

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



March 14, 2000

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Operating Licenses DPR-58 and DPR-74
Docket Nos. 50-315 and 50-316

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:

LER 315/1999-011-01, "Air System for Emergency Diesel Generators (EDG) May Not Support Long Term Operability Due to Original Design Error".

The following commitment was identified in this submittal:

- Permanent design changes have been developed that will upgrade the starting air system for each EDG. The design changes will be installed prior to entry into Mode 2 for each unit.

If you have any questions, please contact Mr. Robert C. Godley, Director, Regulatory Affairs, at 616/465-5901, extension 2698.

Sincerely,

A handwritten signature in black ink, appearing to read 'M. W. Rencheck'.

M. W. Rencheck
Vice President – Nuclear Engineering

/mbd
Attachment

c: J. E. Dyer, Region III
R. C. Godley
D. Hahn
W. J. Kropp
R. P. Powers
R. Whale
Records Center, INPO
NRC Resident Inspector

LICENSEE EVENT REPORT (LER)

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), 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

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TITLE (4)
Air System for Emergency Diesel Generators (EDG) May Not Support Long Term Operability Due to Original Design Error

EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER	
04	07	1999	1999	-- 011 --	01	03	14	2000	Cook Unit 2	05000-316	
									FACILITY NAME	DOCKET NUMBER	

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)								
POWER LEVEL (10)	00	20.2201 (b)			20.2203(a)(2)(v)			50.73(a)(2)(i)		50.73(a)(2)(viii)
		20.2203(a)(1)			20.2203(a)(3)(i)			X 50.73(a)(2)(ii)		50.73(a)(2)(x)
		20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)		73.71
		20.2203(a)(2)(ii)			20.2203(a)(4)			50.73(a)(2)(iv)		OTHER
		20.2203(a)(2)(iii)			50.36(c)(1)			50.73(a)(2)(v)		Specify in Abstract below or n NRC Form 366A
20.2203(a)(2)(iv)			50.36(c)(2)			50.73(a)(2)(vii)				

LICENSEE CONTACT FOR THIS LER (12)	
NAME M. B. Depuydt, Regulatory Compliance	TELEPHONE NUMBER (Include Area Code) 616/465-5901, x1589

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)										
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	

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

Abstract (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)
This supplement is submitted to provide corrective actions and evaluation of safety significance for the identified condition.

In February 1999, during the Expanded System Readiness Review of the Emergency Diesel Generator (EDG) system, the ability of the starting air/control air system to support long term operability of the EDGs was questioned due to the non-safety related design of the compressors. An operability determination was performed which concluded that the EDGs could not maintain long term operability without reliance on the non-safety related, non-seismic starting air compressors, and were therefore inoperable. On April 7, 1999, an ENS notification was made in accordance with 10CFR50.72(b)(2)(i), for an unanalyzed condition with potential safety significance.

The apparent cause of the inadequacy of the EDG starting/control air system is original design error. The designers apparently failed to consider that the starting air system provides the control air to the EDG and loss of air could result in shutdown of the engine. After completion of system maintenance and additional review of the Seismic Qualification Utility Group evaluation guidance for seismic adequacy, it was determined that the compressors could be relied upon to perform the function of providing make-up air to the EDGs. Permanent design changes have been developed that will upgrade the starting air system for each EDG, replacing the existing starting air compressors with qualified components.

Air consumption and leakage data were evaluated to determine the safety significance of the condition. This condition was determined to have had minimal safety significance with respect to past operation of the plant.

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Conditions Prior to Event

Unit 1 was in Mode 5, Cold Shutdown
Unit 2 was in Mode 5, Cold Shutdown

Description of Event

On February 18, 1999, during the Expanded System Readiness Review of the Emergency Diesel Generator (EDG) system, the ability of the starting air/control air system to support long term operability of the EDGs was questioned due to the non-safety related design of the compressors.

The compressors, compressor drive motors, the piping between each compressor and the respective discharge check valve are not safety related components. Although the EDG starting air compressors are supplied from a Class 1E power source and are anchored per Seismic Class 1 criteria, they are neither safety related, or seismically qualified.

When this question arose, Operations requested additional information from Engineering, which led to an operability determination being performed. The determination considered the design function of the EDGs, the starting air compressors, and the control air function of the starting air system. Central to the determination is the design function of the control air for the EDG, which is discussed in detail below, and the "mission time" or how long the EDGs would need to run after an accident.

In the course of performing the operability determination, no definite statement could be found in the design or licensing basis documentation that defined the mission time of the EDGs. A decision was made to use a value of seven days, which is supported by the Technical Specification requirements for the amount of fuel oil that is required to be on hand to run the EDGs.

Using this information, the operability determination concluded that the EDGs could not maintain long term operability without reliance on the non-safety related, non-seismic starting air compressors, and were therefore inoperable.

Cause of Event

The cause of this event was a design deficiency in the EDG and its supporting systems that occurred during original plant design. The designers apparently failed to consider that the starting air system provides the control air to the EDG and that loss of control air could result in shutdown of the engine. Although the EDG starting air compressors are supplied from a Class 1E power source and are anchored per Seismic Class 1 criteria, they might not function following a seismic event because of their lack of qualification. The EDG air system was modified in 1994 and replacement compressors were installed; however, the replacement compressors were also classified non-safety.

Analysis of Event

On April 7, 1999, at 1601 hours EDT, an ENS notification was made in accordance with 10 CFR 50.72(b)(2)(i), any event found while the reactor is shut down, that, had it been found while the reactor was in operation, would have resulted in the nuclear power plant being in an unanalyzed condition that significantly compromises plant safety. This LER is therefore submitted in accordance with 10 CFR 50.73(a)(2)(ii)(A), for the same criterion.

The EDG system is a safety related system that provides reliable and readily available onsite AC power in the event of the loss of offsite power supply to the essential loads necessary to safely shutdown the reactor under any normal operating or accident conditions. The EDGs are designed to start automatically upon receipt of a safety injection signal and/or a loss of offsite power signal and be ready to accept loads within 10 seconds of receiving a start signal.

The starting air system supplies compressed air for starting the EDG. Each EDG has its own starting air system consisting of two redundant starting air compressors. Each compressor has one receiver of sufficient volume, 285 cubic feet, for at

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least two EDG start attempts when pressurized to 220 psig. Each of the two starting air trains supplies starting air within the pressure range of 220 to 247.5 psig. Both starting air trains are independently actuated by the diesel engine control system upon receipt of an EDG start signal. If either compressor/receiver should fail the other is capable of starting the EDG. The system is designed to have the EDG at speed and ready to accept load within 10 seconds of start initiation. The starting air system also provides compressed air for the starting air supply valve actuators, the diesel engine control system and the turbocharger aftercooler cooling water regulating valves.

In addition to providing starting air to the EDG, the starting air system supplies the diesel engine pneumatic control system with 100 psig air via pressure reducing valves. The 100 psig engine control air is required to maintain the throttle control cylinder's actuating rod retracted and thus maintain fuel flow to the engine. The minimum control air pressure required to maintain the throttle control cylinder's actuating rod fully retracted is 60 psig.

If the starting air compressors are unavailable to replenish the air receivers following an EDG start, the volume of air remaining to supply the control air requirements is limited. Based on pre-operational test data, starting air receiver pressure could range from 188 to 132 psig following an emergency start. The value of 188 psig reflects the pressure remaining in both receivers after a single 10 second start sequence. The 132 psig corresponds to the pressure remaining after two 10 second start sequences using one receiver. It was postulated that the leakage from the system would result in a loss of air receiver pressure of approximately 25 psi in a twelve hour period. At this postulated leakage rate, the control air pressure could drop below the critical value of 60 psig in a period fewer than 7 days.

On April 26, 1999, data was collected during a routine surveillance test on 2AB EDG to estimate the combined air consumption and leakage. 2AB EDG was chosen due to the fact that it was scheduled to be the first EDG returned to service. The air leakage and consumption data was collected as follows:

- The EDG was started and loaded per 02-OHP 4021.032.001AB, "DG 2AB Operation".
- Pressure at starting air receivers 2-QT-141-AB1 and AB2 was recorded for 2 hours at 10 minute intervals starting just prior to EDG start, using existing local pressure gauges.

During the surveillance, the air compressors were permitted to start on low air receiver pressure, at 220 psig. As expected, the air consumed during EDG start caused the pressure in both receivers to drop below 220 psig. The compressors started, restored pressure above 240 psig, and then stopped as designed. The data collected for estimating consumption and leakage data was recorded after the compressors stopped. The data showed that the leakage from the AB2 train was higher than the AB1 train. Over the surveyed time period, the AB1 pressure drop was approximately 2 psig, or 1.7 psi/hr. The AB2 train pressure dropped by about 13 psig, or 11 psig/hr.

The EDG operation time was calculated based on the assumption that the EDG would shutdown due to loss of control air at 65 psig when the throttle control cylinder extends. Using a starting air receiver pressure of 170 psig, which accounts for the air usage on an EDG start without replenishment of the air receivers by the compressors from the minimum operability pressure, the EDG would shut down after approximately 9.5 hours of operation using the starting air train with the highest leakage rate. If the starting air train with the lower leakage rate were used, EDG operation would have continued for up to 62 hours. Both figures are substantially fewer than 7 days.

Informal compressor run time data was taken from the 1AB, 1CD and 2CD EDGs to estimate leakage. When compared to the actual air consumption and leakage data for the 2 AB EDG, it was determined that the 2 AB data could be considered representative of all 4 EDGs.

This data was reviewed to determine the safety significance of this condition. The primary failure mode associated with this configuration is a seismic event that causes a loss of offsite power. In addition, for this failure to occur, recovery of

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offsite power would need to take greater than 9 hours. In order to evaluate the risk of this scenario, data from the Cook Probabilistic Risk Assessment and NUREG/CR-5032 "Modeling Time to Recovery and Initiating Event Frequency for Loss of Offsite Power Incidents at Nuclear Power Plants" were used.

The probability of a seismic event up to 0.25g at Cook is 5.76 E-05 per year. This was combined with:

- the probability of a Loss of Offsite Power, and
- the probability of taking longer than 8.9 hours to recover offsite power

to arrive of an increase in core damage frequency (CDF) due to this condition of:

Delta CDF=3.23 E-07.

The NRC guidance for risk significance with plants in Cook's range of CDF, as documented in Regulatory Guide 1.174, is a change of E-6 or greater. The increase in CDF due to this condition is below the level considered significant by the guidance contained in Regulatory Guide 1.174.

It is also important to note that the minimum 9.5 hours of availability of the EDGs without offsite power recovery is in excess of the 4 hours Station Blackout (SBO) coping time that Cook was licensed to in the April 23, 1992 SER titled "Station Blackout Analysis, Donald C. Cook Nuclear Plant, Units 1 and 2".

The disposition of this information yields the conclusion that while this condition could increase the consequences of an accident, the degree of risk is not considered significant. As a result, this condition is considered to have had minimal safety significance with respect to past operation of the plants.

In addition, as part of the Operability Determination described in the Corrective Actions section, the as-built configuration of the compressor and motor assemblies, and the compressor power supply and controls, were reviewed using the best available data provided by the Seismic Qualification Utility Group evaluation guidance for seismic adequacy. As a result of this review, and performance of maintenance identified as being needed during the evaluation, the compressor assemblies were determined to be seismically acceptable.

Corrective Actions

This condition was discovered with both units in cold shutdown. All four EDGs had previously been declared inoperable on January 11, 1999, due to HFA relay problems (see LER 315/99-001-00). No immediate corrective actions were necessary to maintain compliance with the Technical Specifications since the EDGs were already inoperable.

In Revision 0 to this LER it was stated that a temporary modification would be developed to provide a method of supplying control air to the EDGs without reliance on the compressors. However, based on further review of the feasibility of a temporary modification, it was determined that a new operability determination (ODE) should be performed for the starting air compressors to support Modes 5 and 6 operability of the EDGs. The ODE evaluated the seismic adequacy of the starting air compressors and associated mechanical, structural, electrical, and control air components. The ODE also evaluated the preventative maintenance practices applied to the compressors. In support of the ODE, maintenance activities were completed to establish a known acceptable condition for each starting compressor. The ODE concluded that the existing configuration and condition of the starting air compressors and associated components could be reasonably relied upon to perform the function of providing make-up air to the EDGs in Modes 5 and 6. Therefore, no temporary modification was installed.

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Permanent design changes have been developed that will upgrade the starting air system for each EDG, replacing the existing starting air compressors with qualified components. These will be installed prior to Mode 2 for each unit.

Actions to prevent recurrence have been previously provided in AEP:NRC:1260GH, "Enforcement Actions 98-150, 98-151, 98-152 and 98-186, Reply to Notice of Violation Dated October 13, 1998", dated March 19, 1999.

Previous Similar Events

- 315/87-020-00
- 315/87-024-00
- 315/88-014-00
- 315/98-019-02
- 315/98-029-00
- 315/98-031-01
- 315/98-046-00
- 315/98-049-00