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REVIEW 18 MONTH PM ITEMS FOR DIESEL GENERATOR AND EVALUATE EXTENSION TO 30 MONTHS

TOLEDO EDISON
DAVIS-BESSE NUCLEAR STATION
PURCHASE ORDER # 01-6744-50
FUNCTION/JOB ORDER: 2415-1

MORRISON-KNUDSEN COMPANY, INC.
POWER SYSTEMS DIVISION
IWO 6993 - SUPPLEMENT 2

NORTH CAROLINA PROFESSIONAL SEAL 7033 ENGINEER HARRY WILLIAM FALTER

PREPARED BY: Harry W Falter 2/17/89
Harry Falter, P.E. 7033 — Date

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REVISION SHEET

REVISION NO.	DATE	PAGE	DESCRIPTION	APPROVED BY
1	3/7/89	2	Under "Purpose", added paragraphs 2, 3, and 4: "Toledo Edison wishes...approval each time."	
		13	Comment added under "Clean all air passages." "The engine room...TO 30 MONTHS."	
		15	Last paragraph under "Comment": Deleted first two sentences "If diesel generator... on a monthly basis.	
2	8/2/89	3	(a) First paragraph, last sentence revised to clarify example.	

Conclusion:

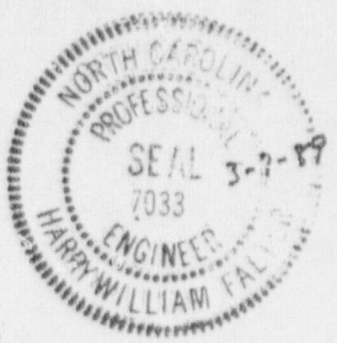
I have reviewed the 18 month preventative maintenance program to evaluate the option of an extension from 18 months to 30 months.

The extension is based upon the concept of trending data to verify that there is no degradation with time.

The attached report identifies the parts of the preventative maintenance that are approved for the 30 month extension as well as those that have not been extended. The extension is based upon our field service experience and engineering judgement.

Harry W Falter 3-7-89

Harry Falter, P.E. 7033



Scope: Surveillance Test Procedure DB-SC-03072, Emergency Diesel Generator 1, Refueling Surveillance Test Revision 0 Dated April 23, 1986

Purpose: Review the surveillance test procedure DB-SC-03072 for the purpose of extending the 18 month Diesel Generator maintenance Schedule to 30 months on.

Toledo Edison wishes to extend the surveillance interval for 18 month requirements to 30 months to accommodate the possibility of an unusually long outage. The plant is currently permitted by its license to extend an 18 month surveillance requirement to 22.5 months.

If a refueling outage lasts longer than originally scheduled, it is possible that a surveillance requirement, such as diesel engine maintenance, could come due again prior to reaching the next scheduled shutdown for refueling. If this occurs, it would force either an expensive shutdown solely for the performance of preventive maintenance, or the attempt to obtain a one-time extension for the maintenance from the NRC.

Toledo Edison prefers to resolve the possible scheduling problem by a technical justification that a maximum maintenance interval of thirty months. rather than the current allowed 22.5 months, is acceptable, with any necessary enhancements in monitoring/trending of diesel performance. The intent is not to perform the maintenance only at this maximum 30 month interval each time. Plant operating cycles are expected to remain as they are now, and the maintenance will normally be performed within the current requirements of 22.5 months. The extension to 30 months is only intended to allow greater flexibility to accommodate the infrequent situations that could make a delay in maintenance desirable, without the need for NRC involvement and approval each time.

Reference: Toledo Edison Task Authorization #177-553-8757-00, Job Order 2415-1.

Toledo Edison DB-SC-03072-00 attachment 3: Diesel Generator maintenance Schedule - 18 month.

Forward: A program that trends diesel generator performance shall be instituted to assure reliability and provide early data for any corrective action that may be warranted.

The trending program will utilize data from the monthly diesel generator load test and other tests by comparing the most recent test results with an old test record (approximately 6 to 12 months ago) and with recent prior tests. No special tests should be required. Readings should be taken at the same test KW load for consistent results.

The parameters are:

(a) Diesel cylinder exhaust temperatures. Diesel exhaust temperatures can vary directly with the variation of combustion air ambient temperatures. For example, if there is a 20°F increase in ambient temperature between different days that exhaust readings are taken, that 20°F increase will also appear in the later exhaust temperature reading.. R2

Consistency of the exhaust temperatures indicates that there are no significant changes in the combustion chamber process. The injectors are in good condition and properly adjusted. Exhaust valves and piston rings are seating properly.

(b) Consistency in the crankcase pressure readings indicates that the crankcase evacuation system is in good order, that there is no excessive piston ring blow-by, and no hot spots are forming in the crankcase.

(c) The engine systems pressure and temperatures (for lube oil, engine water and fuel) should also be compared.

The constancy of the water level of the expansion tank would indicate that the water system is tight.

Consistent readings over a period of time indicate that the systems are performing normally.

(d) The load test run readings for KW, voltage and frequency would verify settings and the units ability to deliver power as well as stable voltage and frequency.

(e) Generator RTD readings that are consistent indicates that the generator is in proper condition.

(f) The action of the air start motors in their ability to crank the diesel generator should also appear consistent to the operator. Comparisons should be made at approximately the same air receiver pressures.

(g) Trending a monthly lube oil analysis may provide data to assist in evaluating the diesel. Figure 1 is an interpretation of lube oil sample analysis taken from the EMD MI 1762.

M.I. 1762

Figure 1

INTERPRETATION OF LUBE OIL SAMPLE ANALYSIS

LUBE OIL ANALYSIS	BASIS FOR ANALYSIS	NORMAL No Action Required	BORDERLINE Take Extra Oil Samples	HIGH Correct Condition	RECOMMENDED ACTION ☐ Shut Down Engine. Drain Lube Oil. Change Filters.
Fuel Leak	Viscosity & Flash Point – Check for dilution if flash point less than 400° F or oil viscosity drops 15% or more at 100° F.	0 to 2%	2 to 5%	Above 5%	Borderline – find and fix fuel leak. High – check main bearings per maintenance manual.
Water Leak	Free Water	None		Any	Resample with dry container. Find and fix leak. Check main bearings per maintenance manual.
	Chromate Inhibitor	0 to 20 ppm	20 to 40 ppm	Above 40 ppm	Find and fix water leak. Check lube oil filter/tank pressure.
	Boron Inhibitor	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	
Air Filtration	Silicon	0 to 5 ppm	5 to 10 ppm	Above 10 ppm	Improved air filter maintenance required.
Excessive Oxidation	TBN (D-664) TBN (D-2896) Viscosity Rise pH Pentane Insolubles			*Min. TBN: (D-664) 0.5 (D-2896) 1.0 Max. Vis. Rise 30% Min. pH 5.0 Max. Pent. Insol. 2%	Change Oil. If short oil life persists, check lube oil quality, fuel sulfur content, oil cooler efficiency, engine temperature controls, power output (governor and rack settings), engine condition (worn rings, cracked pistons, poor combustion), oil filtration, or oil pump suction leak.
Contaminated fuel (cracking catalyst)	Aluminum Magnesium		Above 5 ppm		Check fuel cleanliness. Notify fuel supplier. If engine smokes, check injector calibration and tip erosion. Check if piston rings are excessively worn.
Oil Contamination	Zinc	0 to 10 ppm	Above 10 ppm becomes more dangerous with increasing values.		Check if oil is contacting galvanized or zinc painted surfaces. Check if make up oil in stock is within specifications. Notify lube oil supplier. Check for silver bearing failures.
	Silver	0 to 1 ppm	1 to 2 ppm	Above 2 ppm	Check if oil contains zinc or is corrosive to silver. Check for broken piston cooling tubes, inefficient oil cooler, or improper temperature control. Feel sides of piston pins for signs of distress. Measure piston to head clearance with lead readings. Oil draining is not mandatory. Check strainers and bottom of oil pan for debris. Consider turbo bearing condition.
Abnormal Wear Or Corrosion (Rapid increases within normal range should be considered borderline condition)	Chromium (Not applicable if chromate coolant inhibitor is used)	0 to 10 ppm	10 to 20 ppm	Above 20 ppm	Check for rapid wear of rings & liners.
	Copper	0 to 75 ppm	75 to 150 ppm	Above 150 ppm	Measure piston to head clearance with lead readings to locate worn piston thrust washers
	Iron	0 to 75 ppm	75 to 125 ppm	Above 125 ppm	Check for rapid wear of rings & liners.
	Lead	0 to 50 ppm	50 to 75 ppm	Above 75 ppm	Most likely lead flash is dissolving off bearings. Premature lead removal, before bearings are broken in, can lead to bearing distress. Inspect and replace upper con rod bearings in service less than 6 months if lead flash has been removed from the unloaded area of the fishback bearing surface on turbocharged engines. If con rod bearings require replacement, wrist pin bearings should also be checked and replaced if lead flash has been removed.
In Combination {	Copper Iron Lead }		Two out of three elements in borderline or high range.		Check for debris under crankshaft gear indicative of gear train bushing distress. Check idler gear bearing clearances. Check main and con rod bearings per maintenance manual. Oil draining is not mandatory.

*In areas where fuel sulfur content exceeds 0.5% the TBN level should not be allowed to drop below 1.0 (D-664) or 3.0 (D-2896)

Assumptions:

The diesel generator is an emergency stand-by power supply. It is normally tested once a month which it is load to 3/4 to full load for approximately one hour before being shut down. This test run may be of a one or two hour length. Therefore for the span of thirty months the diesel generator will make 60 starts and operate for approximately 60 hours. In addition the diesel engine may be called upon to run for a seven day period or another 168 hours. This totals an estimated 228 hours and 60 starts over the 30 month period. Therefore wear as a result of operation is minimal.

Evaluation of 18 Month PM Items For Diesel Generator For Extension to 30 Months

Attachment 3: Diesel Generator Maintenance Schedule

18 Months

Engine

Any bolts/nuts/screws found to be loose may be tightened per designed torque values or per the Maintenance Foreman direction.

Comment:

During the periodic diesel generator test run, visually observe exterral fasteners for indications of looseness. Loose fasteners should be scheduled to be tightened when found.

Remove and clean crankcase evacuation system oil separator screen and element. Inspect/clean ejector tube.

Comment:

The diesel generator operating hours during the 30 month extension period is expected to be less than 500 hours. This maintenance can be extended from 18 to 30 months. However, the crankcase pressure should be monitored when the unit periodically tested to trend the increase in pressure. If the crankcase pressure should go from negative to positive pressure as time goes by, the above maintenance should be scheduled.

LUBE OIL

Change all lube oil filters. Clean strainers and housings.

Comments:

The lube oil filters shall be changed on an annual basis because the glue used in the filter element degrades with time.

The lube oil strainers elements should be cleaned at the same time.

Check piston cooling oil tube alignment.

Comment:

There is no history of piston cooling tubes going out of alignment unless they have been struck by some object. This inspection may be extended to 30 months.

Analyze lube oil, if required, change lube oil. (Lube oil must be changed at least every 3 years.)

Comment:

Lube oil shall be analyzed on a monthly schedule noting the changes in water, oxidation, fuel, inhibitor, lead, silver tin, copper or ferrous material for trending purposes. (MI 1760)

Inspect and clean exhaust manifold and manifold screen.

Comment:

The estimated hours of operation for the 30 month period is less than 500 hours. Most of the operation during this period will be at approximately 3/4 load or greater. The engine will be operating at its optimum load for a clean exhaust and negligible lube oil carryover. Therefore there will be very little carbon build up on the manifold screen.So that the flow of exhaust gas will not be restricted by carbon build up on the screen. This maintenance can be extended from 18 months to 30 months.

Inspect crankshaft and connect rods.

Inspect pistons and piston rings.

Inspect cylinder liners.

Inspect cylinder head mechanism and valve gear for proper oiling during post maintenance idle run, with engine at operating temperature.

Comments:

The above maintenance is scheduled every 2000 hours of operation for an industrial engine.

The inspection of the crankshaft and connecting rod is done visually after removing thecrankcase cover doors. Look for signs of heat distress and babbitt at the edges of the bearings.

The piston and piston ring can be visually inspected after removing the air box cover, through the liner ports for scuffing of the piston and worn or broken rings. Improper seating of the rings can cause the crankcase pressure to increase because of blow-by. If there is no increasing trend of crankcase pressure, the piston rings are seated properly.

The liner can also be inspected through the liner ports, inspection is for scuffing. Any evidence of water may indicate a crack in the liner or cylinder head. This would be detected when the unit is "blown down" prior to each test start when the cylinder blowdown valve is open and engine is cranked over.

The cylinder head mechanism can be viewed for proper oil flow by raising the cover enough to view the mechanism while the engine is at idle speed during the engine shut down period.

Based upon previous experience at Davis Besse and the limited expected hours of operation during the 30 month period, this maintenance can be extended from 18 months.

Check fuel injector timing.

Check fuel injector rack length with engine cold.

Comments:

The injector timing and rack length should not change for the limited hours of operation during the 30 month period. Trending the cylinder exhaust gas temperature over a period of time will provide verification that no changes have occurred.

This maintenance can be extended from 18 months to 30 months.

Inspect and clean turbocharger oil filter check valve.

Comment:

Only filtered lube oil passes through the turbocharger oil filter check valve. The valve should remain clean. This maintenance can be extended from 18 months to 30 months.

Replace flexible couplings on all pumps only if excessively worn. Check couplings for wear.

Check all pump seals and bearings, lubricate pumps as required.

Comments:

During monthly operation of diesel generator.

Jacket Water Pump:
Visually check the engine jacket water pump seals and the inlet pipe coupling for signs of water leakage. No lubrication is required.

Lube Oil Scavenging Pumps and Fuel Oil Pump:
There is an oil seal at one scavenging pump shaft that drives the fuel oil pumps. Visually check this area for signs of lube oil leakage. No lubrication is required.

Fuel Oil Pump (Engine Driven):
When the diesel is not in operation, check the condition of the flexible coupling drive on a trimonthly schedule. Note any signs of excessive or progressive wear.

Visually inspect for fuel leakage around the shaft at the housing.

Visually check the flexible pipe connection for oil leaks. No lubrication is required.

Piston Cooling and Pressure Pump:
Visually check the joint of the gasketed end plate for lube oil leakage.

There are no flexible piping connections. No lubrication is required.

Motor Driven Fuel Oil Pump
Motor Driven Circulating Lube Oil Pump (6 GPM)
Motor Driven Turbo-Soak Back Pump (3 GPM)

Comments:

Visually check the pumps for oil leakage.

If motors have means to add oil to the bearings, add oil every three months.

Every six months stop motors to check the flexible coupling for wear. Replace only if worn.

Clean sludge out of engine sump, inspect and clean air box drains crankcase.

Comments:

The monthly analysis of the lube oil for oxidation should be trended. If oxidation shows no significant increase, the sludge is not being formed.

During operation, the air box drain lines should be cracked open. The amount of blow-down collected should be noted. If the trend shows a significant increase with time, an inspection is warranted.

The crankcase inspection may be extended for 30 months, if the lube oil sample trending does not show significant increases in tin or lead. If so, a visual inspection of the main and connecting rod bearings should be done, looking for tell tale babbitt at the ends of the bearing shells.

Generator -

Clean and visually inspect generator.

Comment:

Extend to 30 months.

Check brush tension.

Comment:

Note if sparking at slip rings when diesel generator is tested. If operation is free of sparking, extend 30 months.

Clean all air passages.

Comment: The engine room is clean and no excessive contamination of the air passages through the generator should occur-EXTEND TO 30 MONTHS.

Reverse polarity of brushes (swap leads on brush holders).

Comment:

Extend 30 months.

Check generator air gap.

Comment:

Extend 30 months.

Resistance check SCRs and record.

Comment:

Extend 30 months.

Check oil ring for freedom of movement.

Comment:

When engine is tested monthly check by feel for excessive bearing temperature.

Control -

Calibrate Alnor Pyrometer (cold end adjustment).

Comment:

Extend 30 months.

Clean carbon deposits off of exhaust hermocouples.

Comment:

If trending thermocouple reading shows no significant changes with time, extend 30 months.

Clean air filters on vents of electrical control cabinets.

Comment:

Replace filters on an annual basis.

Inspect voltage regulators, relays, and contactors.

Comment:

If systems indicate normal operation, extend 30 months.

Check door seals on electrical control cabinets.

Comment:

Extend 30 months.

Visually check electrical connections in control cabinets for tightness. Clean cabinets. Spot check condition of electrical contacts.

Check conduit fittings and straps for tightness.

Loop check/calibrate annunciator and engine shutdown devices.

PSL 20145(46), PSL 20147(48), PSL 20149(50)
TSH 20153(54), PSH 20179(80), TSH 20151(52)
PSL 1098(96), PSL 5158(60), PSL 5159(61)
TSL 21055(56), PSH 20143(44)

Check DC fuel oil pump motor brushes and commutators.

Loop check/calibrate engine speed switches and indicators: ST 6221, SI 6222A, SI 6222 (ST 6231, SI 6232A, SI 6232).

Comment:

Trending during periodic monthly tests should show consistent results. This would verify that relaying etc. are working correctly. If results are consistent, extend to 30 months.

Attachment 3: Diesel Generator Maintenance Schedule (cont.)

18 Month (cont.)

Fuel Oil -

Change all fuel oil filters.

Comment:

Extend 30 months.

Clean fuel oil strainer.

Comment:

Extend 30 months.

Engine Air -

Drain air intake oil bath cleaner, clean sump and refill with clean oil.

Comment:

Extend 30 months unless air box pressure trends upward.

Jacket Water -

Inspect and pressure test expansion tank cap, replace if required.

Comment:

Extend 30 months.

Inspect expansion tank filler neck for damage.

Comment:

Extend 30 months.

Check torque of flexible pipe coupling bolts.

Comment:

On an annual basis.

Governor -

Lubricate linkage and moving parts.

Torque governor friction clutch locknut while holding speed setting knob to 4 to 5 lb-in. If locknut was loose, contact Maintenance Engineer.

Comment:

Lubricate at 18 months. Extend torque to 30 months.