DmB

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February 12, 1985
EF2-70382

Mr. James G. Keppler
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Keppler:

Reference: (1) Fermi 2
NRC Docket No. 50-341

(2) Letter, W.F. Colbert to L. L. Kintner, USNRC
August 31, 1981, EF2-54624

Subject: Final Report of 10CFR50.55(e) Item 146
"Failure of Emergency Diesel Generator
Nos. 11 and 12"

On January 18, 1985, Detroit Edison's Mr. J. E. Conen, Engineer - Licensing, telephoned Mr. P. Pelke of NRC Region III to report the discovery of damage to Emergency Diesel Generator (EDG) No. 11. The damage was discovered during an inspection of EDG No. 11 following a diesel trip during a test run on January 10, 1984. On January 21, Mr. Pelke was informed that inspections of the other EDG's revealed that EDG No. 12 had indications of incipient damage. This deficiency is reportable under 10CFR50.55(e) and is being tracked as Item 146.

The standby AC power system for Fermi 2 consists of 4 EDG's (Nos. 11, 12, 13 and 14). These units were manufactured by the Fairbanks Morse Engine Division of Colt Industries. Each unit is a 12 cylinder, opposed piston diesel rated for 3967 horsepower at 900 revolutions per minute.

Description of Deficiency

Approximately 14 minutes after being started for a 24 hour surveillance test, EDG No. 11 tripped automatically as a result of low lubricating oil pressure. The preliminary investigation revealed metal flakes and filings in the lube oil filter and strainer; therefore, a complete inspection of the machine was made with the assistance of the vendor.

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The inspection of EDG No. 11 revealed that the following components in the upper crankline were damaged: the crankshaft and main bearings 1 through 7; connecting rod bearings 1 through 7; pistons 2, 3, and 4; and, the thrust bearing.

Although operating properly, EDG Nos. 12, 13 and 14 were also inspected for damage. The EDG No. 12 filter contained easily visible bearing material and a check of the main bearing to bearing cap clearances revealed that some of the upper crankshaft bearings had abnormally high clearances. The internal inspection of these bearings on EDG No. 12 revealed some damage. The lube oil filters and bearing clearances for EDG Nos. 13 and 14 showed no indications of bearing distress. The subsequent internal inspections of these bearings confirmed that they were satisfactory.

Cause: The apparent cause of EDG No. 11 bearing failure was inadequate lubrication during fast starts. Evaluation of the operating history, operating procedures, and the lube oil system, including the modifications to the system, failed to specifically determine when or why these bearings experienced inadequate lubrication. Based on extensive non-nuclear commercial success and experience at other nuclear power plants with Fairbanks Morse diesels of this design, the manufacturer concluded that the high number of fast starts without prelubrication was the cause of this failure. The results of the analysis of the data on the Fermi 2 diesels supports this conclusion. In particular, it was determined that the period of time that the bearings were allowed to drain before the EDG was restarted without prelubrication was typically longer for EDG Nos. 11 and 12 than for Nos. 13 and 14. Increasing the time a bearing is allowed to drain before the EDG is restarted without prelubrication will decrease the amount of oil in the bearings during the subsequent start.

Background: Detroit Edison, working with the manufacturer, has taken action to improve the reliability of the Fermi 2 diesel generators which are subjected to the fast starts associated with nuclear plant service. Prior to the modifications described in Reference 2, voids of about 60 gallons would form in the lube oil system as the lube oil drained back to the sump when an EDG was shutdown. A 20 gallon per minute prelube pump was used to re-fill the system and establish bearing oil flow prior to planned starts. This procedure eliminated dry (unlubricated) starts except for the relatively few emergency starts of the EDG's. This program of operation was consistent with the goals of

minimizing dry starts and preventing seepage of lube oil from the upper crankline into the cylinders while the engine is shut down.

The modification described in Reference 2 reduced the effects of fast starts without increasing the accumulation of lube oil in the cylinders. The lube oil keepwarm system was modified to supply lube oil to the lower crankline continuously without supplying the upper crankline. The supply pipe to the upper oil supply header was also modified to prevent the header from draining to the sump when the engine is shut down. These changes reduced the size of the voids formed when the engine is shut down to about 5 gallons. An oil booster/accumulator was also added which uses starting air to inject oil to the upper crankline during the starting cycle. These system changes help prevent dry starts even without the operation of the prelube pump.

A vendor recommendation deleted the requirement for prelubrication after the installation of the lube oil system modification. Subsequent to receiving this recommendation, Fermi 2 EDG's were sometimes started without prelubrication. Detroit Edison's investigation revealed that other facilities with Fairbanks Morse Diesels have continued to perform prelubrication prior to planned starts of the engines even after this modification was installed.

Analysis of Safety Implications

The Emergency Diesel Generators start automatically on loss of voltage to a vital bus, on low reactor water level, or on high drywell pressure. The EDG's are intended to ensure that power is available for emergency core cooling in the event that offsite power is lost. The failure of an EDG reduces the assurance of the availability of emergency power.

Corrective Action

Detroit Edison, Colt Industries and expert consultants have concluded that prelubrication prior to all planned starts is the most significant action that can be taken to prevent bearing failures. Therefore, procedures are being revised to require a prelubrication period of approximately 2 minutes prior to planned starts of the EDG's. To insure maximum lubrication during starting, the diesel will be started while the prelubrication pump is running. Only emergency and unplanned starts will occur without prelubrication. Changes to the draft technical specifications are being requested to enhance the reliability of the EDG's based on the lessons learned.

The experience with EDG No. 12 indicated that the bearing deterioration is progressive and can be identified and corrected prior to bearing failure. Analysis indicates that complete bearing failure will be preceded by the accumulation of bearing material on the filter and an increase in the gap between the bearing and bearing cap. Therefore, Detroit Edison will perform a visual inspection of the oil filter once per calendar quarter. If bearing material is found in the filter, the bearing to bearing cap clearance will be checked on each of the crankshaft bearings. The bearing to bearing cap clearance will also be checked every 18 months or after 20 starts conducted without prelubrication if less than 18 months. These quarterly filter inspections and 18 month bearing clearance checks are at conservative intervals for identification and correction of bearing deterioration.

Repairs: EDG Nos. 11 and 12 have been completely inspected by Detroit Edison and the vendor and all damaged components are being replaced. EDG Nos. 13 and 14 have been inspected and no damage was found. The inspection of these machines placed special emphasis on the remote bearings of the upper crankline. It was this area where damage was found on EDG Nos. 11 and 12 and it is this area that is most susceptible to damage caused by inadequate lube oil flow during fast starts.

Testing: EDG Nos. 11 and 12 will be tested in accordance with the manufacturer's recommendations after the completion of repairs. To ensure operability after completion of the repairs, EDG Nos. 11 and 12 will also undergo the applicable Technical Specification Mode 5 Surveillance tests.

This is Detroit Edison's final report on Item 146. If you have questions concerning this matter, please contact Mr. Lewis Bregni, (313) 586-5083.

Sincerely,

Wayne H. Jens

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*All with attachment

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NRR Chron File

*With Attachment

In addition, the study recommended relocating some detectors as summarized in Table 2:

TABLE 2

AREA AUXILIARY BUILDING	DETECTION ZONE NUMBER	NUMBER OF EXISTING DETECTORS	DETECTORS TO BE RELOCATED
Division I Switchgear Rooms	9	4	2*
Division II Switchgear Rooms	14	4	2*
Fifth Floor HVAC Areas	16	4	4
RHR BUILDING			
EDG #11 Switchgear Room	52	6	2*
EDG #12 Switchgear Room	53	6	2*
EDG #13 Switchgear Room	54	6	2*
EDG #14 Switchgear Room	55	6	2*

These detectors are currently planned to be installed and/or relocated by May 30, 1985.

With the existing fire detectors in their existing locations in service, sufficient detector coverage is provided during the interim period of time until the detectors are relocated and/or added as listed in Tables 1 and 2. Additional justification for this interim deviation to NFPA 72E is provided as follows:

a) Auxiliary Building: Because of previous commitments, an hourly fire watch patrol will be making rounds in the Auxiliary Building. His routes will also include the Auxiliary Building areas listed except for the fifth floor. The fifth floor Auxiliary Building contains HVAC systems needed for safe shutdown and the combustible loading for this zone is light. The present detectors need to be relocated to meet NFPA 72E, but the present layout will detect a fire condition.

   This additional fire watch coverage along with the existing fire detector coverage provides sufficient assurance to warrant granting the interim deviation for the Auxiliary Building.

*The existing location of these detectors ~~are~~ is in front of exhaust duct inlets. The detectors are equipped with air shields and should function acceptably. However, to meet code requirements, the detectors will be relocated.

b) Reactor Building: The Reactor Building areas listed in Table 1 are large (approximately 30 ft. ceilings and 10,000 sq. ft floor areas). The existing detectors are located throughout the floor areas. Due to these detectors, the more than 20 ft. seperation of shutdown equipment, and the light fire loading (see FSAR section 9B), a postulated small delay in fire detection due to not explicitly meeting NFPA 72E will not jeopardize safe shutdown capability.

c) RHR Building: The RHR Building is arranged so Division I (EDG's 11 and 12) is separated from Division II (EDG's 13 and 14) by a three hour rated wall. Additionally, the Switchgear Rooms in each division have been separated by fire rated barriers because of Edison standards. The rooms have the proper number of detectors in them presently which will assure detection of a fire. Additionally, any postulated fire will be contained by the fire barriers.

The following sections of this Attachment provide permanent deviation requests from NFPA 72E for the following areas:

Control Room Complex	Performed by Professional Loss Control, Inc.
Torus Room	
Reactor Building Refueling Floor	
Reactor Building Basement Corner Rooms	Performed by Detroit Edison

2.2 Fire Hazards

Combustible loading for the CCHVAC Room is approximately 1 lb/ft^2 consisting of electrical cabling and small amounts of lubricating oil.

The Control Room Area is the air space between the Control Room drop ceiling* and the reinforced concrete ceiling. The amount of combustibles above the drop ceiling is negligible.

2.3 Safe Shutdown Equipment

The CCHVAC Room contains Division II HVAC equipment and Division I and II HVAC Appendix "R" shutdown cables. The Division I cables are enclosed in a 3 hour cable wrap. The Control Room contains all the control and instrumentation necessary for normal safe shutdown.

2.4 Fire Protection

Fire detection is provided in both zones. The Control Room is manned 100% of the time. Manual hose is available along with portable extinguishers being located in each area.

2.5 Evaluation/Conclusion

FD 100 is located in a wall with a minimum one hour rating. This size opening 104" x 68" has been tested for a 1.5 hour rating which is an acceptable fire rating for the fire loading located in each zone.

FD 99 is located in the floor. Damper installation has been sectioned into 3 sets of 8 dampers each (76" x 41"). This size is within the 1.5 hour rating for horizontal openings. The material sub-dividing the opening is a 6" x 76" 10 gauge steel plate. Each damper weighs approximately 14 pounds. This steel bar will provide the necessary fire resistance because of the very low combustible loading in each zone.

In addition, 14 gage steel is typically utilized for the duct sleeves. The Fire Dampers are then attached to this 14 gage sleeve. By anchoring to a 10 gage bar the installation is better than a normal installation anchoring point.

*Ceiling tile is 3 hour rated.

3.0 Division I Control Center HVAC Room (CCHVAC) (Sketch 1)

Dampers FO 101 and FO 102 separates the Control Room from the Division I CCHVAC Room. FO 101 is located in a wall between the two zones. FO 102 is located in the Floor/Ceiling between the two zones.

3.1 Description of Damper Location

The Floor Assembly is rated as a 3 hour barrier between the zones and consists of reinforced concrete. The wall is an 8" concrete block wall with a minimum one hour fire resistance.

3.2 Fire Hazards

Combustible loading for the CCHVAC Room is approximately 1 lb/ft^2 consisting of electrical cabling and small amounts of lubricating oil.

The Control Room Area is the air space between the Control Room drop ceiling* and the concrete ceiling. The amount of combustibles above the drop ceiling is negligible.

3.3 Safe Shutdown Equipment

The CCHVAC Room contains Division I Appendix "R" shutdown cables and equipment. The Control Room contains all the control and instrumentation for normal shutdown.

3.4 Fire Protection

Fire detection is provided in both zones. The Control Room is manned 100% of the time. Manual fire hose is available along with portable extinguishers in each area.

3.5 Evaluation/Conclusion

FO 101 is located in a wall with a minimum one hour rating. This size opening 104" x 68" has been tested for a 1.5 hour rating which is an acceptable fire rating for the fire loading located in each zone.

FO 102 is located in the floor. The opening has been sectioned into 3 sets of 8 dampers each. (76" x 41") This size is within the 1.5 hour rating for horizontal openings. The material sub-dividing the opening is a 6" x 76" 10 ~~gauge~~ 1 gage steel plate. Each damper weighs approximately 14

*Ceiling tile is 3 hour rated.