large pieces of babbitt, which would be expected if the babbitt were damaged so severely it could not be cooled down. Burn patterns of the fiberglass shows that burning was confined near the face where rubbing occurred. Other parts of the bearing had fiberglass which was not damaged further supporting the contention that heating was only localized.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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DONALD C. COOK NUCLEAR PLANT

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Bearing Review (continued)

As was discussed earlier, the primary function of the sleeve bearings is to support the shaft in the radial direction. Operability of the motor depends upon the bearing continuing to provide this support. To accomplish this the bearing must be smooth enough to have an oil film develop between the shaft and bearing. The bearing face that supports the shaft was inspected and found to be smooth. Only a small portion of the surface has worn babbitt, and in that area the babbitt has been worn smooth. Thus the bearing area that supports the shaft is in good condition and capable of continued support for the shaft.

The degradation of this motor bearing was compared to a fossil plant motor bearing (Bearing No. 2) which had considerably more damage to the bearing face and was still in-service. Bearing No. 2 is a similar size sleeve bearing which is also designed to not carry any thrust load. It is believed that the motor with Bearing No. 2 had been running for several weeks with this bad bearing. There was also additional operating time required for Bearing No. 2 to reach this deteriorated condition. Since the bearing surface supporting the motor shaft is worse for Bearing No. 2 than the 1E MDAFP motor bearing, and since it had operated in a degraded condition for considerably longer than nine hours, it is reasonable to expect that the bearing from 1E MDAFP motor should have definitely been able to operate for nine hours, or as needed to perform its safety function.

Conclusion

In conclusion, the 1E MDAFP was capable of performing its safety function. Therefore the 1E MDAFP motor was operable to and on December 30, 1994 when it was manually stopped. This event is not reportable as an LER per 10CFR 50.73. This document shall serve to cancel LER 95-015-00.

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TEXT (If more space is required, use additional NRC Form 365A's) (17)

SKETCH OF 1E MDAFP
OUTBOARD BEARING