NO. EMD9314
DATE 04/16/93

DUKE ENGINEERING & SERVICES, INC.
EMD - PS OWNERS GROUP
INFORMATION BULLETIN

INFORMATION ONLY ☒	RESPONSE REQUESTED ☐ (if checked see below)

SUBJECT: EMD-PS Owners Group "Recommended Maintenance Program - Final Version dated February, 1993.

☒ Enclosed is the final version of the "Recommended Maintenance Program" for the EMD-PS Owners Group. Refer to EMD9309 for a copy of MKW-PS letter of endorsement of this program.

☒ Enclosure (20 pages).

Submit Response to:

R.C. (Dick) Day
Duke Engineering & Services, Inc.
230 South Tryon Street
P.O. Box 1004
Charlotte, NC 28201-1004
Telecopy No. (704)382-8770

IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT R.C. DAY AT (704)382-2763.

EMD OWNERS GROUP
RECOMMENDED MAINTENANCE PROGRAM

FEBRUARY 1993

The following represents the tasks reviewed and considered applicable for Nuclear Standby Service for EMD Diesel Generators. This information was compiled from the EMD Maintenance Instructions MI-1723, MI-1728 and MI-1742. This maintenance program is based on experience generated by the EMD Owner's Group nuclear utility members and is intended to address major engine components and support systems. Instrumentation and electrical components have been purposely excluded from these instructions.

This maintenance program is based on the following conditions:

1. Fuel oil used in the engines will meet the specifications of EMD Maintenance Instruction 1750.

2. Lubricating oil used in the engines will meet the specifications of EMD Maintenance Instructions 1760 and 1764, and will be changed at the intervals specified in this RECOMMENDED MAINTENANCE PROGRAM.

3. Engine coolant used in the engines will meet the specifications of EMD Maintenance Instruction 1748.

4. Lubricating oil filters will be changed at the intervals specified in this RECOMMENDED MAINTENANCE PROGRAM.

5. Operating load limitations will be adhered to.

6. Torquing procedures contained in this RECOMMENDED MAINTENANCE PROGRAM will be followed for new engines and for newly installed replacement parts.

TABLE OF CONTENTS

NON-OPERATING ENGINE LOG (DAILY/WEEKLY)

Component	Task	Comments
Cooling	Check for leaks	Ops shift (Daily or Weekly)
Cooling	Check coolant level	"
Fuel	Check for leaks	"
Fuel	Check Fuel supply	"
Lube	Check for leaks	"
Lube	Check oil level	"
Start	Check for leaks	"
Start	Drain Condensate	"
Gov	Check oil level	"
Engine	Keep warm system	" Check for proper operation.

ENGINE PRESTART CHECKS

Component	Task	Comments
Gov	Check oil level	See Manufacturer Spec.
Fuel	Check fuel supply	initiate engine prime
Cooling	Check coolant level	Expansion tank
Engine	Manual Bar over	Unless run within last 24 hour period.
Engine	Prelube thru main pump	Only if MI 9644 not installed. (2)
Engine	Check no oil @ cams	Top deck inspection (1).
Lube	Check oil level in pan	
Lube	Check strainer oil level	Not required (2).
Lube	Check lube oil circ. pump(s) operation	Insure proper standby oil system operation. (3)
Start	Drain condensate	Unless installed air start dryers (4).
Start	Check Air Pressure	Prior to start. (3)
Start	Visual inspection leaks/degradation	Should be prestart check. Most engine runs are performed on a monthly frequency.

ENGINE PRESTART CHECKS (continued)

JUSTIFICATION:

(1) This check is to verify that the turbo filter check valves are not leaking by opening the top deck and verifying that there is no oil pumping down on the cams.

(2) Pre-lube not required if LO mod installed. If prelube mod is installed, check prelube mod parameters (LO level gauges, pump pressures, etc.). This assures strainer is full. Otherwise, >30psi at circ. pump discharge. Still no need to open strainer.

(3) Most engine runs are done on a monthly basis. For those cases where the engine runs are more frequent, this type of check is considered good practice. The pumping components are necessary for reliable engine performance. The objective being to assure that engine turbocharger has oil during starting for proper lubrication.

(4) This a good practice regardless. However, the use of air dryers will eliminate most all condensate concerns which would require this task.

MONTHLY ENGINE OPERATING CHECKS

Component	Task	Comments
Intake	Check air box drains	For excess fluids before start, for blockage while engine running.
Intake	Inspect handhole covers for leaks	While engine running
Intake	Inspect cylinder test valves for leaks	While engine running
Intake	Visual inspection for leaks/degradation	While engine running
Lube	Check for leaks	While engine running
Lube	Idle-check LO level	Not required if prestart check is performed. 24hr runs will however require periodic checks.
Lube	Check Oil Pressure	At Load
Lube	Filter press DP <=25psi	Filter clogging check.
Cooling	Visual inspection for leaks/degradation	While engine running.
Fuel	Visual inspection for leaks/degradation	While engine running.
Exhaust	Check for leaks	While engine running.
Ops	Run min 1 HR >= 75%	Yes if at all possible. Not a firm requirement but considered a good practice. Reduces exhaust system fouling and cylinder glazing.
Starter	Check air line lubr. oil level or verify proper operation	Prior to each start. (1)
Starter	Check air compressor	

JUSTIFICATION:

(1) The vendor recommends that the oil level be checked monthly. It is unlikely that the oil lubricator will consume the entire contents within the normal periodic testing frequencies done between refueling cycles. Normal lube oil consumption is approximately 1 tablespoon with each start. At this rate, the lubricator reservoir contains sufficient oil to properly operate for a full fuel cycle unless in accelerated testing. Therefore, it is recommended that proper operation be checked with each start (ie. oil residue or some other appropriate means).

(2) PM for Station batteries should not be governed by engine maintenance. Most plants have air start motors and battery power is required for engine controls or field flashing. This is normally part of the plant station battery systems and checked accordingly. If using electric start motors, then this parameter is not to be omitted.

QUARTERLY ENGINE CHECKS

Component	Task	Comments
Cooling	Check engine coolant	Quarterly analysis Reference MI-1748
Fuel	Drain condensate from day tank	Monthly (1)
Lube	Take LO sample for analysis	Lube Oil Analysis serves as the basis for many tasks & frequencies (3)
Intake	Check air filter oil level (oil bath type)	Where applicable
Engine	Check LO drain @ turbo	Check quarterly (2)

JUSTIFICATION:

(1) The vendor does not recommend this task. However, based on the type of service, it is considered good practice to assure that there is not a buildup of condensate in the day tank. This also be considered as an engine prestart check.

(2) The vendor recommends a quarterly check. It is considered very unlikely that the soak back system would not be draining properly. With the prestart check of the circulating pump operation, it is very unlikely that the engine oil would not be draining from the turbocharger gear train. Trending of the pumping system pressures will give indications that there may be a blockage in the turbocharger.

(3) Lube oil analysis should be a part of every utility maintenance program in the EMD Owners Group. The basis for many of the frequencies of tasks requires a lube oil analysis program be in place. The minimum recommendation is for quarterly analysis, however, the preferred frequency would be monthly (or following every loaded engine run). The analysis program selected should evaluate the oil qualities, (wear metals, etc) and take into consideration the oil additive package.

REFUEL CYCLE (18 - 24 MONTHS)

Component	Task	Comments
Starter	Test operation of sep. bank of starter motors	Refuel interval inspection. (1)
Starter	(grease/lube) starters	Omit for air start motors w/air line lubricators, otherwise perform @ refuel intervals (2).
Starter	Remove/Clean/Inspect starter motors	Applies to electric starter motors only.
Exhaust	Manifold bolt torque check	Refuel interval inspection. (1)
Exhaust	Inspect turbo screen	Refuel interval inspection. (1)
Exhaust	Visually inspect flex connectors	Refuel interval inspection. (1)
uel	Fuel line leak check	Refuel interval inspection. (3)
Fuel	Clean FO pump suction strainers	Refuel interval inspection.
Fuel	Clean FO transfer pump strainers/filters	Refuel interval inspection.
Fuel	Replace fuel xfer filt.	Or on high filter DP.
Fuel	Replace fuel filters	Or on high filter DP.
Intake	Check Aftercooler DP	For oil bath filters only.
Intake	Insp oil bath filter	Clean/change as required (4)
Cooling	Cooling system leak check	Refuel interval inspection. (3)
Cooling	Rebuild/Repl AMOT vlv	Leave at 3 years. Perform @ refuel intervals for 24 month refuel cycles only.
Cooling	Check cooling fan/motor	Check belts, tension, blade clearances/pitch, lubricate bearings & motor Quarterly (9).

REFUEL CYCLE (18 - 24 MONTHS) continued

Component	Task	Comments
Cooling	Check shutter linkage and blades	Check and adjust as req. (9)
Lube	Replace lube oil	Use LO analysis and change based on analysis (5).
Lube	Clean strainer box	Refuel interval inspection
Lube	Change main filters	To include cutout and full inspection of filter media (6).
Lube	Change aux turbo filter	See Main filter changeout (6).
Lube	Check DC pump operation	Refuel interval inspection (7).
Lube	Replace DC circulating pump brushes	Refuel intervals only for continuous duty service. For standby service, inspection PM recommended.
Lube	Check Turbo-filter check valves	Refuel interval inspection
Lube	Replace Turbo filter element	Refuel interval inspection
Lube	Clean Main oil filter housing	Perform with filter change
Lube	Clean/Inspect circ pump and motor	Check alignment, seal, grease/lube.
Engine	Check lash adjusters	Refuel interval inspection (8).
Engine	Check auto start sequ.	Refuel interval inspection (8).
Engine	Inspect upper deck area	Refuel interval inspection (8).
Engine	Adjust injector timing and rack settings	Refuel interval inspection (8).
Engine	Perform overspeed trip	Refuel interval inspection (8).
Engine	Inspect pistons & rings	Refuel interval inspection (8).

REFUEL CYCLE (18 - 24 MONTHS) continued

Component	Task	Comments
Engine	Inspect cylinder liners	Refuel interval inspection (8).
Engine	Check torq on crab bolts	Refuel interval inspection.
Engine	Perform lead wire readings	Refuel interval inspection.
Engine	Perform visual ckcs insp	Includes connecting rod & crankshaft inspection as well as P pipe alignment check (11)
Gov	Lube gov. linkage	Refuel interval inspection (8).
Gov	Replace oil	Check @ refuel intervals & change as per governor manufacturer guidelines
Gen	Chk brush condition	Refuel interval inspection (8).
Gen	Inspect/replace brushes	Refuel interval inspection (8).
Gen	Clean/Inspect collector rings	Refuel interval inspection (8)
Elec	Perform alarm test	Refuel interval test (8).
Elec	Megger LO circ pump mtr	Not required unless incorporated in predictive maintenance.
Elec.	Calibrate all TDR relays	See (10)
Elec.	Check voltage regulator operation	See (10)
Elec.	Clean/inspect voltage regulator	See (10)
Elec.	Check operation of relays/controls/breakers	See (10)

JUSTIFICATION:

(1) The vendor recommended frequency would require an engine outage to perform the task. This is undesirable. In nuclear standby service, there is approximately 50 hours (or less) run time placed on the engine. With so few operating hours, it is very unlikely that any significant wear has been accumulated. The components inspected have no degradation as a result of the installation (ie. heat, oil, water, corrosion, etc. attack causing degradation).

(2) All air start installations have in line lubricators, There is no need to provide additional lubrication. For greased motors, it is feasible to extend the maintenance interval to refuel cycles based on the fact that the grease will not be consumed, evaporate, or loose its lubricating properties within this time period.

(3) Each monthly engine operating check will inspect engine systems for leaks. The task can be considered redundant. However, at refuel, the engine is operated for maintenance activities which include a open top deck inspection. Fuel or coolant leaks in this area can be located visually. Similar leaks can be detected with oil analysis.

(4) The oil does not evaporate (appreciably) and is not consumed with the low engine run time. The condition of the filter can be inspected and if necessary, cleaned at regular scheduled outages. This inspection frequency applies to all filter types.

(5) Most all signs of engine distress are detected early via lube oil analysis. MI-1760 provides detailed basis for lube oil analysis and likewise recommends such a program. Lube oil analysis is strongly recommended. It should be noted that lube oil analysis is the basis for much of the owners group recommendations. Without implementation of oil analysis, much of the justification presented herewith cannot be substantiated and therefore extension of vendor recommended maintenance practices cannot be supported by the owners group. Maximum calendar time between lube oil changes should not exceed 6 years. Lube oil analysis programs should include means for analyzing current condition of oil additive materials.

(6) Vendor recommendations for annual filter replacement are based upon experiences where engine lube oil has caused deterioration fo the filter media. MI-1760 qualifies this recommendation based on the type of lubricating oil used and prolonged high temperature service. Nuclear standby service experiences does not appear to cause severe deterioration of the filter media. Additionally, there is not sufficient engine run time to cause filter fouling.

JUSTIFICATION:

(6) (cont) Lube oil keep warm system temperature is not considered high. It has not been determined if any one type of oil will cause accelerated filter media degradation. While maintaining lube oil quality in accordance with MI-1760, it is further recommended that the filters be replaced at each refuel cycle and that every filter be cut open and the media inspected for signs of degradation.

(7) For continuous duty service, the DC brushes will wear considerably faster than that for standby applications. If the engine uses DC circulating pumps in continuous operation, it is recommended that they be first inspected new, then at the recommended annual interval measuring the accumulated wear and finally at the refueling interval to quantify the wear. At this point it can be determined if refueling service intervals are sufficient. Most nuclear standby service applications use DC circulating pumps as a backup to AC pumps which are normally in continuous operation. For this application, there is very few actual hours of operation over the life of the motor such that this PM may be deleted entirely.

(8) These engine checks are basic maintenance items done on either a "calendar" periodic basis or every 8000 hours of operation. It is acknowledged that nuclear standby emergency diesel engines will not accrue major maintenance overhaul operational hours. However, the annual recommendation likewise, does not account for the considerable idle time associated with nuclear standby service. Between refuel cycle, actual engine operating hours will be less that 1% of the 8000 hours recommended for the same inspections. Actual experience has shown that inspections performed at refuel intervals yields negligible variance from vendor specified operating limits.

(9) The engines are in stand by service and the cooling fans do not see more that 20 hours of operation monthly during normal operation.

(10) These components vary in manufacturer and model. The exact operation can likewise vary based upon the vendor of the Diesel-Generator package. Maintenance is to be performed in accordance with the specific manufacturers recommendations consistent with site specific requirements which may inclued generic applications.

JUSTIFICATION:

(11) Engine crankcase, crankshaft and connecting rod inspections are primarily visual inspections which attempt to locate obvious signs of engine distress. The use of oil analysis will indicate any abnormal signs of engine wear long before they become visible in the crankcase. With the engine full of oil, there is a greater potential for oil contamination with the opening of the lower covers for such an inspection. A visual inspection is virtually useless without some breakdown of various components such that bearing surfaces can be properly inspected and service limits measured. If the oil is to be changed, then it is advisable to inspect the engine crankcase, crankshaft and connecting rods. Likewise, if oil analysis indicates that significant problems are located in these areas, proper attention should be given to determination of cause and problem resolution regardless of this recommendation.

ALTERNATE REFUEL CYCLE (36 - 48 MONTHS)

Component	Task	Comments
Engine	Check wtr jumper torque	Note Power Pointer 2P-78 (1).
Cooling	Repl Coolant Fill Cap	2nd refuel inspection. (1).
Cooling	Inspect filler neck for damage	2nd refuel inspection. (1)
Cooling	Rebuild/Repl AMOT vlv	3 year replacement. Perform every other refuel interval for 18 month refuel cycles only.
Starter	Dissas. Clean/insp/repl. Sol.vlv. & Starters.	Every 4 years with air dryers. Otherwise. every 50 starts (2).
Lube	LO circ system check valves (30# & 75#)	2nd refuel inspection to clean and inspect valves.
Lube	Repl 6GPM circ pump/mtr	Replace as required per performance monitoring otherwise every 4 years (3).
Lube	Replace 6 gpm Circ Pump coupling spider	Replace as required if DC backup Otherwise every 4 years (3).
Turbo	Replace 3 gpm circ pump	Replace as required if DC back up otherwise every 4 yrs. (3)
Engine	Check torque on duct to aftercooler	2nd refuel inspection. (1)
Engine	Check torque on head frame to crankcase	2nd refuel inspection. (1)
Engine	Check torque on turbo to duct bolts	2nd refuel inspection. (1)
Engine	Check vibration damper for freedom of movement	2nd refuel inspection. (1)
Engine	Replace crankcase pressure detector	See engine protector recommendation below. (4)
Engine	Check Engine protector for proper operation	Replace every 2nd refuel and delete this requirement. (4)

ALTERNATE REFUEL CYCLE (36 - 48 MONTHS)

JUSTIFICATION:

(1) The owners group recommendation affects only those utilities which have 2 year refuel cycles (18 month refuel cycles meet the vendor recommendations). Based on actual operating hours, the engine does not accumulate sufficient wear to require; a) replacement of fuel oil pump coupling spider, b) replacement of coolant fill cap and filler neck inspection, c) vibration damper check - especially when vibration analysis/trending is also performed. Bolt torque checks on various engine components are primarily utilized to assure leak tightness. Complete engine inspections are recommended to be performed by the owners group of the associated systems at each refuel cycle whereby leaks are to be detected and corrected. With the exception of the water inlet jumpers, all other potential leak paths can and are recommended by the owners group to be inspected prior to or during monthly engine runs. Oil analysis will identify any internal water leaks which are not readily visible.

(2) The vendor recommends annual maintenance on the air start motors. This component may see more activity in nuclear standby service than in other forms of stationary power application. However, it is recognized that the quality of air is considered the governing factor affecting degradation. With clean, dry, lubricated air, the wear associated in starting the engine is significantly reduced. Water and other corrosion induced contaminants are not present with air dryer installations and therefore, extending the qualified life of the air start motor is justified.

(3) The 6GPM soak back (circulating) pump operates continuously. However,m most nuclear applications utilize a DC backup. The performance of the main soak back pump can be trended and replaced upon failure or near failure with no impact on engine operability status.

(4) Check not recommended. The engine protector (Low water, Crankcase pressure) must be removed to check. Calibration testing involves actual trip of the component. Each trip can, and in most cases, induces some degradation. It is considered more detrimental to the reliability of the component to test it rather that mere replacement. There are no consumable or time dated components within the detector assembly. The elastomer materials used (O-rings, diaphragms, gaskets, screws) are not in corrosive, harmful, or high wear environments. The engine maintenance manual recommends periodic testing but not replacement. Experience has shown that calibration testing is harmful to the component. Replacement as recommended meets the intent of the vendor recommendations.

6 YEAR ENGINE CHECKS

Component	Task	Comments
Fuel	Replace eng drvn fuel pump coupling spider	6 yrs or 3rd refuel. (2)
Fuel	Replace DC Fuel pump coupling spider	6 yrs or 3rd refuel.
Fuel	Qualify injectors	6 yrs or 3rd refuel.
Lube	Inspect and clean lube oil separator	6 yrs or 3rd refuel. (1)
Lube	Clean/inspect eductor tubes	6 yrs or 3rd refuel. (1)
Governor	Inspect booster motor seals and brushes	6 yrs or 3rd refuel.
Generator	Reverse collector ring polarity latches	6 yrs or 3rd refuel.
Generator	Insp. & grease bearing	Also suggest grease sample analysis at this time
Engine	Replace power assembly head gasket	6 yrs or 3rd refuel.
Engine	Replace power assembly head to liner water seals (grommets)	6 yrs or 3rd refuel.
Engine	Replace wtr jumper seals	6 yrs or 3rd refuel.

6 YEAR ENGINE CHECKS (cont)

JUSTIFICATION:

(1) The fouling associated with this component is primarily related to engine run time. In nuclear standby service, the engine run time is minimal (< 500 hours). Both engine operation at light load (idle and < 75% power) and lube oil/fuel oil add some fouling since low load operation induces higher lube oil consumption and poor lube oil/fuel oil quality yields higher carbon fouling. However, fouling of any type can only be induced while the engine is operating regardless of load. In nuclear standby service, the fuel oil and lube oil quality strictly adheres to manufacturers specifications (Ref. MI-1750 and MI-1760). Assuming 500 hours of actual engine operation, the extension of this maintenance interval is justified.

(2) Based on actual operating hours, the engine does not accumulate sufficient wear to require the replacement of the fuel oil pump coupling spider. The engine will accumulate approximately 600 run hour during this period. This component does not degrade over time such that replacement at the extended interval meets the vendor recommendation.

12 YEAR ENGINE CHECKS

Component	Task	Comments
Cooling	Replace rubber seals on cooling system	Leave at 12 years
Cooling	Clean/inspect heat ex.	Leave at 12 years
Cooling	Repl/rebuild wtr pumps	Perform every 12 years. (1)
Fuel	Replace eng drvn fuel pump	Replace every 12 years. (1)
Lube	Clean/insp LO cooler	Leave at 12 years
Lube	Replace lube oil filter bypass valve	Perform every 12 years. (1)
Engine	Replace top deck seals and latches	Replace every 12 years (2)
Engine	Replace power assembly lower liner seals	Perform every 12 years (already EMD approved).
Engine	Check exh valve timing	Perform every 12 years (3).
Engine	Replace crankshaft damper	Applies to viscous type damper only. Gear type damper does not require replacement.

JUSTIFICATION:

(1) In nuclear standby service, there is approximately 1000 hours (or less) run time placed on the engine. With so few operating hours, it is very unlikely that any significant wear has been accumulated. These components have no degradation as a result of the installation (ie. heat, oil, water, corrosion, etc. attack causing degradation). The primary failure mode associated with the pumping components will be mechanical seal failure which will be detected during either prestart or operating engine checks.

(2) There is no major consequence with the failure of either of these components. Leakage will be the main concern which will either become a housekeeping concern or prompt a corrective maintenance job to replace these components. These components have no degradation as a result of the installation (ie. heat, oil, water, corrosion, etc. attack causing degradation).

12 YEAR ENGINE CHECKS (cont)

JUSTIFICATION:

(3) This inspection is primarily used to check engine gear train wear. Engines used for nuclear standby service do not accumulate sufficient operating hours to require this inspection over the life of the plant. Unless there has been engine operation with severe oil contamination or other forms of catastrophic engine failure, it is very unlikely that there has been sufficient gear train wear to require this check at the six (6) year interval..

ENCLOSURE 3

MKW-PS OWNERS GROUP PROPOSED MAINTENANCE PROGRAM
LETTERS DATED MAY 25, 1993

EMDF1, Rev. 0

NO. EMD 9323
DATE 5-31-93

DUKE ENGINEERING & SERVICES, INC.
EMD – PS OWNERS GROUP
INFORMATION BULLETIN

INFORMATION ONLY ☒	RESPONSE REQUESTED ☐ (if checked see below)

SUBJECT: MKW-PS/Owners Group Proposed Maintenance Program
.Letter dated 5-25-93 from Larry Deans, VP MKT/Sales
.Letter dated 5-25-93 from David Strickland, Prod. Sup. Engr.

Enclosed are two letters from MKW-PS related to the Proposed Maint. Program. Please use as appropriate to support your Diesel's.

.No response to DE&S required. Contact two correspondents if any questions

.Enclosures (4 pages)

Submit Response to:

R.C. (Dick) Day
Duke Engineering & Services, Inc.
230 South Tryon Street
P.O. Box 1004
Charlotte, NC 28201-1004
Telecopy No. (704)382-8770

IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT R.C. DAY AT (704)382-2763.

EMD-9323

MKW POWER SYSTEMS, Inc.

May 25, 1993

EMD-PS Owners Group
Duke Engineering and Services, Inc.
230 Tryon Street
P. O: Box 1004
Charlotte, NC 28201.

Attention: R. C. Day

Subject: Proposed Maintenance Program

Reference:
(1) Meeting on January 19, 1993 with the Owners Group, MKW Power Systems and Electro-Motive Division of General Motors
(2) EMD Owners Group Recommended Maintenance Program Document Dated February, 1993
(3) EMD Maintenance Instruction (MI) 17.23, 1728 and 1742

Dear Mr. Day:

The Owners Group recommended Maintenance Program, as defined in Reference (2), has been reviewed by MKW Power Systems as the Authorized Distributor for EMD servicing the nuclear industry. We support and encourage all of our customers in efforts made to increase the overall operating efficiency of the equipment. Increased operating efficiency provides overall cost reductions, while maintaining or increasing reliability.

This program has been developed to coincide with the scheduled outages, which has altered scheduled maintenance periods defined in EMD's Maintenance Instructions (MIs) shown in Reference (3). These Maintenance Instructions are not written specifically for the nuclear industry and are only intended to serve as a guide to establish a maintenance schedule. Noting that these Maintenance Instructions are provided as a guide only and are not necessarily addressing the nuclear power industry, the history which the industry has experienced becomes very important information when defining its scheduled maintenance. Based on this historical information, and the experience MKW Power Systems has gained through working for 20 years in every domestic nuclear power plant operating EMD engines, we approve of

Post Office Box 1928 • Rocky Mount, North Carolina 27802-1928 • Phone: (919) 977-2720
TWX: (510) 929-0725 • FAX: (919) 446-3830

this program (Reference 3) with the following three modifications:

Reference 3 states that the following tasks are to be performed during the 18 - 24 month refueling cycle.

Refuel Cycle (18 - 24 months)

Component	Task	Comments
Fuel	Change fuel filter	or on high filter DP
Lube	Change aux turbo filter	or on high filter DP
Lube	Change main filters	or on high filter DP

It is necessary to have the ability to monitor the differential pressure (DP) on the above filters if the usage cycle is to be increased to 18 - 24 months. Without the ability to monitor DP, the condition of these filters is not clearly defined.

With the implementation of this program, we stress the importance of monitoring and trending. Any new information should be considered for action. This action will continually improve operation, efficiency and the reliability of the industries emergency diesel generators.

If you have any questions or comments, please do not hesitate to call.

Sincerely,

MKW POWER SYSTEMS, INC.

Larry L. Deans
Vice President
Marketing and Sales

lld/bhp

st5-19

EMD9323

MKW POWER SYSTEMS, Inc.

May 25, 1993

EMD-PS Owners Group
Duke Engineering and Services, Inc.
230 South Tryon Street
P.O. Box 1004
Charlotte, NC 28201

Attention: R.C. Day

Reference: Proposed Maintenance Program

Gentlemen:

MKW Power Systems, Inc. has completed our review of the Owners Group Proposed Maintenance Program. As we have indicated in our previous letter we find the Proposed Maintenance Program acceptable with the stipulation that monitoring of differential pressures across the main lube oil filter, auxiliary turbo filter and fuel filters should be included before extending the change out interval of the filter elements.

The pricing for each of the modifications listed below includes all necessary materials, drawings and installation instructions for installation of the differential pressure gauges in a safety related application.

Installation of each modification is available through MKW Power System, Inc. under our standard rates for field service at nuclear facilities. The estimated installation time required is listed with each modification.

MAIN LUBE OIL FILTER DIFFERENTIAL PRESSURE	$ 3,311.00
Installation	1 Day
AUXILIARY TURBO DIFFERENTIAL PRESSURE	$ 4,457.00
Installation	1 Day

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FUEL OIL FILTER DIFFERENTIAL PRESSURE	$ 3,311.00
Installation	1 Day

Additionally, all 16 cylinder engines without the water manifold support bracket as described in Power Pointer 2P-78 will require this modification.

PARTS KIT 9326240 WATER MANIFOLD SUPPORT KIT Two required per engine	$ 62.30
Installation	1 day

Please do not hesitate to contact us at 1-800-759-2720 if you have questions or require clarification for any of the above modifications.

Sincerely,

MKW Power Systems, Inc.

David A. Strickland
Product Support Engineer

ENCLOSURE 4

ADDITIONAL INFORMATION CONCERNING
EDG TECHNICAL SPECIFICATION CHANGE

ENCLOSURE 4

ADDITIONAL INFORMATION CONCERNING EDG
TECHNICAL SPECIFICATION CHANGE

(1) BFN has eight Emergency Diesel Generators (EDGs). Since accurate records concerning start and valid test data have been kept (beginning in 1987), BFN has had a total of 586 valid tests (as defined in USNRC Reg Guide 1.108), and only three valid failures (two load run failures and one start failure). This corresponds to an estimated reliability of approximately 99.5 percent.

(2) BFN currently has a performance monitoring program in use for the EDGs. This program consists of recording diesel operating parameters at 15 minute intervals for the first hour of operation, and then 30 minute intervals thereafter. This data is then compiled and analyzed to determine if any adverse trend is developing. This trend may be done by manual comparison, or by computerized database manipulation. The data has been recorded and maintained since 1987. The data points monitored and trended are: priming fuel oil pressure, normal fuel oil, engine lube oil pressure, lube oil filter pressure, engine cooling water outlet temperature, lube oil cooler cooling water outlet temperature, and lube oil cooler lube oil outlet temperature. The engine oil level, governor oil level, and expansion tank level are also monitored. Due to the vintage EDGs in use at BFN, no additional trending points are available to monitor.

BFN also has a program in place to monitor the condition of the lubricating oil used in the EDGs. This program takes a sample of the lubricating oil and analyzes it for contaminants, viscosity, total base number, etc., as required by Electomotive Division (EMD) Maintenance Instruction (MI) 1760. This sample is taken every other month. Upon final implementation of the EMD Owners Group maintenance program, this interval will be increased to a monthly check.

(3) The Morrison Knudsen Wartsila - Power System (MKW-PS) concurrence letter dated May 25, 1993, stipulated that in order to extend the changeout interval of the lube oil filters and the fuel oil transfer filters, differential pressure indication must be available and monitored. BFN currently has no dP indicators for these filters, so the current yearly changeout will continue. The engine driven and motor driven fuel oil filters each have filter input pressure gauges which are recorded and trended on a monthly basis. The original EMD Maintenance Instructions (MI 1728 and 1742) set the replacement interval for these filters at two years. The replacement interval will be two years for these filters based on the MI's and the trending.

The endorsement of the EMD Owners Group maintenance program by MKW-PS in the letter to the EMD Owners Group dated May 25, 1993, contained three exceptions to the standard as written in the February 1993 revision. These three exceptions required differential pressure monitoring of the main, auxiliary turbocharger, and fuel filters in order to increase the replacement interval to once every two years. BFN does not have this type monitoring installed, so the changeout interval for these filters will remain at once every year.

The technical specifications currently require annual maintenance based on vendor recommendations. The vendor (EMD) recommendations give specific tasks to perform once per year and make no mention of allowable deviances. BFN currently allows a 25 percent deviation in surveillance intervals. This revision will perform vendor maintenance at two year intervals based on the EMD Owners Group maintenance program. A 25 percent surveillance extension will be allowed in accordance with BFN current technical specifications. As with the current one year requirement, the proposed two year interval does not represent an absolute maximum interval.

The per engine reliability breakdown is as follows:

Diesel Generator	Number of valid tests	Number of valid failures	Reliability (%)
A	76	0	100
B	78	0	100
C	69	0	100
D	77	0	100
3A	74	1	98.6
3B	65	0	100
3C	73	1	98.6
3D	74	1	98.6
Total for site	586	3	99.5

The EMD Owners Group recommends that fuel oil, lube oil, and coolant be maintained in accordance with the applicable EMD Maintenance Instruction (MI). BFN maintains and analyzes its diesel fuel oil in accordance with ASTM D975-89. MI 1750 (Diesel Fuel Recommendations) is consistent with BFN's program. BFN's lube oil analysis program is consistent with the requirements of EMD MI 1760, Lubricating Oil for EMD Engines. The engine coolant used in the BFN diesels is water with an EMD approved corrosion inhibitor. The inhibitor is checked monthly to ensure the proper concentration is in use. This is in accordance with EMD MI 1748, Engine Coolant.

ENCLOSURE 5

BFN'S PROPOSED EDG 18-24 MONTHS INSPECTIONS AND CHECKS

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BFN'S PROPOSED EDG 18-24 MONTHS INSPECTION AND CHECKS

The following is a item by item discussion of the Electromotive Division (EMD) Owners Group Maintenance Program, revision dated February 1993 (ref. EMD9314, EMD9309, and EMD9323). This discussion will cover only the 18 - 24 month checks. The 18 - 24 month checks are comprised of the 12 month checks currently used at BFN as required by the existing annual maintenance technical specification. All checks are currently performed at BFN on an annual maintenance basis unless noted.

1) Test operation of separate bank of starter motors.

   This item is currently performed every six months by performing a fast start using starter bank 1 in December and starter bank 2 in July of each year. This will not change.

2) Grease/lube starters.

   BFN uses starters with air line lubricators. If the existing starters have grease/lube fittings, then perform as recommended by EMD Owners Group maintenance program.

3) Remove/clean/inspect starter motors.

   This item applies only to electric starters. BFN uses air starters.

4) Exhaust manifold bolt torque check.

   This check is currently performed every 18 months. Perform as recommended by EMD Owners Group maintenance program.

5) Inspect turbocharger screen.

   Perform as recommended by EMD Owners Group maintenance program.

6) Visually inspect exhaust flex connectors.

   Perform as recommended by EMD Owners Group maintenance program.

7) Fuel line leak check.

   Fuel leaks checks are performed every month during the monthly surveillance. Perform additional leak checks under the top deck as recommended by EMD Owners Group maintenance program.

8) Clean fuel oil pump suction strainers.

Perform as recommended by EMD Owners Group maintenance program.

9) Clean fuel oil transfer pump strainers.

Perform as recommended by EMD Owners Group maintenance program.

10) Replace fuel transfer filters.

This task will continue to be performed on a yearly basis. As Morrison Knudsen Wartsila - Power System (MKW-PS) stated in their letter dated May 25, 1993, these filters may be changed every 24 months if pressure drop (dP) across these filters is monitored. BFN does not have dP indication across these filters, so the changeout frequency will remain once every 12 months.

11) Replace fuel filters.

Perform as recommended by EMD Owners Group maintenance program. These filters are currently replaced every 12 months to correspond with the existing annual maintenance requirement. The original EMD Maintenance Instructions on which the EMD Owners Group document and BFN's diesel maintenance is based requires changeout of these filters every two years. Fuel oil filter inlet pressure is monitored and trended and replacements may be required based on increasing filter pressure.

12) Check aftercooler differential pressure.

BFN does not check aftercooler dP because our diesels do not have the instrumentation installed to perform this check.

13) Inspect oil bath air filter.

Perform as recommended by EMD Owners Group maintenance program.

14) Cooling system leak check.

Cooling system leak checks are performed every month during the monthly surveillance. Perform additional leak checks under the top deck and in the air box as recommended by EMD Owners Group maintenance program. Lube oil analysis will also identify any coolant leaks.

15) Rebuild/replace AMOT valve.

This item is currently performed once every three years. If BFN implements a two year diesel outage schedule, the AMOT valve will be replaced/rebuilt once every two years.

16) Check cooling fan/motor.

This item is not applicable to BFN.

17) Check shutter linkage and blades.

This item is not applicable to BFN.

18) Replace lube oil.

BFN currently replaces the engine lube oil once every three years. The interval will be changed to once every four years, or when lube oil analysis recommends changeout. BFN currently performs lube oil analysis and may base the frequency of changeout only on this analysis in the future. This is in accordance with the proposed maintenance program.

19) Clean strainer box.

Perform as recommended by EMD Owners Group maintenance program.

20) Change main lube oil filters.

This task will continue to be performed on a yearly basis. As MKW-PS stated in their letter dated May 25, 1993, these filters may be changed every 24 months if pressure drop (dP) across these filters is monitored. BFN does not have dP indication across these filters, so the changeout frequency will remain once every 12 months.

21) Change auxiliary turbocharger lube oil filter.

This task will continue to be performed on a yearly basis. As MKW-PS stated in their letter dated May 25, 1993, these filters may be changed every 24 months if pressure drop (dP) across these filters is monitored. BFN does not have dP indication across these filters, so the changeout frequency will remain once every 12 months.

22) Check DC pump operation (lube oil).

Not applicable to BFN.

23) Replace DC circulating pump brushes (lube oil).

Not applicable to BFN.

24) Check turbocharger filter check valve.

Perform as recommended by EMD Owners Group maintenance program.

25) Replace turbocharger filter element.

Perform as recommended by EMD Owners Group maintenance program.

26) Clean main oil filter housing.

This task will be performed with the main oil filter change.

27) Clean/inspect lube oil circulating pump and motor.

Perform as recommended by EMD Owners Group maintenance program.

28) Check lash adjusters.

Perform as recommended by EMD Owners Group maintenance program.

29) Check autostart sequence.

This task is performed every six months during the redundant start test. The six month test schedule will not be changed.

30) Inspect upper deck area.

Perform as recommended by EMD Owners Group maintenance program.

31) Adjust injector timing and rack settings.

Perform as recommended by EMD Owners Group maintenance program.

32) Perform overspeed trip test.

Perform as recommended by EMD Owners Group maintenance program.

33) Inspect pistons and rings.

Perform as recommended by EMD Owners Group maintenance program.

34) Inspect cylinder liners.

Perform as recommended by EMD Owners Group maintenance program.

35) Check torque on crab bolts.

Perform as recommended by EMD Owners Group maintenance program.

36) Perform lead wire readings

Perform as recommended by EMD Owners Group maintenance program.

37) Perform visual crankcase inspection

Perform as recommended by EMD Owners Group maintenance program.

38) Lubricate governor linkages.

Perform as recommended by EMD Owners Group maintenance program.

39) Replace governor oil.

Perform as recommended by EMD Owners Group maintenance program.

40) Check generator brush condition.

Perform as recommended by EMD Owners Group maintenance program. The brushes are also checked each month during the two hour load run.

41) Inspect/replace generator brushes.

Perform as recommended by EMD Owners Group maintenance program.

42) Clean/inspect collector rings.

Perform as recommended by EMD Owners Group maintenance program.

43) Perform alarm tests.

Perform as recommended by EMD Owners Group maintenance program.

44) Megger lube oil circulating pump motor.

This item will be done every two years. BFN determines the need for motor replacement based on these periodic megger readings.

45) Calibrate all time delay relays.

The timers will be checked every two years. The critical timers which involve the proper operation of the starting circuits will continue to be checked every six months during performance of the redundant start tests.

46) Check voltage regulator operation.

The regulator setpoints will be checked every two years. Operation of the regulator is checked during every run of the diesel (typically once a month).

47) Clean/inspect voltage regulator.

This item will be performed every two years. Any regulator performance problems will be noted during the monthly runs.

48) Check operation of relays/controls/breakers.

This check will be done once every two years. Any operational problems will be detected during the monthly runs or the six month redundant start tests.