Wayne H. Jens
Vice President
Nuclear Operations

Detroit Edison

Fermi-2
6400 North Dixie Highway
Newport, Michigan 48166
(313) 586-4150

Nuclear Operations

September 20, 1985
RC-LG-85-0048

Director of Nuclear Reactor Regulation
Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Youngblood:

Reference: (1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

(2) Detroit Edison to NRC, "Clarification of Diesel Generator Commitments", NE-85-0459, dated March 14, 1985

Subject: Diesel Generator Lubrication Analysis Program

In Reference (2), Detroit Edison committed to develop a program to sample, analyze and trend lubricating oil in the four Fermi 2 diesel generators. This program is presented in the attachment to this letter. The attachment also provides information concerning the Detroit Edison/Colt Industries design review of the air boost prelubrication system which is ongoing, and a discussion of the diesel generator slow start design modification that will be implemented during the October, 1985 outage.

This submittal is in compliance with License Condition 10 to the Fermi 2 Operating License. If you should have any questions, please contact Mr. Robert L. Woolley at (313) 586-4211.

Sincerely,

Wayne H. Jens

cc: (all with attachment)
Mr. P. M. Byron
Mr. M. David Lynch
Mr. A. R. Ungaro
Mr. G. C. Wright (Region III)
USNRC Document Control Desk
Washington, D.C. 20555

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The following discussion provides information in accordance with Detroit Edison commitments in Reference 1. The information below is intended to complement information previously transmitted to the NRC in References 2, 3 and 4 (see pg. 5).

A. <u>EDG Lubrication Analysis Program</u>

Reference 1 committed to sample and analyze the EDG lubrication oil stating:

> "Detroit Edison will establish a program to evaluate and trend the data for use in prediction and detection of bearing failure. The program, if possible, will establish limiting criteria to initiate action if the criteria are exceeded. Until this program is established, the results of these analyses will be reviewed by cognizant Edison engineering personnel and by a contracted analysis laboratory. Detroit Edison commits to provide its proposed program for use of this data and any preliminary results six months after receipt of the Operating License."

Since the January 1985 failures of EDGs 11 & 12, changes have been accomplished in the methods by which lubrication-related data is obtained and analyzed. The following discussion summarizes the current data gathering and review methodology, and presents the data and observations made.

Consistency in lube oil sampling has been greatly improved. Samples of the oil entering the filter are drawn after oil temperature has stabilized during the monthly start and load test, to ensure that a representative sample is obtained. The sample is divided and sent to the following three laboratories for the referenced analysis:

1) The Detroit Edison Fermi 2 site lab performs both pentane insolubles and kinematic viscosity analyses. These provide quick, gross indications of oil quality and associated engine wear.

2) The Detroit Edison Engineering Research Physical and Analytical Chemistry (ER-PAC) lab performs pentane insolubles and insoluble metals analyses. These provide the concentrations of specific metals suspended in the circulating oil, which may indicate wear of a particular engine component.

3) The Cleveland Technical Center (CTC) lab performs suspended metals analyses and six other tests that provide:
   a) specific metal concentrations in the circulating oil, possibly indicating engine component wear;
   b) indications of fuel oil, water, and dirt intrusion to the lube oil system; and
   c) indications of specific oil qualities (e.g., oxidation resistance and anti-wear additive quantities).

Test data from oil samples taken to date on the four diesel engines is provided in Table 1. Due to the limited quantity of data available, final conclusions on the effectiveness of the revised surveillance program cannot be developed. However, a review of the data in Table 1 indicates the following.

1) The oil quality is comparable to new oil, in that the neutralization number for all sixteen data values is an average of 8.5. [Oil degradation for each engine will be slow due to infrequent engine operation (approximately 50 hours per year per engine).]

2) The amount of insoluble material is low in all four engines, generally indicating little wear of engine components. The nineteen data points for pentane insolubles identified by the Edison ER-PAC lab reflect values at or slightly above the level of detection. These low values are significantly below the upper limit defined by the ER-PAC lab for diesel engine operation in similar applications at other facilities.

3) Of all the wear metals measured, iron and aluminum have been detected in the largest concentrations. (The piston rings are made of iron and the main bearings of aluminum.) As indicated in the table, though, these values are still below the proposed acceptance criteria limits.

Table 1 also reflects a proposed criteria that will be used by Detroit Edison to evaluate and quantify engine wear of the four diesel generators. The proposed criteria identified in Table 1 was developed by Detroit Edison using both past experience with the utility's peaker units and the engineering judgement of both Edison and CTC personnel. If the proposed acceptance criteria is exceeded for a given parameter in two consecutive months, a bearing clearance check will be

performed. As additional test and operating data becomes available, and the significance of the various parameters examined is determined, the proposed acceptance criteria may be revised.

The data in Table 1 also confirms that consistent results are provided by the different testing methods used at the Detroit Edison ER-PAC lab and the CTC.

In addition to the enhanced oil sampling and analysis program discussed above, Detroit Edison has revised the frequency of lube oil filter changes and inspections. As committed to in Reference 3, the frequency of filter changes has been increased from yearly to quarterly, in order to avoid possible excessive deposition and differential pressure buildup. Furthermore, the frequent filter changes ensure that any foreign material that entered the lube oil system during the January/February corrective maintenance inspections would be removed. The filter elements are visually inspected for metallic fragments larger than 1/16". If more than an average of one such fragment per filter disc is seen, the clearance between the upper crankline bearing and bearing cap is checked.

Six filter changes have been accomplished since the January/February corrective maintenance; two each on EDGs 11 and 12 and one each on EDGs 13 and 14. On EDGs 11 and 12, the second set of filters had much less metal deposited than on the first set of filters, but enough to trigger the bearing clearance check in the case of EDG 11. The subsequent bearing check on EDG 11 confirmed that the clearance was within the acceptance criteria. The filters from EDGs 13 and 14 reflected less than one fragment per disc.

The replaced filters are examined by removing that portion of the filter with the heaviest deposits and having it ashed at 1000° F. The metals left behind are suspended in oil and analyzed by emission spectroscopy. The resulting values indicate relative amounts of each metal measured. The total amounts are compared with an estimation of oil volume through the filter vessel and are listed in Table 2.

Three sets of filters have been analyzed to date - those from the first changes on EDGs 11, 12 and 13. Due to the limited data available, no comprehensive assessment of the data in Table 2 has been made as yet. The data is being provided consistent with Detroit Edison commitments to the NRC.

Similarly, in response to a Region III inspector's request during a recent inspection (Item 3(h)(2) in Reference 5), Detroit Edison has sent a sample of new lube oil to CTC for analysis. The results of this analysis have not been received to date. The data from this sample can be used to evaluate the proposed acceptance criteria and test results.

B. Air Boost Prelubrication System

In Reference 1, Detroit Edison committed to perform a review of the lube oil booster/accumulator system with the diesel generator vendor (Colt Industries) and provide the results of that review to the NRC. This review presently is ongoing; an interim report is provided below.

Detroit Edison requested an engineering evaluation of the lube oil booster/accumulator design by Colt Industries. The evaluation is to include a review of available test data collected during the development of the booster system for fast-start engines. A model has been developed by Colt Industries and reflects booster system parameters, e.g., flow rates, booster volume and oil distribution.

The analytical model of the existing system consists of a multiple branched piping system and booster tank. This model is augmented with features from the existing engine such as pumps, skid piping and engine piping. The computer program is intended to analyze time development of pressures and flows in the system model. The model provides the requested data relative to booster volume, distribution of oil and time required to deliver oil.

Preliminary results of the study have been discussed with Colt Industries. Results from the model of the booster system have been reviewed and favorably compared with measured data from a six cylinder engine. These preliminary results show that approximately one cup of oil is delivered to each bearing and the booster is emptied in one second. Pressure is not developed at the bearing from the oil discharged from the booster.

As indicated in Reference 3, the lube oil booster/accumulator system provides some oil to all bearings during an EDG start, but is not an adequate replacement for the manual prelubrication

system. Colt Industries is continuing their analysis for a 12 cylinder model and will provide a final report to Detroit Edison. Detroit Edison will review and submit the report to the NRC upon completion of the study.

In accordance with Reference 3, all planned starts of the EDG are being prelubricated to ensure adequate lubrication.

C. Slow Start Design Modification

In Reference 3, Detroit Edison indicated that a design modification to permit slow starts of the Emergency Diesel Generators (EDGs) would be developed. The design change for slow start of the EDG will be implemented during the forthcoming October, 1985 outage.

The slow start design modification was initially discussed with both the NRC and Colt Industries in January, 1985 following the EDG #11 bearing failure. A slow start is an air start of the EDGs using the mechanical governor to achieve low speed engine operation (300-400 RPM) followed by a gradual increase of the engine speed to 900 RPM. To accomplish low speed engine operation the exciter circuitry must be bypassed to avoid possible component damage and false alarms/trips. Bypassing of the EDG circuitry will be achieved by installing an exciter bypass switch with contacts in both the exciter reset/shutdown circuits and the time delay for the field failure trip circuit.

Subsequent to implementation of this design modification, the monthly operation of the diesel generators required by Technical Specifications will be conducted with slow starts, whenever possible, while fast starts (EDG attains 900 RPM in less than 10 seconds) will be conducted once per 184 days in accordance with the Fermi 2 Technical Specifications.

References

1. Detroit Edison letter to NRC, "Clarification of Diesel Generator Commitments", NE-85-0459, dated March 14, 1985

2. Detroit Edison letter to NRC, "Final Report on 10CFR50.55(e) Item 146, Failure of Emergency Diesel Generator Nos. 11 and 12", EF2-70382, dated February 12, 1985

3. Detroit Edison letter to NRC, "Additional Information on Diesel Generators", NE-85-0345, dated March 6, 1985

4. Detroit Edison letter to NRC, "Transmittal of Additional Information Relative to Diesel Generator Commitments", NE-85-0462, dated March 15, 1985

5. NRC Inspection Report 50-341/85006, dated September 10, 1985

TABLE 1: Data from EDG Lube Oil Samples

EDG #11

Parameter	Lab	Units							Proposed Criteria
Sample Date (1985)			4/10	5/17	6/3	6/28*	7/29	8/26	
K. Visc.	Site	cSt @40C	181	179	175	189	184	175	170-200
P. Insolubles	Site	vol. %	<0.1	<1	0.2	<1	0.3	<0.1	3 max.
P. Insolubles	ER-PAC	wt. %	.02	.01	.02	.03	.04	P	3 max.
Iron	ER-PAC	wt. ppm	5.3	3.4	2.4	11.0	6.6	P	25 max.
Aluminum	ER-PAC	wt. ppm	1.5	1.5	0.8	<0.5	0.9	P	2.5 max.
Tin	ER-PAC	wt. ppm	<0.5	<0.5	<0.5	<0.5	<0.5	P	1.5 max.
Zinc	ER-PAC	wt. ppm	1.5	0.4	0.4	6.0	0.6	P	2.5 max.
Iron	CTC	wt. ppm	6	6	11	9	5	P	50 max.
Aluminum	CTC	wt. ppm	0	0	0	2	0	P	15 max.
Tin	CTC	wt. ppm	2	2	2	5	4	P	10 max.
Zinc	CTC	wt. ppm	2	3	3	3	7	P	15 max.
Neut. No.	CTC	mg KOH/gm	9.3	8.3	8.2	8.8	8.8	P	2 min.

P - Performing analysis at stated lab. Awaiting results.

* - Anomalous sample - contamination of sample postulated.

TABLE 1 - cont'd
EDG #12

Parameter	Lab	Units						Proposed Criteria
Sample Date (1985)			4/22	5/17	6/17	7/15	8/12	
K. Visc.	Site	cSt @40C	173	179	178	171	170	170-200
P. Insolubles	Site	vol. %	0.4	<1	<1	<1	<0.1	3 max.
P. Insolubles	ER-PAC	wt. %	.01	.05	.04	D	.01	3 max.
Iron	ER-PAC	wt. ppm	0.4	3.4	7.5	D	1.4	25 max.
Aluminum	ER-PAC	wt. ppm	1.7	0.8	<0.5	D	0.8	2.5 max.
Tin	ER-PAC	wt. ppm	<0.5	<0.5	<0.5	D	<0.5	1.5 max.
Zinc	ER-PAC	wt. ppm	0.4	0.8	0.9	D	0.3	2.5 max.
Iron	CTC	wt. ppm	6	12	7	D	7	50 max.
Aluminum	CTC	wt. ppm	0	0	0	D	0	15 max.
Tin	CTC	wt. ppm	0	1	5	D	1	10 max.
Zinc	CTC	wt. ppm	0	1	2	D	2	15 max.
Neut. No.	CTC	mg KOH/gm	8.0	8.8	9.1	D	8.6	2 min.

D - Sample damaged in shipment - results not available.

TABLE 1 - cont'd
EDG #13

Parameter	Lab	Units								Proposed Criteria
Sample Date (1985)			4/4	4/27	5/16	6/12	7/10	7/12	8/6	
K. Visc.	Site	cSt @40C	190	188	188	188	188	187	184	170-200
P. Insolubles	Site	vol. %	<1	0.5	<1	0.4	0.7	<1	<1	3 max.
P. Insolubles	ER-PAC	wt. %	.02	.04	.04	.06	.04	P	P	3 max.
Iron	ER-PAC	wt. ppm	0.9	2.5	1.7	6.7	6.3	P	P	25 max.
Aluminum	ER-PAC	wt. ppm	1.0	0.7	1.0	<0.5	<0.5	P	P	2.5 max.
Tin	ER-PAC	wt. ppm	<.5	<.5	<.5	<.5	<.5	P	P	1.5 max.
Zinc	ER-PAC	wt. ppm	0.5	0.6	0.7	0.9	0.9	P	P	2.5 max.
Iron	CTC	wt. ppm	4	9	7	10	9	17	P	50 max.
Aluminum	CTC	wt. ppm	0	0	0	0	0	0	P	15 max.
Tin	CTC	wt. ppm	0	4	2	0	5	5	P	10 max.
Zinc	CTC	wt. ppm	3	5	4	8	7	8	P	15 max.
Neut. No.	CTC	mg KOH/gm	8.5	8.1	7.8	8.9	8.7	8.8	P	2 min.

P - Performing analysis at stated lab. Awaiting results

TABLE 1 - cont'd
EDG #14

Parameter	Lab	Units							Proposed Criteria
Sample Date (1985)			4/5	5/27*	6/24	7/22	7/25	8/19	
K. Visc.	Site	cSt @40C	174	173	NA	198	173	174	170-200
P. Insolubles	Site	vol. %	<1	0.7	NA	0.5	<0.1	<0.1	3 max.
P. Insolubles	ER-PAC	wt. %	.03	.14	.06	.04	.14	P	3 max.
Iron	ER-PAC	wt. ppm	42	110	6.7	5.4	1.9	P	25 max.
Aluminum	ER-PAC	wt. ppm	0.4	1.0	<0.5	0.8	2.1	P	2.5 max.
Tin	ER-PAC	wt. ppm	<0.5	0.5	<0.5	<0.5	<0.5	P	1.5 max.
Zinc	ER-PAC	wt. ppm	0.5	31	0.9	0.5	2	P	2.5 max.
Iron	CTC	wt. ppm	8	11	10	6	8	P	50 max.
Aluminum	CTC	wt. ppm	0	0	3	0	0	P	15 max.
Tin	CTC	wt. ppm	0	1	5	3	4	P	10 max.
Zinc	CTC	wt. ppm	5	4	4	1	2	P	15 max.
Neut. No.	CTC	mg KOH/gm	8.6	8.1	8.8	8.3	8.2	P	2 min.

P - Performing analysis at stated lab. Awaiting results.

* - Anomalous sample - contamination of sample postulated.

NA - Data not available

Table 2: Data from EDG Lube Oil Filter Changes

EDG	Removal from Service	Service Duration (est.)	Volume Throughput (est.)	Deposited Metals					
				Al	Fe	Cr	Sn	Cu	Zn
	Date	Days	10^6 Gallons	(For comparison only)					
11	5/7/85	69	1.2	59	19	0	0	2	5
12	5/8/85	64	1.1	71	18	2	4	3	2
13	6/7/85	118	2.0	109	17	4	1	2	1