

TDI DIESEL GENERATOR
DESIGN REVIEW
AND
QUALITY REVALIDATION
REPORT

prepared for
THE CLEVELAND ELECTRIC ILLUMINATING COMPANY
PERRY NUCLEAR POWER PLANT

by
TDI DIESEL GENERATOR OWNERS GROUP
Revision 1
February, 1985

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2.6 FINAL DOCUMENTATION

The DR/QR program has been completed for The Cleveland Electric Illuminating Company. A summary of the results of this effort are contained in Section 3.0.

Appendix I contains component DR/QR Summary Reports which provide a detailed summary of the review and analysis performed on each component including references to supporting documentation and the recommendations and conclusions resulting from this effort.

Appendix II contains a comprehensive set of maintenance and surveillance recommendations for each component. These recommendations were derived from existing vendor recommendations and the individual component DR/QR Summary reports. The purpose of this Appendix is to provide the utility a basis for its maintenance and surveillance program which will maintain the qualification of its diesel generators for the life of the plant.

This entire report constitutes final documentation of the completion of the DR/QR Program on the Perry TDI diesel generators.

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3.1 Summary Resolution of Sixteen Generic Components (Phase I)

The results of the Phase I program have been submitted to the NRC in a series of reports and supplements (Refs. 2 through 44) that covered the 16 generic components. The results of these reviews are summarized below.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Turbocharger (MP-022/3)	Unlimited Life	Additional testing and maintenance requirements. Revision of operating procedures.
Base and Bearing Caps (03-305A, 03-305C, 03-305D)	Unlimited Life	Additional maintenance and inspection requirements.
Crankshaft (03-310A)	Unlimited Life	None
Cylinder Block and Liner (03-315A, 03-315C)	Unlimited Life	Additional maintenance and inspection requirements.
Cylinder Head Studs (03-315E)	Unlimited Life	None
Connecting Rods: Connecting Rods and Bushings (03-340A)	Unlimited Life	Additional inspection requirements.
Connecting Rod Bearing Shells (03-340B)	Unlimited Life	Additional maintenance requirements. Additional inspections recommended.
Pistons (03-341A)	Unlimited Life	AN piston skirt should be replaced with AE piston skirt.
Air Start Valve (03-359)	Unlimited Life	Additional maintenance requirements. Verification of dimensions recommended.
Cylinder Heads (03-360A)	Unlimited Life	Additional maintenance requirements.
Fuel Injection Equipment: Tube Assembly (03-365C)	Unlimited Life	Additional testing and maintenance requirements. Procurement specification requirement.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Main and Connector Pushrods (03-390C, 03-390D)	Unlimited Life	Additional procurement requirement. Additional inspections recommended. Random destructive testing recommended.
Rocker Arm Capscrews (03-390F)	Unlimited Life	Additional maintenance requirements.
Jacket Water Pump (03-425A)	Unlimited Life	Additional maintenance requirements.
Wiring and Terminations (03-668B)	Unlimited Life	None

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<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>	
Turbocharger - Bracket: Bolting and Gaskets (02-475A&C)	Unlimited Life	Implementation of proper torque on bracket bolting. Additional Quality Revalidation inspections recommended. Additional inspections recommended.	1
Air Butterfly Valve Assembly (02-475B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.	
Intake Air Silencer (02-805A)	Unlimited Life	None	
Intake Air Filter (02-805B)	Unlimited Life	Additional maintenance recommendations.	
Flex Connections (02-805D)	Unlimited Life	None	
<u>LUBE OIL</u>			
Lube Oil Pressure Regulating Valve (00-420)	Unlimited Life	Additional maintenance recommendations.	
Lube Oil Fittings Internal Headers (Large Bore Scope Only) (02-307A-LB)	Unlimited Life	None	
Lube Oil Fittings- Internal: headers (Small Bore Scope Only) (02-307A-SB)	Unlimited Life	Verify as-built conditions are as indicated in Component Design Review Checklist 02-307D.	
Lube Oil Fittings- Internal-Tubing and Fittings (Small Bore Scope Only) (02-307B)	Unlimited Life	None	

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Lube Oil Fittings Internal-Supports (Small Bore Scope Only) (02-307D)	Modifications	Replace all 1/4-inch U-bolts with 3/8-inch U-bolts. U-bolts should be torqued sufficiently to prevent the header from moving axially without overstressing the header. Nuts should have suitable locking devices installed.
Engine Driven Lube Oil Pump (02-420)	Modifications	Addition of a Dresser coupling on the pump suction line to mitigate the thermal expansion loading and stresses on the pump inlet nozzle.
Lube Oil Lines - External Tubings, Fittings, Couplings (Large Bore Scope Only) (02-465A-LB)	Modifications	Replace 12-inch Dresser coupling gasket with VITON gaskets. Ensure a minimum installation gap of 0.171 inches, between pipe ends, exists at the 12-inch Dresser coupling.
Lube Oil Lines - External-Tubing, Fittings, Coupling (Small Bore Scope Only) (02-465A-SB)	Modifications	Addition/modification of supports. Refer to DR/QR report 02-465C for details.
Lube Oil Lines External - Valves (02-465B)	Unlimited Life	None
Lube Oil Lines External-Supports (Large Bore Scope Only) (02-465C-LB)	There are no supports for this component. No design review is required.	
Lube Oil Lines External-Supports (Small Bore Scope Only) (02-465C-SB)	Modifications	Addition/modification of supports. Refer to DR/QR report 02-465C-SB for details.
Turbocharger - Lube Oil Fitting- Piping (Large Bore Scope Only) (02-467A-LB)	Modifications	Replace 2½-inch Dresser couplings (located between the turbocharger and lube oil sump tank for both drain lines) with 2½-inch 150 lb. S.O. flanges with A307 bolts.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Crankshaft & Bearings: Thrust Bearing Ring (02-310C)	Unlimited Life	Additional maintenance recommendations.
Crankcase: Crankcase Assembly (02-311A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Crankcase: Crankcase Mounting Hardware (02-311D)	Unlimited Life	None
Crankcase: Crankcase Gaskets and Mounting Hardware (02-386B)	Unlimited Life	Additional Quality inspections recommended.

CYLINDER BLOCK, LINERS & WATER MANIFOLD

Cylinder Block (02-315A)	Unlimited Life	Implementation of routine inspections recommended. Perform cylinder liner/block bore dimensional check. Additional Quality inspections recommended.
Cylinder Block Liners & Water Manifold - Cylinder Liner (02-315C)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Jacket Water Manifold Piping (Large Bore Scope Only) (02-315D)	Unlimited Life	None
Cylinder Block Liners & Water Manifold: Studs (02-315E)	Unlimited Life	The installation torque should be changed to lower the stresses in the cylinder block. Additional Quality inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Starting Air Manifold: Valves, Strainers, & Filters (02-441B)	Modifications	Additional maintenance recommendations. Addition of free flowing drains to the air distributor filter.
Starting Air Manifold - Supports (Large Bore Scope Only) (02-441C-LB)	Unlimited Life	None
Starting Air Manifold - Supports (Small Bore Scope Only) (02-441C-SB)	Modifications	Addition/modification of supports. Refer to DR/QR report 02-441C-SB for details.
Barring Device- Pneumatic Regulator Valve/Shutoff Valve (02-525B)	Unlimited Life	Additional maintenance recommendations.
Starting Air Tank (02-835B)	Unlimited Life	Additional maintenance recommendations.
Air Start Tank Relief Valves (02-835E)	Unlimited Life	None

CONNECTING RODS

Connecting Rods: Rods and Bushings (02-340A)	Unlimited Life	Additional maintenance recommend- ations. Additional Quality inspections recommended.
Connecting Rods: Bearing Shells (02-340B)	Unlimited Life	Additional maintenance recommend- ations. Additional Quality Revalidation inspections recommended.

PISTONS

Pistons (02-341A)	Unlimited Life	Additional Quality inspections recommended.
Pistons: Rings (02-341B)	Unlimited Life	Additional maintenance recommend- ations. Additional Quality Revalidation inspections re- commended.

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How To Use This Report

Tabs in this report identify the following categories:

- Turbo, Intake, Intercooler & Exhaust
- Lube Oil
- Engine Base & Bearing Caps
- Crankshaft & Bearings
- Cylinder Block, Liners & Water Manifold
- Air Start & Barring Device
- Connecting rods
- Pistons
- Camshaft & Valve Train
- Idler Gear Assembly & Front Gear Case
- Flywheel
- Engine Instrumentation & Wiring
- Overspeed Trip & Governor
- Engine Shutdown & Equipment
- Jacket Water
- Cylinder Heads & Valves
- Fuel Oil Injection
- Generator
- Control Panel Assembly
- Engine & Auxiliary Sub-Base & Foundation Bolts

These categories have been defined to allow the reader to review a complete diesel generator subsystem in a convenient manner.

Within each category tabs identify Perry specific component numbers.

A given component report can be found by:

- a) If the component number is known - use the alpha - numeric index which identifies the volume number and category in which the component report is located.
- b) If only the component name is known - Section 3.2 may be used as a cross-reference to find the volume number where the component report may be found.

Some reports address more than one component. a tab is provided for each component. However, some components are combined under one report. Slip sheets are provided where required to reference back to the appropriate tab. Some components required more than one report. These are identified by the abbreviation LB-Large Bore and SB-Small Bore on the component number tabs.

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Component Number	Component Description	Category	Volume No.
F-068	Intercooler	Turbo, Intake Intrclr. & Exhaust	2
MP022/23	Turbocharger	Turbo, Intake, Intrclr. & Exhaust	2
00-420	Lube Oil Pressure Regulating Valve	Lube Oil	2
00-442A	Starting Air Distributor: Distributor Assembly	Air Start & Barring Device	3
00-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	Air Start & Barring Device	3
00-621A	Fuel Oil Drip Tank Assembly	Fuel Oil Injection	4
02-CFR	Turbocharger Thrust Bearing Lubricant System	Turbo, Intake, Intrclr. & Ex- haust	2
02-305A	Base and Bearing Caps: Base Assembly	Engine Base & Bearing Caps	2
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	Engine Base & Bearing Caps	2
02-305D	Base and Bearing Caps: Main Bearing Caps	Engine Base & Bearing Caps	2
02-307A	Lube Oil Fittings: Internal - Headers	Lube Oil	2
02-307B	Lube Oil Fittings: Internal - Tube & Fittings	Lube Oil	2
02-307D	Lube Oil Fittings Internal: Supports	Lube Oil	2
02-310A	Crankshaft	Crankshaft & Bearings	2
02-310B	Main Bearings	Crankshaft & Bearing	2

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Component Number	Component Description	Category	Volume No.
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	Crankshaft & Bearing	2
02-311A	Crankcase: Crankcase Assy	Crankshaft & Bearing	2
02-311D	Crankcase: Crankcase Mounting Hardware	Crankshaft & Bearings	2
02-315A	Cylinder Block	Cyl. Block & Liners & Water Manifold	2
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	Cyl. Block & Liners & Water Manifold	2
02-315D	Cylinder Block Liners & Jacket Water Manifold & Piping	Cyl. Block & Liners & Water Manifold	2
02-315E	Cylinder Block Liners & Water Manifold: Studs	Cyl. Block & Liners & Water Manifold	2
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	Cyl. Block & Liner & Water Manifold	2
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	Cyl. Block & Liners & Water Manifold	2
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	Jacket Water	4
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	Jacket Water	4
02-316C	Jacket Water Inlet Manifold: Vent line to Discharge Manifold	Jacket Water	4
02-317A	Water Discharge Manifold: Jacket Water Discharge Manifold/Piping	Jacket Water	4

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Component Number	Component Description	Category	Volume No.
02-317B	Water Discharge Manifold: Coupling & Seals	Jacket Water	4
02-317C	Water Discharge Manifold: Supports	Jacket Water	4
02-330A	Flywheel	Flywheel	3
02-330B	Flywheel - Bolting	Flywheel	3
02-335B	Front Gearcase - Gaskets and Bolting	Idler Gear Assembly & Front Gear Case	3
02-340A	Connecting Rods: Connecting Rods & Bushings	Connecting Rods	3
02-340B	Connecting Rod Bearing Shells	Connecting Rods	3
02-341A	Pistons	Pistons	3
02-341B	Pistons: Rings	Pistons	3
02-341C	Piston Pin Assembly	Pistons	3
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	Camshaft & Valve Train	3
02-345B	Tappets and Guides: Fuel Tappet Assembly	Camshaft & Valve Train	3
02-345C	Tappets and Guides: Fuel Pump Base Assembly	Camshaft & Valve Train	3
02-350A	Camshaft: Camshaft Assembly	Camshaft & Valve Train	3
02-350B	Camshaft: Camshaft Bearing	Camshaft & Valve Train	3
02-350C	Camshaft: Supports, Bolting and Gear	Camshaft & Valve Train	3
02-355A	Idler Gear Assembly Crank To Pump Gear	Idler Gear Assembly & Front Gear Case	3

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Component Number	Component Description	Category	Volume No.
02-355B	Idler Gear Assembly: Idler Gear Assembly	Idler Gear As- sembly & Front Gear Case	3
02-359	Air Start Valve	Air Start & Barring Device	3
02-360A	Cylinder Heads	Cylinder Heads & Valves	4
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	Cylinder Heads & Valves	4
02-360C	Cylinder Head and Valves: Bolting and Gaskets	Cylinder Heads & Valves	4
02-360D	Cylinder Head & Valves: Springs	Cylinder Heads & Valves	4
02-362A	Subcover	Camshaft & Valve Train	3
02-365A	Fuel Injection Pump	Fuel Oil In- jection	4
02-365B	Fuel Injection Equipment - Fuel Injection Tips	Fuel Oil In- jection	4
02-365C	Fuel Injection Equipment - Tube Assembly	Fuel Oil In- jection	4
02-365D	Fuel Injection Equipment: Supports	Fuel Oil In- jection	4
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	Fuel Oil In- jection	4
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	Fuel Oil In- jection	4
02-375	Intake Manifold and Piping	Turbo, Intake, Intrclr. & Ex- haust	2
02-380A	Exhaust Manifold	Turbo, Intake, Intrclr. & Ex- haust	2

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Component Number	Component Description	Category	Volume No.
02-380B	Exhaust Manifold: Gasket and Bolting	Turbo, Intake, Intrclr. & Ex- haust	2
02-385B	Cylinder Block Covers: Gaskets and Bolting	Cyl. Block & Liners & Water Manifold	2
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	Crankshaft & Bearings	2
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390C	Main and Connector Pushrods	Camshaft & Valve Train	3
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	Camshaft & Valve Train	3
02-390E	Rocker Arms and Pushrods: Bushings	Camshaft & Valve Train	3
02-390F	Rocker Arms and Pushrods: Lifters	Camshaft & Valve Train	3
02-390G	Rocker Arms and Pushrods: Misc. Bolts & Drive Studs	Camshaft & Valve Train	3
02-410A	Overspeed Trip Governor	Overspeed Trip & Governor	3
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	Overspeed Trip & Governor	3
02-410C	Overspeed Trip: Coupling	Overspeed Trip & Governor	3
02-410D	Overspeed Trip Vent Valve	Overspeed Trip & Governor	3

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Component Number	Component Description	Category	Volume No.
02-411A	Governor Drive: Governor & Tachometer Drive Gear and Shaft	Overspeed Trip & Governor	3
02-411B	Governor Drive: Couplings, Pins & Keys	Overspeed Trip & Governor	3
02-413A	Governor Linkage	Overspeed Trip & Governor	3
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	Fuel Oil Injection	4
02-415A	Governor Assembly: Woodward Governor	Overspeed Trip & Governor	3
02-415B	Governor Assembly - Booster Servomotor	Overspeed Trip & Governor	3
02-415C	Governor Assembly - Heat Exchanger	Overspeed Trip & Governor	3
02-420	Engine Driven Lube Oil Pump	Lube Oil	2
02-425A	Engine Driven Jacket Water Pump	Jacket Water	4
02-435A	Jacket Water Fittings: Pipe & Fittings	Jacket Water	4
02-435B	Jacket Water Fittings - Supports	Jacket Water	4
02-435C	Jacket Water Inlet Fittings - Valves	Jacket Water	4
02-436A	Intercooler Piping	Turbo, Intake Intercooler & Exhaust	2
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	Turbo, Intake Intercooler & Exhaust	2

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Component Number	Component Description	Category	Volume No.
02-437	Turbo Water Piping: Pipe & Fittings	Jacket Water	4
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	Air Start & Barring Device	3
02-441B	Starting Air Manifold Valves, Filters & Strainer	Air Start & Barring Device	3
02-441C	Starting Air Manifold: Supports	Air Start & Barring Device	3
02-445	Fuel Oil Booster Pump	Fuel Oil In- jection	4
02-450A	Fuel Oil Header: Piping/Tubing	Fuel Oil In- jection	4
02-450B	Fuel Oil Header: Fuel Oil Supports	Fuel Oil In- jection	4
02-455A	Fuel Oil Filters & Strainers: Filters	Fuel Oil In- jection	4
02-455B	Fuel Oil Filters & Strainers: Strainers	Fuel Oil In- jection	4
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	Fuel Oil In- jection	4
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	Lube Oil	2
02-465B	Lube Oil Lines - External Valves	Lube Oil	2
02-465C	Lube Oil Lines External Supports	Lube Oil	2
02-467A	Turbocharger: Lube Oil Fitting - Pipe, Tubing, Fittings & Flexible Coupling	Lube Oil	2
02-467B	Turbocharger: Lube Oil Fittings - Supports	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-475A	Turbocharger: Bracket Bolting and Gaskets	Turbo, Intake, Intrclr. & Exhaust	2
02-475B	Air Butterfly Valve Assembly	Turbo, Intake, Intrclr. & Exhaust	2
02-475C	Turbocharger: Bracket - Bolting & Gaskets	Turbo, Intake, Intrclr. & Exhaust	2
02-500A	Control Panel Assembly Cabinet/System	Control Panel Assembly	4
02-500F	Control Panel Assembly Accumulator	Control Panel Assembly	4
02-500G	Control Panel Valves	Control Panel Assembly	4
02-500H	Control Panel Assembly Pressure Switch	Control Panel Assembly	4
02-500I	Control Panel Assembly: Control Relays	Control Panel Assembly	4
02-500J	Control Panel Assembly: Solenoid Valves	Control Panel Assembly	4
02-500L	Control Panel Assembly - Piping, Tubing, Fittings	Control Panel Assembly	4
02-500M	Control Panel Assembly: Terminal Boards/Switches/Wiring	Control Panel Assembly	4
02-525B	Barring Device - Pneumatic: Regulator Valve/Shut Off Valve	Air Start & Barring Device	3
02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports	Air Start & Barring Device	3
02-540A	Lube Oil Sump with Strainer Assembly and Mounting Hardware	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	Lube Oil	2
02-540C	Lube Oil Sump Tank: Mounting Hardware	Lube Oil	2
02-550	Foundation Bolts: Anchors, Bolts, Misc. Hardware	Engine & Aux. Sub Base & Foundation Bolts	4
02-630A	Pyrometer Conduit Assembly: Conduit	Engine Instru-mentation & Wiring	3
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	Engine Instru-mentation & Wiring	3
02-630C	Pyrometer Conduit Assembly: Support	Engine Instru-mentation & Wiring	3
02-630D	Pyrometer Conduit Assembly Thermocouple	Engine Instru-mentation & Wiring	3
02-650A	Emergency Diesel Generator	Generator	4
02-650B	Generator Control	Generator	4
02-650C	Generator-Shaft & Bearing	Generator	4
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	Engine Instru-mentation & Wiring	3
02-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	Engine Instru-mentation & Wiring	3

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Component Number	Component Description	Category	Volume No.
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals	Engine Instru- mentation & Wiring	3
02-689	Off-Engine Alarm Sensors	Engine Instru- mentation & Wiring	3
02-690	Engine Alarm Sensors - Temperature & Level Switches	Engine Instru- mentation & Wiring	3
02-691	Off Engine Safety Alarm Sensors - Level & Pressure Switches	Engine Instru- mentation & Wiring	3
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	Engine Shut- down & Equip- ment	3
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	Engine Shut- down & Equip- ment	3
02-695C	Engine Shutdown Trip Switches	Engine Shut- down & Equip- ment	3
02-700A	Jacket Water Standpipe: Pipe, Fittings, Gaskets	Jacket Water	4
02-700B	Jacket Water Standpipe: Valves	Jacket Water	4
02-700C	Jacket Water Standpipe: Pipe Supports	Jacket Water	4
02-700E	Jacket Water Standpipe: Switches	Jacket Water	4
02-700F	Jacket Water Standpipe & Misc. Bolting	Jacket Water	4
02-717A	Auxiliary Skid	Jacket Water	4

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Component Number	Component Description	Category	Volume No.
02-717B	Aux Sub Base & Oil & Water Piping - Jacket Water: Valves	Jacket Water	4
02-717C	Aux Sub Base & Oil & Water Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers	Engine & Aux. Sub Base & Foundation Bolts	4
02-717D	Aux Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting	Jacket Water	4
02-717E	Aux Sub Base & Oil & Water Piping - Jacket Water: Supports	Jacket Water	4
02-717F	Aux. Sub Base & Oil & Water Piping - Lube Oil: Pipe and Fittings	Lube Oil	2
02-717G	Aux Sub Base & Oil & Water Piping - Lube Oil: Valves	Lube Oil	2
02-717H	Aux. Sub-Base & Oil & Water Piping - Lube Oil: Gaskets & Bolting	Lube Oil	2
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	Lube Oil	2
02-717J	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	Fuel Oil	2
02-717K	Aux Sub Base & Oil & Water Piping - Fuel Oil: Valves	Fuel Oil Injection	4
02-717L	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	Fuel Oil Injection	4

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Component Number	Component Description	Category	Volume No.
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil: Supports	Fuel Oil Injection	4
02-805A	Intake Air Silencer	Turbo, Intake, Intercooler & Exhaust	2
02-805B	Intake Air Filter	Turbo, Intake, Intercooler & Exhaust	2
02-805D	Flex Connections	Turbo, Intake, Intercooler & Exhaust	2
02-810A	Jacket Water Standby Heater Pump	Jacket Water	4
02-810B	Jacket Water Heat Exchanger	Jacket Water	4
02-810C	Thermostatic Valve	Jacket Water	4
02-810D	Misc. Equipment - Heater, Jacket Water	Jacket Water	4
02-820A	Misc. Equipment - Heater, Lube Oil Sump Tank	Lube Oil	2
02-820B	Before & After Lube Oil Pump	Lube Oil	2
02-820C	Lube Oil Full Pressure Strainer	Lube Oil	2
02-820D	Lube Oil System - Lube Oil Keepwarm Strainer	Lube Oil	2
02-820E	Oil Prelube Filter	Lube Oil	2
02-820F	Full Flow Lube Oil Filter	Lube Oil	2
02-820G	Lube Oil Heat Exchanger	Lube Oil	2
02-825A	Fuel Oil Day Tank	Fuel Oil Injection	4

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Component Number	Component Description	Category	Volume No.
02-825D	Fuel Oil System - Fuel Oil Duplex Strainer	Fuel Oil Injection	4
02-835B	Starting Air Tank	Air Start & Barring Device	3
02-835E	Misc. Equipment - Starting Air Tank Relief Valve	Air Start & Barring Device	3

COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

Turbocharger-Bracket:	
COMPONENT <u>Bolting and Gaskets</u>	UTILITY <u>Cleveland Electric Illuminating Company</u>
GROUP PARTS LIST NO. <u>02-475A,C</u>	TASK DESCRIPTION NO. <u>DR-03-02-475A,C-1</u>
SNPS GPL NO. <u>03-475A,D</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Design review for these components is not required based on a review of the following:

- The Comanche Peak lead engine DR/QR report (Ref. 1).
- TDI Parts Manuals, Volume II for Perry and Comanche Peak Power Stations (Refs. 2 and 3).
- TDI drawings (Ref. 4).
- The EDG Component Tracking System for applicable industry and site experience (Refs. 5 and 6). Nuclear and non-nuclear experience identifies a few incidents of broken welds on fabricated items or piping supported by the turbocharger bracket; such events were caused by loosened or broken turbocharger hold-down bolts, all resulting from engine vibration. To prevent recurrence of similar events, verification of the torque values applied to the turbocharger hold-down bolts and the bracket mounting bolts during installation is required.

The Comanche Peak lead engine DR/QR report indicates that the pipe thermal loads, along with the engine vibration loads, are the most significant loads experienced by the brackets and the mounting bolts. The design of the water jacketed, multi-pipe, exhaust manifold connecting the cylinders to each turbocharger is identical for both stations. The adapter piece (transitional piece) at the turbocharger exhaust connection and its expansion joint is similarly designed, though the dimensions are different. The thermal loads experienced by the turbocharger brackets and the associated mounting hardware for both stations should therefore remain similar.

Review of the amplified response acceleration spectra curves for Perry Station (Ref. 7) indicates that the seismic loadings are more favorable than those at the Comanche Peak Station.

TASK DESCRIPTIONS (continued)

Based on the above review the turbocharger brackets at Perry should be adequate to resist the seismic inertia loads, deadweight, thermal loads, and engine vibration loads. Similarly, the 3/4 in. capscrews (12 screws for each bracket) attaching the bracket to the engine block should be satisfactory; however, based on the DR/QR report for Comanche Peak Station, the review of the turbocharger bracket and bolting finds that in the worst case load condition, vibration and manifold nozzle loads could potentially produce bolt loads in excess of preloads. Therefore, the bracket to engine and bracket to turbo base screws (P.N. GB-001-143 and GB-001-120) are recommended to be inspected on a regular basis as discussed below:

- Each month for the first three months of commercial operation these screws should be inspected to assure that no screw has loosened because of engine operating loads. If during these inspections none of the screws are found loosened or damaged, from then on inspections are to be conducted on a yearly basis (or during plant shutdown). But if any time during inspection any screw is found loosened or damaged, it must then be replaced (if damaged) and all screws retorqued as follows; 125 ft-lbs for the bracket to engine screws and 75 ft-lbs for the bracket to turbo base screws.

To avoid damage to bracket to engine, and/or bracket to turbo, base screws, the proper torques as delineated above should be utilized for each respective bracket bolting application.

There are no modification recommendations for these components.

The following inspections as described in the Component Quality Revalidation Checklist for Component No. 02-475C should be performed on both engines:

- Verification of compliance to the TDI Instruction Manual for bolt torque loads applied to the bolted connections through review of existing documentation.
- Visual inspection to verify proper installation of the bracket bolting.
- Verification of the material of the bracket-to-engine bolting.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 3 of 4
DR-03-02-475A,C-1

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

1. Comanche Peak Steam Electric Station - Unit 1, DR/QR Report for Group Parts List No. 02-475A and C.
2. TDI Manual Volume II, for Model DSRV-16-4 Diesel Engine/Generator, Perry Nuclear Power Plant, Units 1 and 2, Parts List No. 02-475-22-02, Rev. 3, dated October 22, 1979, and Drawing 02-475-22, Rev. B, dated February 9, 1978.
3. TDI Manual Volume II for Model DSRV-16-4 Diesel Engine/Generator, Comanche Peak Steam Electric Station - Unit 1, Parts List No. 02-475-22-02, Rev. C.
4. TDI Drawings

<u>Drawing No.</u>	<u>Description</u>
02-475-22-AL	Bar Support Outer
02-475-22-AK	Bar Support Inner
02-475-21-AD	Adapter, Intercooler Inlet - Right Bank
02-475-21-AE	Adapter, Intercooler Inlet - Left Bank
02-475-21-AF	Bracket, Turbo G-90 - Right Bank
02-475-21-AG	Bracket, Turbo G-90 - Left Bank
02-475-22-AA	Adapter, Intercooler Outlet - Right Bank
02-475-22-AB	Adapter, Intercooler Outlet - Left Bank

5. Emergency Diesel Generator Component Tracking System - Nuclear and Non-nuclear Industry Experience dated November 5, 1984.
6. Emergency Diesel Generator Component Tracking System - Perry Nuclear Power Station dated November 5, 1984.
7. Gilbert Associates, Inc., Specification SP-562-4549-00 for Class 1E Diesel Generator Units, Rev. II dated January 11, 1977, Attachment Specification for Seismic Analysis, Testing, and Documentation, Perry Nuclear Power Station - Units 1 and 2, SP-750-4549-00, dated August 30, 1973.

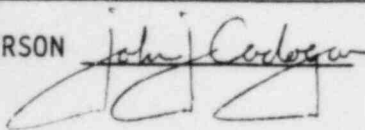
COMPONENT DESIGN REVIEW CHECKLIST

Page 4 of 4
DR-03-02-475A,C-1

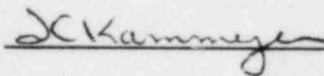
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

Engine Driven COMPONENT <u>Lube Oil Pump</u>	UTILITY <u>Cleveland Electric Illuminating Company</u>
GROUP PARTS LIST NO. <u>02-420</u>	TASK DESCRIPTION NO. <u>DR-03-02-420-1</u>
SNPS GPL NO. <u>03-420</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that previously addressed in the lead engine report. There was no site experience listed in the Component Tracking System.
- A review of the lead engine DR/QR report for Comanche Peak.
- Similarity of the Perry component to the lead engine component. Both are IMO Model 8JK-437D.

There are no maintenance recommendations for this component as a result of lead engine design review.

It is recommended that a Dresser coupling be added on the pump suction line to mitigate the thermal expansion loading and stresses on the pump inlet nozzle. The coupling should be located between the relief valve branch connection and the pump inlet nozzle.

Quality revalidation is not deemed necessary for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

COMPONENT	<u>Before & After</u> <u>Lube Oil Pump</u>	UTILITY	<u>Cleveland Electric Illuminating Company</u>
GROUP PARTS LIST NO.	<u>02-820B</u>	TASK DESCRIPTION NO.	<u>DR-03-02-820B-1</u>
SNPS GPL NO.	<u>10-113</u>	CLASSIFICATION TYPE	<u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry and site experience, except that already addressed in the lead engine report.
- A review of the lead engine DR/QR report (Comanche Peak).
- The before and after lube oil pump at Perry is the same as the component in the lead engine.

A review of pump nozzle loads indicates that the applied piping loads are above the manufacturer's recommended allowables. There has however been no experience of pump leakage due to these loads at Comanche Peak or other V-16 installations. As such, the following inspection should be performed as part of the daily engine walkdown:

- The pump should be inspected for signs of leakage and corrective modifications (addition of flexible piping connections) be implemented as required.

There are no modifications required based on the lead engine report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-03-02-820B-1

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

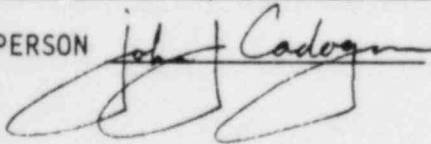
REFERENCES

Not required

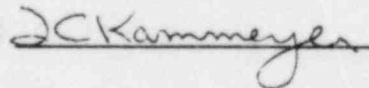
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

PERRY NUCLEAR POWER PLANT - UNIT 1

CYLINDER BLOCK COMPONENT PART NO. 02-315A

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Perry Nuclear Power Plant requires Design and Quality Revalidation reviews of the cylinder blocks to determine the adequacy of design for the intended use at Perry. The blocks are manufactured by TDI and are supplied under their part number 02-315-03-AE. The cylinder block forms the framework of the liquid cooled engine and provides passage for coolant and support for the cylinder liners and cylinder heads.

II OBJECTIVE

The objective of this review was to evaluate the structural adequacy of the cylinder block for its intended use at Perry Nuclear Power Plant.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- Evaluation of steady state stresses, alternating stresses and stiffness in key portions for the cylinder block.
- Review of engine operating experience.
- Review of engine operating conditions at Perry and identification of any differences from those at Comanche Peak.
- Review of metallurgical/microstructure analysis of cylinder block material.
- Performance of dimensional check and evaluation of liner/block interaction.
- Evaluation of crack growth rate for cylinder block landing and counterbore diameter by comparison with conservative Shoreham data and analysis.
- Review of liquid penetrant inspections of Perry DSRV-16-4 1A and 1B engine blocks.
- Review of Perry site, nuclear and non-nuclear experiences (see Appendix C).
- Review of Quality Revalidation Checklist results for acceptability.

IV RESULTS AND CONCLUSIONS

A generic investigation of the structural adequacy of the TDI R-4 and RV-4 series diesel engine cylinder blocks for emergency standby service in nuclear power plants is summarized in Reference 1. The investigation considers the cause, extent, and consequences of cylinder block cracking, and the inspections required to assure a sufficient margin of safety during continued operation under test and postulated accident conditions. 1

Evaluation of steady state stresses, alternating stresses and stiffness in key portions of the cylinder block was accomplished as part of the strain gage testing at Shoreham and the results were included in the cumulative damage and crack growth analyses (Ref. 1). 1

Diesel generators 1A and 1B have had limited operational experience. Engine hours of operation accumulated to date consist of factory test hours performed by TDI.

The engine operating conditions at Perry were compared to those at Comanche Peak and Shoreham. No significant differences were found that would affect the structural integrity assessment of the Perry blocks.

It is recommended that liner bore and mating block dimensions be checked in order to evaluate the interaction of the block and liner. These results are utilized in applying the cumulative damage methodology outlined in Figure 5-1 of Reference 1. For the purpose of analyzing the steady state and alternating stresses present, cylinder liner/block bore interaction is assumed similar to that present at Shoreham. This assumption must be verified prior to the next emergency standby for engines 1A and 1B. 1

The power output for this engine is 7000 kW at 100 percent load. Maximum output required for LOOP/LOCA is 4460 kW (Ref. 2). The duration of a LOOP/LOCA used in this analysis is 168 hours.

Strain gage testing of the original Shoreham EDG 103 block, inspection data from before and after extensive test operation, and materials testing were used as a basis to predict adequate life for cylinder blocks. The rate of propagation of cracks between stud holes during operation of the original Shoreham EDG 103 block, when compared with the Perry LOOP/LOCA requirements, indicates that even if the Perry blocks had ligament cracks they are predicted to withstand with sufficient margin a LOOP/LOCA event. 1

To date, no inspection results for Engine 1A and 1B block tops have been reported. With no block top inspection results, application of the cumulative damage analysis, Figures 5-1 and 5-3 of Reference 1, shows that continued operation is acceptable provided that:

- a. Cylinder liner/block bore dimensions are satisfactory.
- b. Inspections show that no stud-to-stud or stud-to-end cracks are present either between the cylinder heads or at the end of the block whenever the engine is placed into emergency standby service after any operation greater than 50 percent nameplate load. If cracks are found, further inspection must demonstrate that the cracks are less than 1.5 inches deep before returning the engine to standby status.

Alternatively, it is recommended that when the engines are disassembled for the cylinder liner/block bore dimensional inspection, the block tops be inspected for cracks. Then, application of the cumulative damage analysis, Figure 5-1 of Reference 1, shows that continued engine operation without inspection is justified for 572 hours at 100 percent power level (or variable power operation resulting in equivalent cumulative damage) with sufficient margin remaining for a LOOP/LOCA event (Reference 2) provided that:

- a. Inspections show that block tops are without detectable block top cracks.
- b. Cylinder liner/block bore dimensions are satisfactory.

Engine operation in excess of the above listed time periods without repeated inspection is justified so long as the fatigue damage index since the last complete block top inspection does not exceed the allowable fatigue damage index based upon the last complete inspection. In the future this process may be repeated, and additional engine operation without repeated inspection may continue until the additional fatigue damage index equals the allowable fatigue damage index established by the last complete inspection which showed no cracking.

Optionally, in the future after additional engine operation without repeated inspection has accumulated fatigue damage index which exceeds the allowable fatigue damage index, engine operation can continue without removal of cylinder heads and maintain sufficient margin to withstand a LOOP/LOCA event provided repeated eddy current inspections described in Figure 5-1 of Reference 1 are performed between the cylinder heads and adjacent to the cylinder heads at the ends of the blocks.

The information provided on TER 03-004 has been reviewed and is consistent with the final conclusions of this report.

Quality Revalidation Inspection results identified in Appendix B have been reviewed and considered in the performance of this design review, and the results are consistent with the final conclusions of this report.

Based on the above review, subsequent completion and review of block top inspections, and cylinder liner/block bore dimensional check as identified in Appendix B for Engines 1A and 1B, and implementation of inspections, it is concluded that the cylinder blocks are acceptable for their intended use at Perry.

IV REFERENCES

1. Design Review of TDI-R4 and RV-4 Series Emergency Diesel Generator Cylinder Blocks FaAA-84-9-11.1.
2. Letter from E. C. Christiansen (Perry Nuclear Power Plant) to C. L. Ray, Jr. (TDI Owners Group), dated 7/23/84.
3. FaAA Support Package Number SP-84-6-12(i).

1

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Cylinder Block</u>	UTILITY <u>Cleveland Electric Illuminating Co. Perry Nuclear Power Plant - Unit 1</u>
GPL NO. <u>02-315A</u>	REV. NO. <u>3</u>
SNPS GPL NO. <u>03-315A</u>	

TASK DESCRIPTIONSEngine 1A

1. Assemble and review existing documentation.
2. Perform a dimensional check on the area around the cylinder liner for all cylinder block liner landings.
3. Perform a Liquid Penetrant test or Magnetic Particle test on the cylinder block liner landing along the top landing surface, fillet radius, and vertical face adjacent to the landing surface. Liner landings 3L, 4L, 5L, 6L and 3R, 4R, 5R, 6R should be inspected with the liners removed. If linear indications are found, increase inspection plan to all liner landings.
4. Perform a Liquid Penetrant test or Magnetic Particle test on the cylinder head mating surface on top of the cylinder block. The area between stud hole and liner, and between adjacent cylinder stud hole should be inspected. The inspection plan should include cylinders 3L, 4L, 5L, 6L and 3R, 4R, 5R and 6R. If linear indications are found, increase inspection plan to all cylinders.
5. Perform an Eddy Current test on the cylinder head stud holes if required (i.e. linear indications found at stud hole extending into threads).
6. Remove a sample from each cylinder block by drilling and cutting. The samples shall be tetrahedral in shape with a one inch square base and a height of 5/8 inch. Attachment B shows the locations where the samples should be taken.

TASK DESCRIPTIONS (continued)

Engine 1B

Same as Engine 1A

ATTRIBUTES TO BE VERIFIED

Engine 1A

1. Quality status of Component Document Package
2. Dimensions of the cylinder block liner landing area
- 3-5. Surface integrity of the cylinder block liner landing
6. Samples are taken from the cylinder block in accordance with TER #99-016.

Engine 1B

Same as Engine 1A

ACCEPTANCE CRITERIA

Engine 1A

1. Satisfactory Document Package
2. Review of inspection report by Design Group
- 3-4. See Attachment A
- 5-6. Review of inspection report by the Design Group

Engine 1B

Same as Engine 1A

COMPONENT QUALITY REVALIDATION CHECKLIST

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03-02-315A

REFERENCES

Engine 1A

1. QCI No. 52
2. Approved Site NDE Procedures
- 3-4. TER#s 99-004, 99-018, 99-036
5. FaAA Procedure NDE 11.8
6. TER #99-016, 99-031

Engine 1B

Same as Engine 1A

DOCUMENTATION REQUIRED

Engine 1A

1. Document Summary Sheet
- 2-6. Inspection Report

Engine 1B

Same as Engine 1A

GROUP CHAIRPERSON

Michael S. [Signature]

PROGRAM MANAGER

J. Kammerer [Signature]

COMPONENT REVIEW

Engine 1A

1. No EDGCTS site experience documents are in evidence.

COMPONENT QUALITY REVALIDATION CHECKLIST

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03-02-315A

COMPONENT REVIEW (continued)

Engine 1A (continued)

- 2-5. No inspection reports have been received which fulfill these requirements.
6. The block sample was forwarded to design for analysis. The block was found to be typical Class 40 grey cast iron. These results were reported by TER# 03-004.

Engine 1B

Same as Engine 1A

RESULTS AND CONCLUSION

Engine 1A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine 1B

Same as Engine 1A

GROUP CHAIRPERSON Nita A. Suleta

PROGRAM MANAGER JC Kammerer

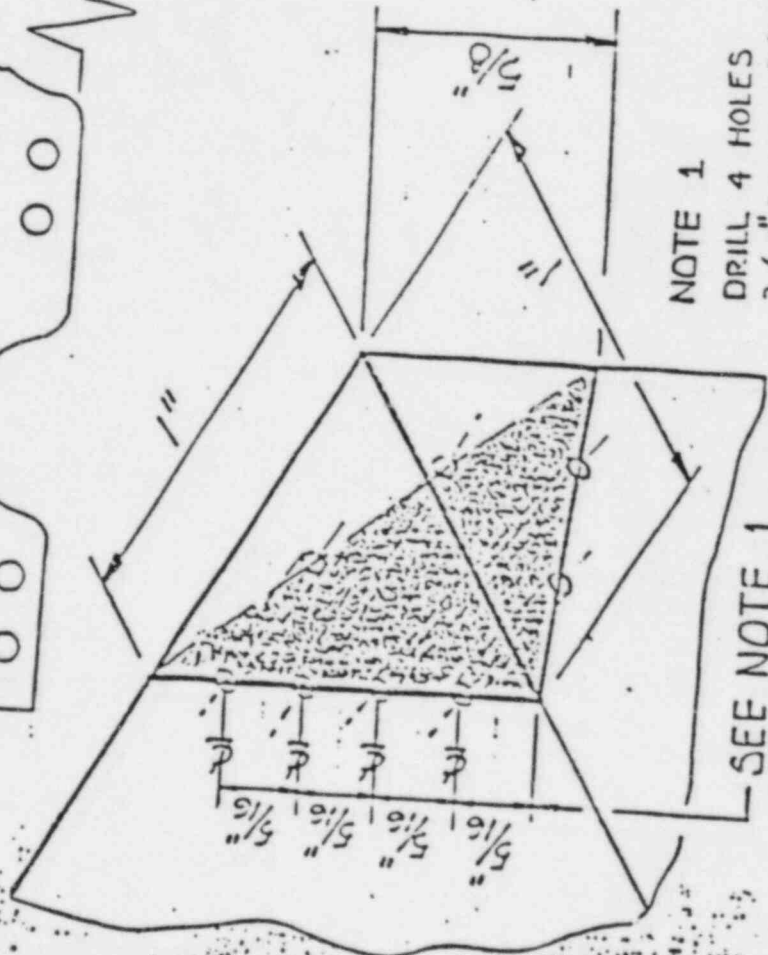
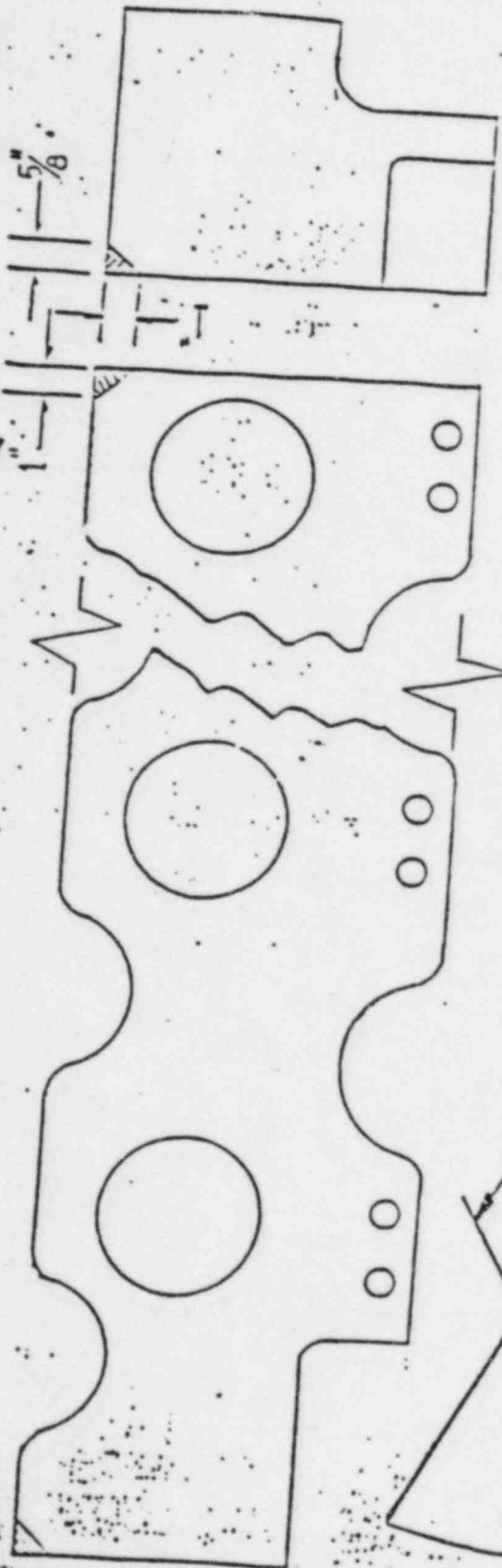
COMPONENT QUALITY REVALIDATION CHECKLIST

ACCEPTABLE CRITERIA

- A) Area to be inspected
 - 1. Top of Block
 - 2. Liner counterbore
- B) Reference Standard ASTM E125
- C) Evaluation of indications
 - 1. Relevant indications are:
 - a) Hot tears and cracks, linear indications that exceed ASTM E125 Class I-2
 - b) Shrink that exceeds ASTM E125 Class II-3
 - c) Inclusions that exceed ASTM E125 Class III-3
 - d) Porosity that exceeds ASTM E125 Class V-1
 - 2. All indications exceeding the specification listed above shall be documented and submitted to the Design Group.
 - 3. Indications that do not exceed the ASTM E125 reference regardless of size and quantity are acceptable.
- D) Non Relevant Indication
 - 1. The indications referenced below shall be considered non relevant.
 - a) Magnetic writing
 - b) Linear grain boundaries (carbon, ferrite, or graphite induced)
 - c) Rounded grain boundaries (carbon, ferrite, or graphite induced)

TYP. EITHER END

SEE ISOMETRIC DETAIL A-A



NOTE 1
DRILL 4 HOLES
3/32" DIA. 45°
CUT OUT PIECE

SEE NOTE 1
ISOMETRIC DETAIL A-A
(DARKENED AREA INDICATES
CUTTING PLANE)

COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

Cylinder Block
COMPONENT Covers: Gaskets & Bolts UTILITY Cleveland Electric Illuminating Company
GROUP PARTS LIST NO 02-385B TASK DESCRIPTION NO. DR-03-02-385B-1
SNPS GPL NO. 03-385B CLASSIFICATION TYPE C

TASK DESCRIPTIONS

Design review for this component is not required based on a review of the lead engine DR/QR report (Comanche Peak) and the applicable site and industry experience.

There have been cases of fastener failures on the cylinder block covers, however these failures are not attributed to design deficiencies of this component. Based on the lead engine DR/QR report, the recommended torque value of 30 ft-lbs is appropriate and the specified bolting and stud materials (SAE GR 5 and SAE GR 1120 respectively) are acceptable for their intended function of holding the covers onto the cylinder block. Isolated failures can occur when the torque is not applied properly or a lesser grade material is substituted. Barring any deviations as mentioned above the bolting is acceptable for use on the diesel engines.

There are no modification or maintenance recommendations for this component.

The following quality inspections are recommended to be performed on one engine:

- Verify that the proper torque is applied and the specified material is installed. Plant personnel should review site documentation or perform the necessary inspection to make these determinations.
- Visually inspect gaskets for signs of elastomeric compound breakdown and cracking.

1

PRIMARY FUNCTION

Not required

How To Use This Report

Tabs in this report identify the following categories:

- Turbo, Intake, Intercooler & Exhaust
- Lube Oil
- Engine Base & Bearing Caps
- Crankshaft & Bearings
- Cylinder Block, Liners & Water Manifold
- Air Start & Barring Device
- Connecting rods
- Pistons
- Camshaft & Valve Train
- Idler Gear Assembly & Front Gear Case
- Flywheel
- Engine Instrumentation & Wiring
- Overspeed Trip & Governor
- Engine Shutdown & Equipment
- Jacket Water
- Cylinder Heads & Valves
- Fuel Oil Injection
- Generator
- Control Panel Assembly
- Engine & Auxiliary Sub-Base & Foundation Bolts

These categories have been defined to allow the reader to review a complete diesel generator subsystem in a convenient manner.

Within each category tabs identify Perry specific component numbers.

A given component report can be found by:

- a) If the component number is known - use the alpha - numeric index which identifies the volume number and category in which the component report is located.
- b) If only the component name is known - Section 3.2 may be used as a cross-reference to find the volume number where the component report may be found.

Some reports address more than one component. a tab is provided for each component. However, some components are combined under one report. Slip sheets are provided where required to reference back to the appropriate tab. Some components required more than one report. These are identified by the abbreviation LB-Large Bore and SB-Small Bore on the component number tabs.

INDEX (continued)

Component Number	Component Description	Category	Volume No.
F-068	Intercooler	Turbo, Intake Intrclr. & Exhaust	2
MP022/23	Turbocharger	Turbo, Intake, Intrclr. & Exhaust	2
00-420	Lube Oil Pressure Regulating Valve	Lube Oil	2
00-442A	Starting Air Distributor: Distributor Assembly	Air Start & Barring Device	3
00-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	Air Start & Barring Device	3
00-621A	Fuel Oil Drip Tank Assembly	Fuel Oil Injection	4
02-CFR	Turbocharger Thrust Bearing Lubricant System	Turbo, Intake, Intrclr. & Ex- haust	2
02-305A	Base and Bearing Caps: Base Assembly	Engine Base & Bearing Caps	2
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	Engine Base & Bearing Caps	2
02-305D	Base and Bearing Caps: Main Bearing Caps	Engine Base & Bearing Caps	2
02-307A	Lube Oil Fittings: Internal - Headers	Lube Oil	2
02-307B	Lube Oil Fittings: Internal - Tube & Fittings	Lube Oil	2
02-307D	Lube Oil Fittings Internal: Supports	Lube Oil	2
02-310A	Crankshaft	Crankshaft & Bearings	2
02-310B	Main Bearings	Crankshaft & Bearing	2

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	Crankshaft & Bearing	2
02-311A	Crankcase: Crankcase Assy	Crankshaft & Bearing	2
02-311D	Crankcase: Crankcase Mounting Hardware	Crankshaft & Bearings	2
02-315A	Cylinder Block	Cyl. Block & Liners & Water Manifold	2
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	Cyl. Block & Liners & Water Manifold	2
02-315D	Cylinder Block Liners & Jacket Water Manifold & Piping	Cyl. Block & Liners & Water Manifold	2
02-315E	Cylinder Block Liners & Water Manifold: Studs	Cyl. Block & Liners & Water Manifold	2
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	Cyl. Block & Liner & Water Manifold	2
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	Cyl. Block & Liners & Water Manifold	2
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	Jacket Water	4
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	Jacket Water	4
02-316C	Jacket Water Inlet Manifold: Vent line to Discharge Manifold	Jacket Water	4
02-317A	Water Discharge Manifold: Jacket Water Discharge Manifold/Piping	Jacket Water	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-317B	Water Discharge Manifold: Coupling & Seals	Jacket Water	4
02-317C	Water Discharge Manifold: Supports	Jacket Water	4
02-330A	Flywheel	Flywheel	3
02-330B	Flywheel - Bolting	Flywheel	3
02-335B	Front Gearcase - Gaskets and Bolting	Idler Gear As- sembly & Front Gear Case	3
02-340A	Connecting Rods: Connecting Rods & Bushings	Connecting Rods	3
02-340B	Connecting Rod Bearing Shells	Connecting Rods	3
02-341A	Pistons	Pistons	3
02-341B	Pistons: Rings	Pistons	3
02-341C	Piston Pin Assembly	Pistons	3
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	Camshaft & Valve Train	3
02-345B	Tappets and Guides: Fuel Tappet Assembly	Camshaft & Valve Train	3
02-345C	Tappets and Guides: Fuel Pump Base Assembly	Camshaft & Valve Train	3
02-350A	Camshaft: Camshaft Assembly	Camshaft & Valve Train	3
02-350B	Camshaft: Camshaft Bearing	Camshaft & Valve Train	3
02-350C	Camshaft: Supports, Bolting and Gear	Camshaft & Valve Train	3
02-355A	Idler Gear Assembly Crank To Pump Gear	Idler Gear As- sembly & Front Gear Case	3

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-355B	Idler Gear Assembly: Idler Gear Assembly	Idler Gear Assembly & Front Gear Case	3
02-359	Air Start Valve	Air Start & Barring Device	3
02-360A	Cylinder Heads	Cylinder Heads & Valves	4
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	Cylinder Heads & Valves	4
02-360C	Cylinder Head and Valves: Bolting and Gaskets	Cylinder Heads & Valves	4
02-360D	Cylinder Head & Valves: Springs	Cylinder Heads & Valves	4
02-362A	Subcover	Camshaft & Valve Train	3
02-365A	Fuel Injection Pump	Fuel Oil Injection	4
02-365B	Fuel Injection Equipment - Fuel Injection Tips	Fuel Oil Injection	4
02-365C	Fuel Injection Equipment - Tube Assembly	Fuel Oil Injection	4
02-365D	Fuel Injection Equipment: Supports	Fuel Oil Injection	4
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	Fuel Oil Injection	4
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	Fuel Oil Injection	4
02-375	Intake Manifold and Piping	Turbo, Intake, Intrclr. & Exhaust	2
02-380A	Exhaust Manifold	Turbo, Intake, Intrclr. & Exhaust	2

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-380B	Exhaust Manifold: Gasket and Bolting	Turbo, Intake, Intrclr. & Ex- haust	2
02-385B	Cylinder Block Covers: Gaskets and Bolting	Cyl. Block & Liners & Water Manifold	2
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	Crankshaft & Bearings	2
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390C	Main and Connector Pushrods	Camshaft & Valve Train	3
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	Camshaft & Valve Train	3
02-390E	Rocker Arms and Pushrods: Bushings	Camshaft & Valve Train	3
02-390F	Rocker Arms and Pushrods: Lifters	Camshaft & Valve Train	3
02-390G	Rocker Arms and Pushrods: Misc. Bolts & Drive Studs	Camshaft & Valve Train	3
02-410A	Overspeed Trip Governor	Overspeed Trip & Governor	3
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	Overspeed Trip & Governor	3
02-410C	Overspeed Trip: Coupling	Overspeed Trip & Governor	3
02-410D	Overspeed Trip Vent Valve	Overspeed Trip & Governor	3

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-411A	Governor Drive: Governor & Tachometer Drive Gear and Shaft	Overspeed Trip & Governor	3
02-411B	Governor Drive: Couplings, Pins & Keys	Overspeed Trip & Governor	3
02-413A	Governor Linkage	Overspeed Trip & Governor	3
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	Fuel Oil Injection	4
02-415A	Governor Assembly: Woodward Governor	Overspeed Trip & Governor	3
02-415B	Governor Assembly - Booster Servomotor	Overspeed Trip & Governor	3
02-415C	Governor Assembly - Heat Exchanger	Overspeed Trip & Governor	3
02-420	Engine Driven Lube Oil Pump	Lube Oil	2
02-425A	Engine Driven Jacket Water Pump	Jacket Water	4
02-435A	Jacket Water Fittings: Pipe & Fittings	Jacket Water	4
02-435B	Jacket Water Fittings - Supports	Jacket Water	4
02-435C	Jacket Water Inlet Fittings - Valves	Jacket Water	4
02-436A	Intercooler Piping	Turbo, Intake Intercooler & Exhaust	2
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	Turbo, Intake Intercooler & Exhaust	2

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Component Number	Component Description	Category	Volume No.
02-437	Turbo Water Piping: Pipe & Fittings	Jacket Water	4
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	Air Start & Barring Device	3
02-441B	Starting Air Manifold Valves, Filters & Strainer	Air Start & Barring Device	3
02-441C	Starting Air Manifold: Supports	Air Start & Barring Device	3
02-445	Fuel Oil Booster Pump	Fuel Oil In- jection	4
02-450A	Fuel Oil Header: Piping/Tubing	Fuel Oil In- jection	4
02-450B	Fuel Oil Header: Fuel Oil Supports	Fuel Oil In- jection	4
02-455A	Fuel Oil Filters & Strainers: Filters	Fuel Oil In- jection	4
02-455B	Fuel Oil Filters & Strainers: Strainers	Fuel Oil In- jection	4
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	Fuel Oil In- jection	4
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	Lube Oil	2
02-465B	Lube Oil Lines - External Valves	Lube Oil	2
02-465C	Lube Oil Lines External Supports	Lube Oil	2
02-467A	Turbocharger: Lube Oil Fitting - Pipe, Tubing, Fittings & Flexible Coupling	Lube Oil	2
02-467B	Turbocharger: Lube Oil Fittings - Supports	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-475A	Turbocharger: Bracket Bolting and Gaskets	Turbo, Intake, Intrclr. & Exhaust	2
02-475B	Air Butterfly Valve Assembly	Turbo, Intake, Intrclr. & Exhaust	2
02-475C	Turbocharger: Bracket - Bolting & Gaskets	Turbo, Intake, Intrclr. & Exhaust	2
02-500A	Control Panel Assembly Cabinet/System	Control Panel Assembly	4
02-500F	Control Panel Assembly Accumulator	Control Panel Assembly	4
02-500G	Control Panel Valves	Control Panel Assembly	4
02-500H	Control Panel Assembly Pressure Switch	Control Panel Assembly	4
02-500I	Control Panel Assembly: Control Relays	Control Panel Assembly	4
02-500J	Control Panel Assembly: Solenoid Valves	Control Panel Assembly	4
02-500L	Control Panel Assembly - Piping, Tubing, Fittings	Control Panel Assembly	4
02-500M	Control Panel Assembly: Terminal Boards/Switches/Wiring	Control Panel Assembly	4
02-525B	Barring Device - Pneumatic: Regulator Valve/Shut Off Valve	Air Start & Barring Device	3
02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports	Air Start & Barring Device	3
02-540A	Lube Oil Sump with Strainer Assembly and Mounting Hardware	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	Lube Oil	2
02-540C	Lube Oil Sump Tank: Mounting Hardware	Lube Oil	2
02-550	Foundation Bolts: Anchors, Bolts, Misc. Hardware	Engine & Aux. Sub Base & Foundation Bolts	4
02-630A	Pyrometer Conduit Assembly: Conduit	Engine Instrumentation & Wiring	3
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	Engine Instrumentation & Wiring	3
02-630C	Pyrometer Conduit Assembly: Support	Engine Instrumentation & Wiring	3
02-630D	Pyrometer Conduit Assembly Thermocouple	Engine Instrumentation & Wiring	3
02-650A	Emergency Diesel Generator	Generator	4
02-650B	Generator Control	Generator	4
02-650C	Generator-Shaft & Bearing	Generator	4
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	Engine Instrumentation & Wiring	3
02-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	Engine Instrumentation & Wiring	3

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Component Number	Component Description	Category	Volume No.
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals	Engine Instru- mentation & Wiring	3
02-689	Off-Engine Alarm Sensors	Engine Instru- mentation & Wiring	3
02-690	Engine Alarm Sensors - Temperature & Level Switches	Engine Instru- mentation & Wiring	3
02-691	Off Engine Safety Alarm Sensors - Level & Pressure Switches	Engine Instru- mentation & Wiring	3
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	Engine Shut- down & Equip- ment	3
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	Engine Shut- down & Equip- ment	3
02-695C	Engine Shutdown Trip Switches	Engine Shut- down & Equip- ment	3
02-700A	Jacket Water Standpipe: Pipe, Fittings, Gaskets	Jacket Water	4
02-700B	Jacket Water Standpipe: Valves	Jacket Water	4
02-700C	Jacket Water Standpipe: Pipe Supports	Jacket Water	4
02-700E	Jacket Water Standpipe: Switches	Jacket Water	4
02-700F	Jacket Water Standpipe & Misc. Bolting	Jacket Water	4
02-717A	Auxiliary Skid	Jacket Water	4

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Component Number	Component Description	Category	Volume No.
02-717B	Aux Sub Base & Oil & Water Piping - Jacket Water: Valves	Jacket Water	4
02-717C	Aux Sub Base & Oil & Water Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers	Engine & Aux. Sub Base & Foundation Bolts	4
02-717D	Aux Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting	Jacket Water	4
02-717E	Aux Sub Base & Oil & Water Piping - Jacket Water: Supports	Jacket Water	4
02-717F	Aux. Sub Base & Oil & Water Piping - Lube Oil: Pipe and Fittings	Lube Oil	2
02-717G	Aux Sub Base & Oil & Water Piping - Lube Oil: Valves	Lube Oil	2
02-717H	Aux. Sub-Base & Oil & Water Piping - Lube Oil: Gaskets & Bolting	Lube Oil	2
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	Lube Oil	2
02-717J	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	Fuel Oil	2
02-717K	Aux Sub Base & Oil & Water Piping - Fuel Oil: Valves	Fuel Oil Injection	4
02-717L	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	Fuel Oil Injection	4

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Component Number	Component Description	Category	Volume No.
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil: Supports	Fuel Oil Injection	4
02-805A	Intake Air Silencer	Turbo, Intake, Intercooler & Exhaust	2
02-805B	Intake Air Filter	Turbo, Intake, Intercooler & Exhaust	2
02-805D	Flex Connections	Turbo, Intake, Intercooler & Exhaust	2
02-810A	Jacket Water Standby Heater Pump	Jacket Water	4
02-810B	Jacket Water Heat Exchanger	Jacket Water	4
02-810C	Thermostatic Valve	Jacket Water	4
02-810D	Misc. Equipment - Heater, Jacket Water	Jacket Water	* 4
02-820A	Misc. Equipment - Heater, Lube Oil Sump Tank	Lube Oil	2
02-820B	Before & After Lube Oil Pump	Lube Oil	2
02-820C	Lube Oil Full Pressure Strainer	Lube Oil	2
02-820D	Lube Oil System - Lube Oil Keepwarm Strainer	Lube Oil	2
02-820E	Oil Prelube Filter	Lube Oil	2
02-820F	Full Flow Lube Oil Filter	Lube Oil	2
02-820G	Lube Oil Heat Exchanger	Lube Oil	2
02-825A	Fuel Oil Day Tank	Fuel Oil Injection	4

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Component Number	Component Description	Category	Volume No.
02-825D	Fuel Oil System - Fuel Oil Duplex Strainer	Fuel Oil Injection	4
02-835B	Starting Air Tank	Air Start & Barring Device	3
02-835E	Misc. Equipment - Starting Air Tank Relief Valve	Air Start & Barring Device	3

COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

COMPONENT <u>Pistons</u>	UTILITY <u>Cleveland Electric Illuminating Company</u>
GROUP PARTS LIST NO. <u>02-341A</u>	TASK DESCRIPTION NO. <u>DR-03-02-341A-1</u>
SNPS GPL NO. <u>03-341A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review is not required for this component based on review of the lead engine DR/QR reports (Shoreham/Comanche Peak), the Phase I report and the applicable site and industry experience in the EDG Component Tracking System.

CEI has replaced the originally supplied AH piston skirts with the product improvement AE piston skirts at Perry Nuclear Power Plant. The AE piston skirt incorporates design changes and has not been observed to crack in service.

The following Quality inspections as delineated in the CQRC are recommended for the replacement AE pistons:

- Prior to installation, perform a liquid penetrant test on the piston skirts. Map all linear indications in the stud boss area and document with photographs.

(Note: If the results of the above inspections reveal indications greater than 1/32 inch length, either remove the indications by surface conditioning, or perform an eddy current test to determine if the indications must be removed.)

- Perform a liquid penetrant test on the rib area near the wrist pin and on the rib at the intersection of the wrist pin boss to check for indications in the casting.
- Visually inspect all piston skirt and crown outside diameters for scuffing, and the combustion bowls in the crowns for pitting.

There are no maintenance or modification recommendations for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

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ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kenneth T. Fitzgerald

PROGRAM MANAGER

J. C. Kammeyer

How To Use This Report

Tabs in this report identify the following categories:

- Turbo, Intake, Intercooler & Exhaust
- Lube Oil
- Engine Base & Bearing Caps
- Crankshaft & Bearings
- Cylinder Block, Liners & Water Manifold
- Air Start & Barring Device
- Connecting rods
- Pistons
- Camshaft & Valve Train
- Idler Gear Assembly & Front Gear Case
- Flywheel
- Engine Instrumentation & Wiring
- Overspeed Trip & Governor
- Engine Shutdown & Equipment
- Jacket Water
- Cylinder Heads & Valves
- Fuel Oil Injection
- Generator
- Control Panel Assembly
- Engine & Auxiliary Sub-Base & Foundation Bolts

These categories have been defined to allow the reader to review a complete diesel generator subsystem in a convenient manner.

Within each category tabs identify Perry specific component numbers.

A given component report can be found by:

- a) If the component number is known - use the alpha - numeric index which identifies the volume number and category in which the component report is located.
- b) If only the component name is known - Section 3.2 may be used as a cross-reference to find the volume number where the component report may be found.

Some reports address more than one component. a tab is provided for each component. However, some components are combined under one report. Slip sheets are provided where required to reference back to the appropriate tab. Some components required more than one report. These are identified by the abbreviation LB-Large Bore and SB-Small Bore on the component number tabs.

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Component Number	Component Description	Category	Volume No.
F-068	Intercooler	Turbo, Intake Intrclr. & Exhaust	2
MP022/23	Turbocharger	Turbo, Intake, Intrclr. & Exhaust	2
00-420	Lube Oil Pressure Regulating Valve	Lube Oil	2
00-442A	Starting Air Distributor: Distributor Assembly	Air Start & Barring Device	3
00-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	Air Start & Barring Device	3
00-621A	Fuel Oil Drip Tank Assembly	Fuel Oil Injection	4
02-CFR	Turbocharger Thrust Bearing Lubricant System	Turbo, Intake, Intrclr. & Ex- haust	2
02-305A	Base and Bearing Caps: Base Assembly	Engine Base & Bearing Caps	2
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	Engine Base & Bearing Caps	2
02-305D	Base and Bearing Caps: Main Bearing Caps	Engine Base & Bearing Caps	2
02-307A	Lube Oil Fittings: Internal - Headers	Lube Oil	2
02-307B	Lube Oil Fittings: Internal - Tube & Fittings	Lube Oil	2
02-307D	Lube Oil Fittings Internal: Supports	Lube Oil	2
02-310A	Crankshaft	Crankshaft & Bearings	2
02-310B	Main Bearings	Crankshaft & Bearing	2

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Component Number	Component Description	Category	Volume No.
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	Crankshaft & Bearing	2
02-311A	Crankcase: Crankcase Assy	Crankshaft & Bearing	2
02-311D	Crankcase: Crankcase Mounting Hardware	Crankshaft & Bearings	2
02-315A	Cylinder Block	Cyl. Block & Liners & Water Manifold	2
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	Cyl. Block & Liners & Water Manifold	2
02-315D	Cylinder Block Liners & Jacket Water Manifold & Piping	Cyl. Block & Liners & Water Manifold	2
02-315E	Cylinder Block Liners & Water Manifold: Studs	Cyl. Block & Liners & Water Manifold	2
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	Cyl. Block & Liner & Water Manifold	2
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	Cyl. Block & Liners & Water Manifold	2
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	Jacket Water	4
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	Jacket Water	4
02-316C	Jacket Water Inlet Manifold: Vent line to Discharge Manifold	Jacket Water	4
02-317A	Water Discharge Manifold: Jacket Water Discharge Manifold/Piping	Jacket Water	4

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Component Number	Component Description	Category	Volume No.
02-317B	Water Discharge Manifold: Coupling & Seals	Jacket Water	4
02-317C	Water Discharge Manifold: Supports	Jacket Water	4
02-330A	Flywheel	Flywheel	3
02-330B	Flywheel - Bolting	Flywheel	3
02-335B	Front Gearcase - Gaskets and Bolting	Idler Gear As- sembly & Front Gear Case	3
02-340A	Connecting Rods: Connecting Rods & Bushings	Connecting Rods	3
02-340B	Connecting Rod Bearing Shells	Connecting Rods	3
02-341A	Pistons	Pistons	3
02-341B	Pistons: Rings	Pistons	3
02-341C	Piston Pin Assembly	Pistons	3
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	Camshaft & Valve Train	3
02-345B	Tappets and Guides: Fuel Tappet Assembly	Camshaft & Valve Train	3
02-345C	Tappets and Guides: Fuel Pump Base Assembly	Camshaft & Valve Train	3
02-350A	Camshaft: Camshaft Assembly	Camshaft & Valve Train	3
02-350B	Camshaft: Camshaft Bearing	Camshaft & Valve Train	3
02-350C	Camshaft: Supports, Bolting and Gear	Camshaft & Valve Train	3
02-355A	Idler Gear Assembly Crank To Pump Gear	Idler Gear As- sembly & Front Gear Case	3

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Component Number	Component Description	Category	Volume No.
02-355B	Idler Gear Assembly: Idler Gear Assembly	Idler Gear As- sembly & Front Gear Case	3
02-359	Air Start Valve	Air Start & Barring Device	3
02-360A	Cylinder Heads	Cylinder Heads & Valves	4
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	Cylinder Heads & Valves	4
02-360C	Cylinder Head and Valves: Bolting and Gaskets	Cylinder Heads & Valves	4
02-360D	Cylinder Head & Valves: Springs	Cylinder Heads & Valves	4
02-362A	Subcover	Camshaft & Valve Train	3
02-365A	Fuel Injection Pump	Fuel Oil In- jection	4
02-365B	Fuel Injection Equipment - Fuel Injection Tips	Fuel Oil In- jection	4
02-365C	Fuel Injection Equipment - Tube Assembly	Fuel Oil In- jection	4
02-365D	Fuel Injection Equipment: Supports	Fuel Oil In- jection	4
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	Fuel Oil In- jection	4
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	Fuel Oil In- jection	4
02-375	Intake Manifold and Piping	Turbo, Intake, Intrclr. & Ex- haust	2
02-380A	Exhaust Manifold	Turbo, Intake, Intrclr. & Ex- haust	2

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Component Number	Component Description	Category	Volume No.
02-380B	Exhaust Manifold: Gasket and Bolting	Turbo, Intake, Intrclr. & Ex- haust	2
02-385B	Cylinder Block Covers: Gaskets and Bolting	Cyl. Block & Liners & Water Manifold	2
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	Crankshaft & Bearings	2
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390C	Main and Connector Pushrods	Camshaft & Valve Train	3
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	Camshaft & Valve Train	3
02-390E	Rocker Arms and Pushrods: Bushings	Camshaft & Valve Train	3
02-390F	Rocker Arms and Pushrods: Lifters	Camshaft & Valve Train	3
02-390G	Rocker Arms and Pushrods: Misc. Bolts & Drive Studs	Camshaft & Valve Train	3
02-410A	Overspeed Trip Governor	Overspeed Trip & Governor	3
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	Overspeed Trip & Governor	3
02-410C	Overspeed Trip: Coupling	Overspeed Trip & Governor	3
02-410D	Overspeed Trip Vent Valve	Overspeed Trip & Governor	3

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Component Number	Component Description	Category	Volume No.
02-411A	Governor Drive: Governor & Tachometer Drive Gear and Shaft	Overspeed Trip & Governor	3
02-411B	Governor Drive: Couplings, Pins & Keys	Overspeed Trip & Governor	3
02-413A	Governor Linkage	Overspeed Trip & Governor	3
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	Fuel Oil Injection	4
02-415A	Governor Assembly: Woodward Governor	Overspeed Trip & Governor	3
02-415B	Governor Assembly - Booster Servomotor	Overspeed Trip & Governor	3
02-415C	Governor Assembly - Heat Exchanger	Overspeed Trip & Governor	3
02-420	Engine Driven Lube Oil Pump	Lube Oil	2
02-425A	Engine Driven Jacket Water Pump	Jacket Water	4
02-435A	Jacket Water Fittings: Pipe & Fittings	Jacket Water	4
02-435B	Jacket Water Fittings - Supports	Jacket Water	4
02-435C	Jacket Water Inlet Fittings - Valves	Jacket Water	4
02-436A	Intercooler Piping	Turbo, Intake Intercooler & Exhaust	2
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	Turbo, Intake Intercooler & Exhaust	2

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Component Number	Component Description	Category	Volume No.
02-437	Turbo Water Piping: Pipe & Fittings	Jacket Water	4
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	Air Start & Barring Device	3
02-441B	Starting Air Manifold Valves, Filters & Strainer	Air Start & Barring Device	3
02-441C	Starting Air Manifold: Supports	Air Start & Barring Device	3
02-445	Fuel Oil Booster Pump	Fuel Oil In- jection	4
02-450A	Fuel Oil Header: Piping/Tubing	Fuel Oil In- jection	4
02-450B	Fuel Oil Header: Fuel Oil Supports	Fuel Oil In- jection	4
02-455A	Fuel Oil Filters & Strainers: Filters	Fuel Oil In- jection	4
02-455B	Fuel Oil Filters & Strainers: Strainers	Fuel Oil In- jection	4
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	Fuel Oil In- jection	4
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	Lube Oil	2
02-465B	Lube Oil Lines - External Valves	Lube Oil	2
02-465C	Lube Oil Lines External Supports	Lube Oil	2
02-467A	Turbocharger: Lube Oil Fitting - Pipe, Tubing, Fittings & Flexible Coupling	Lube Oil	2
02-467B	Turbocharger: Lube Oil Fittings - Supports	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-475A	Turbocharger: Bracket Bolting and Gaskets	Turbo, Intake, Intrclr. & Ex- haust	2
02-475B	Air Butterfly Valve Assembly	Turbo, Intake, Intrclr. & Ex- haust	2
02-475C	Turbocharger: Bracket - Bolting & Gaskets	Turbo, Intake, Intrclr. & Ex- haust	2
02-500A	Control Panel Assembly Cabinet/System	Control Panel Assembly	4
02-500F	Control Panel Assembly Accumulator	Control Panel Assembly	4
02-500G	Control Panel Valves	Control Panel Assembly	4
02-500H	Control Panel Assembly Pressure Switch	Control Panel Assembly	4
02-500I	Control Panel Assembly: Control Relays	Control Panel Assembly	4
02-500J	Control Panel Assembly: Solenoid Valves	Control Panel Assembly	4
02-500L	Control Panel Assembly - Piping, Tubing, Fittings	Control Panel Assembly	4
02-500M	Control Panel Assembly: Terminal Boards/Switches/ Wiring	Control Panel Assembly	4
02-525B	Barring Device - Pneumatic: Regulator Valve/Shut Off Valve	Air Start & Barring Device	3
02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports	Air Start & Barring Device	3
02-540A	Lube Oil Sump with Strainer Assembly and Mounting Hardware	Lube Oil	2

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Component Number	Component Description	Category	Volume No.
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	Lube Oil	2
02-540C	Lube Oil Sump Tank: Mounting Hardware	Lube Oil	2
02-550	Foundation Bolts: Anchors, Bolts, Misc. Hardware	Engine & Aux. Sub Base & Foundation Bolts	4
02-630A	Pyrometer Conduit Assembly: Conduit	Engine Instrumentation & Wiring	3
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	Engine Instrumentation & Wiring	3
02-630C	Pyrometer Conduit Assembly: Support	Engine Instrumentation & Wiring	3
02-630D	Pyrometer Conduit Assembly Thermocouple	Engine Instrumentation & Wiring	3
02-650A	Emergency Diesel Generator	Generator	4
02-650B	Generator Control	Generator	4
02-650C	Generator-Shaft & Bearing	Generator	4
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	Engine Instrumentation & Wiring	3
02-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	Engine Instrumentation & Wiring	3

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Component Number	Component Description	Category	Volume No.
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals	Engine Instrumentation & Wiring	3
02-689	Off-Engine Alarm Sensors	Engine Instrumentation & Wiring	3
02-690	Engine Alarm Sensors - Temperature & Level Switches	Engine Instrumentation & Wiring	3
02-691	Off Engine Safety Alarm Sensors - Level & Pressure Switches	Engine Instrumentation & Wiring	3
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	Engine Shutdown & Equipment	3
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	Engine Shutdown & Equipment	3
02-695C	Engine Shutdown Trip Switches	Engine Shutdown & Equipment	3
02-700A	Jacket Water Standpipe: Pipe, Fittings, Gaskets	Jacket Water	4
02-700B	Jacket Water Standpipe: Valves	Jacket Water	4
02-700C	Jacket Water Standpipe: Pipe Supports	Jacket Water	4
02-700E	Jacket Water Standpipe: Switches	Jacket Water	4
02-700F	Jacket Water Standpipe & Misc. Bolting	Jacket Water	4
02-717A	Auxiliary Skid	Jacket Water	4

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Component Number	Component Description	Category	Volume No.
02-717B	Aux Sub Base & Oil & Water Piping - Jacket Water: Valves	Jacket Water	4
02-717C	Aux Sub Base & Oil & Water Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers	Engine & Aux. Sub Base & Foundation Bolts	4
02-717D	Aux Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting	Jacket Water	4
02-717E	Aux Sub Base & Oil & Water Piping - Jacket Water: Supports	Jacket Water	4
02-717F	Aux. Sub Base & Oil & Water Piping - Lube Oil: Pipe and Fittings	Lube Oil	2
02-717G	Aux Sub Base & Oil & Water Piping - Lube Oil: Valves	Lube Oil	2
02-717H	Aux. Sub-Base & Oil & Water Piping - Lube Oil: Gaskets & Bolting	Lube Oil	2
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	Lube Oil	2
02-717J	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	Fuel Oil	2
02-717K	Aux Sub Base & Oil & Water Piping - Fuel Oil: Valves	Fuel Oil Injection	4
02-717L	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	Fuel Oil Injection	4

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Component Number	Component Description	Category	Volume No.
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil: Supports	Fuel Oil Injection	4
02-805A	Intake Air Silencer	Turbo, Intake, Intercooler & Exhaust	2
02-805B	Intake Air Filter	Turbo, Intake, Intercooler & Exhaust	2
02-805D	Flex Connections	Turbo, Intake, Intercooler & Exhaust	2
02-810A	Jacket Water Standby Heater Pump	Jacket Water	4
02-810B	Jacket Water Heat Exchanger	Jacket Water	4
02-810C	Thermostatic Valve	Jacket Water	4
02-810D	Misc. Equipment - Heater, Jacket Water	Jacket Water	4
02-820A	Misc. Equipment - Heater, Lube Oil Sump Tank	Lube Oil	2
02-820B	Before & After Lube Oil Pump	Lube Oil	2
02-820C	Lube Oil Full Pressure Strainer	Lube Oil	2
02-820D	Lube Oil System - Lube Oil Keepwarm Strainer	Lube Oil	2
02-820E	Oil Prelube Filter	Lube Oil	2
02-820F	Full Flow Lube Oil Filter	Lube Oil	2
02-820G	Lube Oil Heat Exchanger	Lube Oil	2
02-825A	Fuel Oil Day Tank	Fuel Oil Injection	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-825D	Fuel Oil System - Fuel Oil Duplex Strainer	Fuel Oil Injection	4
02-835B	Starting Air Tank	Air Start & Barring Device	3
02-835E	Misc. Equipment - Starting Air Tank Relief Valve	Air Start & Barring Device	3

COMPONENT DESIGN REVIEW CHECKLIST
PERRY NUCLEAR POWER PLANT - UNIT 1

COMPONENT	<u>Control Panel Assembly</u> <u>Cabinet/System</u>	UTILITY <u>Cleveland Electric Illuminating Company</u>
GROUP PARTS LIST NO.	<u>02-500A</u>	TASK DESCRIPTION NO. <u>DR-03-02-500A-1</u>
SNPS GPL NO.	<u>03-500A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

A design review of the control panel assembly cabinet/system is not required for Perry based on the following:

- A review of the DR/QR lead engine report (Comanche Peak).
- The application of the electropneumatic control system used on Perry to start, stop, operate, protect, and monitor the diesel is identical to Comanche Peak design.
- The logic design used on Perry to disable the Group II trip functions during initial diesel startup and bypass all the Group I and Group II trips during an emergency condition is identical to Comanche Peak design. In addition, the controls to lock out the diesel for maintenance on Perry are also identical to those on Comanche Peak.
- The applicable industry experience listed in the EDG Component Tracking System showed non-1E interlocks were used to initiate the diesel generator building ventilation system at Perry. Contacts from non-1E relays, supplied by TDI for customer use, were used incorrectly by Perry for this purpose. Corrective action has been taken at Perry to rewire those relays with Class 1E safety related power. The remaining industry experience listed does not show any significant or generic problems associated with the type of electropneumatic system used on Perry.

There are no maintenance or modification recommendations for the control panel assembly cabinet/system.

Quality revalidation of the control panel assembly cabinet/system is not deemed necessary.

COMPONENT DESIGN REVIEW CHECKLIST

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PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

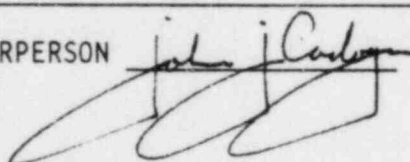
REFERENCES

Not required

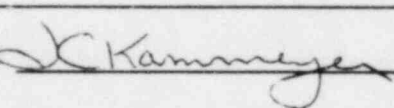
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP
for
PERRY NUCLEAR POWER PLANT
MAINTENANCE REVIEW
APPENDIX - II

I INTRODUCTION

The purpose of this Appendix is to provide Perry with a set of maintenance and surveillance recommendations for diesel generator components which have been developed by TDI and/or the Owners Group as a result of the overall Owners Group Program. This Appendix is intended to supplement the existing TDI Instruction Manual, Volume I and Volume III, which will maintain the qualification of the diesel generators for the life of the plant.

II METHODOLOGY

During the implementation of the Owners Group Program Plan, the Owners Group Technical Staff reviewed many sources of information regarding the maintenance and surveillance for the diesel generator components identified in this Appendix. These sources included TDI Instruction Manuals, Service Information Memos (SIMS), and TDI correspondence on specific components. This review along with Technical Staff input regarding the adequacy of the recommendations found in the sources mentioned above, and additional maintenance recommendations identified during the DR/QR review, forms the basis for the content of this matrix.

III RESULTS AND CONCLUSIONS

Proper maintenance is important in ensuring long, reliable and satisfactory service of the emergency diesel generators. Maintenance work, in order to be effective, must be carried out thoroughly and regularly. It is for these reasons that a detailed schedule of maintenance service has been laid out by the Owners Group for the TDI Diesel Generators at Perry Nuclear Power Plant. The schedule details specific components requiring maintenance on a regular basis. This schedule separates the maintenance activities into a daily, monthly, outage, alternate outage (every other), 5-year and 10-year frequencies. It should be noted here that the duration time between outages at Perry is assumed to be 18 months.

Those less significant diesel generator system components with which standard engineering practice and maintenance will ensure continued operation, are not specifically addressed in the matrix. Standard maintenance practices are briefly discussed below.

The engine and generator should be kept clean and dry at all times. Oil and water leakage should be wiped off the unit as quickly as possible in order to assist in locating the source of leakage, prevent potential equipment damage and maintain a safe working environment. Leaking pipes, gaskets and packing glands should be attended to promptly so as not to impair the reliability and/or operation of the system. Flanged gasketed connections may be retightened to stop leaks and any abnormal engine noises or vibrations. Actions required to correct any abnormal conditions should be carried out in a timely manner. Loose bolts and electrical terminals should be attended to in a safe, practical manner.

Specific items to be maintained on a DAILY basis consist of the following:

1. Observe and record lubricating oil and jacket water temperatures (keep warm pump running).
2. Drain all low point water collectors, barring device air filter and air receiver tank float traps in the air start system.
3. Check engine and auxiliary equipment and piping connections for oil, water, and fuel oil leaks.
4. Check level of lubricating oil in the governor and pedestal bearing. Add oil as needed.
5. Check fuel oil pump rack for freedom of movement through full limit of travel. Do not disconnect from governor.
6. Check turbocharger bearing lubricating oil system sight glass for oil flow.
7. Drain water from crankcase vent piping drip legs.
8. Verify all controls in proper position for standby mode.
9. Check all governor knob settings.

Load	Maximum Droop	Zero
Speed	To provide mechanical governor control at 460 rpm.	

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10. Visually inspect lube oil heat exchanger and jacket water heat exchanger for signs of leakage from the lantern ring leakoff ports, indicating leaking packing rings.

The following Preventive Maintenance Recommendation Matrix was designed to assist the Maintenance Department in determining the scope of work required to maintain the intended design function of the diesel generators at Perry on a planned schedule basis. It should be followed closely and referred to often.

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
F-068	Intercoolers	1. Evaluate heat exchanger performance by checking engine operating parameters.	X					
		2. Clean/inspect shell and tube sides every outage or as necessary.		X				Ref: Lead engine DR/QR Report #F-068 (Items 2, 3, 4)
		3. Visually inspect for external leaks.	X					Ref: 7/26/84 IOC from J. Cadogan to M. McGerigle, Ref: 08/14/84 letter to C. Ray from M. Lowrey
		4. The drain connection on the air intake system low point should be verified open, and cleaned daily						To be performed daily.
MP-022/3	Turbocharger	1. Measure vibration and check with base line data.		X				To be accomplished during 24 hour test run.
		2. Clean impeller and diffuser.		X				
		3. Measure rotor end play (axial clearance) to identify trends of increasing clearance, i.e; thrust bearing degradation.		X				Review thrust bearing axial clearances after inspection to determine if a trend exists. Any trend toward increasing axial clearance could signify thrust bearing degradation. Ref: Lead engine DR/QR Report #MP-022/3
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PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		4. Perform visual and blue check inspections of the thrust bearing.				X		NOTE: Thrust bearing inspection should also be performed after 40 non-prelubed (automatic) fast starts. Ref: Lead engine DR/QR Report #MP-022/3
		5. Disassemble inspect and refurbish.				X		
		6. Perform a spectro-chemical engine oil analysis to assist the bearing monitoring program. To further expand/clarify chemical analysis, ferrographic analysis may be utilized. Particular attention shall be paid to copper level, and particulate size, which could signify thrust bearing degradation.		X				To be performed during the last monthly test run prior to oil change. NOTE: Sample to be drawn up stream of lube oil filter. Ref: Lead engine DR/QR Report MP-022/3
00-420	Lube Oil Pressure Regulating Valve	1. Disassemble and clean.		X				If valve sticks repeatedly, more frequent cleaning may be necessary. If valve plugging becomes a problem, the dimensions of the valves' internal parts should be checked to ensure proper clearance.

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
								Ref: Lead engine DR/QR Report #00-420
		2. During initial startup after a major reassembly of Lube Oil piping, the L.O. regulating valve should be disassembled and cleaned until abnormal L.O. pressure excursions subside.						
00-442A	Starting Air Distributor Assembly	1. Visually inspect the poppet valve spool ends and timing cam of the starting air distributor.		X				Evaluate the degree of wear to determine whether existing condition would have an adverse effect on timing and the specified ability to start the engine.
		2. Ensure that the starting air manifold vent is open and unobstructed.	X					Ref: Lead engine DR/QR Report #00-442A (STAD), Items 1 & 2
02-305A	Base Assembly	1. Perform a visual inspection of the base. The inspection should include the areas adjacent to the nut pockets of each bearing saddle and be conducted after a thorough wipe down of the surfaces, using good lighting.		X				NOTE: Any cracks detected must be investigated further before the engine is allowed to return to service. The mating surfaces of the base and cap shall be thoroughly cleaned with solvent before

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
								any reassembly. Ref: Lead engine DR/QR Report #02-305B
02-305C	Main Bearing Caps - Studs and Nuts	1. Upon removal of bearing caps, clean mating surfaces with a solvent prior to reassembly of the caps to the base.						Ref: Lead engine DR/QR Report #02-305C
02-307B	Lube Oil Tubing and Fittings - Internal	1. Check tubing for dents or crimps.			X			Items 1, 2; Ref: TDI Instruction Manual, Vol. I, Maintenance Schedule
		2. Perform gear-train spray check.			X			
02-310A	Crankshaft	1. Measure crankshaft web deflection.			X			Complete TDI Inspection and Maintenance Record Form No. 310-1-1, TDI Instruction Manual, Volume I, Section 6. Ref: TDI Instruction Manual, Vol. I, Mainte- nance Schedule
		2. Measure diameter of crank journals.			X			Complete TDI Inspection and Maintenance Record Form No. 310-3-1, TDI Instruction Manual, Volume I, Section 6.

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
02-310B	Main Bearings Shells	1. Inspect and measure main bearing shell thickness. Inspection shall evaluate bearing wear and evidence of harmful crankshaft misalignment. If results show evidence of misalignment, TDI recommendations for crankshaft realignment should be implemented.			X			The first inspection should be performed at the first fuel outage and at alternate outages thereafter. Complete TDI Inspection and Maintenance Record Form No. 310-2-1, TDI Instruction Manual, Volume I, Section 6 - one sheet for each main bearing. Use Volume I, Appendix III for clearance values. Ref: TDI Instruction Manual, Vol. 1, Maintenance Schedule, Ref: Lead engine DR/QR Report #02-310B
02-310C	Thrust Bearing Ring	1. Measure thrust bearing ring clearance via "bump check" method to be performed in conjunction with crankshaft web deflection measurements. The following information should be recorded: ° Date of inspection ° Hours of engine operation			X			Complete applicable sections of TDI Inspection and Maintenance Record Form No. 310-1-1 TDI Instruction Manual, Volume I, Section 6. NOTE: If the clearance is greater than the maximum allowed in the TDI

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		<ul style="list-style-type: none"> ° Hours of engine operation since last bearing replacement (Last bearing replaced: _____ forward _____ back) ° Bearing clearance 						<p>Instruction Manual, then at least one bearing must be replaced. Bearings should also be replaced if they are cracked or gouged. Ref: Lead engine DR/QR Report #02-310C, Ref: 8/13/84 memo from G. McCarthy to D. Pasquale</p>
		2. Visually inspect thrust bearing ring for signs of cracks, gouges, wear or degradation.			X			<p>To be performed simultaneously with main bearing shell inspection. Ref: Lead engine DR/QR Report #02-310C</p>
02-311A	Crankcase Assembly	1. Perform a visual inspection of the vertical portion of the crankcase arch wall to the nut pocket area for indications of cracking.		X				<p>The first inspection to be performed after 185 hours of at or near full load operation, may be used to justify the discontinuation of further inspections. Ref: Lead engine DR/QR Report #02-311A</p>
02-315A	Cylinder Block	1. Perform an inspection of the cylinder block per DR/QR Report #02-315A.						<p>Ref: DR/QR Report #02-315A</p>

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
02-315C	Cylinder Liners	1. Perform a visual inspection of liners for potential progressive wear.		X				Borescopic inspection is acceptable if heads are not removed. Complete TDI Inspection and Maintenance Record form No. 315-1-1, TDI Instruction Manual, Volume I, Section 6. Ref: Lead engine DR/QR Report #02-341B
02-317A&B	Water Discharge Manifold - Jacket Water Discharge Piping, couplings and seals	1. Visually inspect for leaks. Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.	X					This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George. Ref: DR/QR Report #02-317A&B
02-340A/B	Connecting Rods, Bushings and Bearing Shells	1. Inspect and measure connecting rod bearing shell to verify lube oil maintenance which affects wear rate. The visual and dimensional inspection of the bearing shells should be conducted at the fuel outage which precedes 500 hours of operation by at least the						To be performed in conjunction with piston pin inspection. Complete TDI Inspection and Maintenance Record Form No. 340-1-1, TDI Instruction Manual, Volume I, Section 6, Appendix III for clearance values. Ref: Lead engine DR/QR

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PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		sum of hours of operation in a LOOP/LOCA event plus the expected hours of operation between outages.						Report #02-340B
		2. Inspect and measure the connecting rods.				X		Complete TDI Inspection Maintenance Record Form No. 340-2-1, 2, TDI Instruction Manual, Volume I, Section 6.
		3. Perform an x-ray examina- tion on all replacement bearing shells to accep- tance criteria developed by Owners Group Technical Staff.						This is to be performed prior to installation of any replacement bearing shells. Ref: Lead engine DR/QR Report #02-340B
		4. Measure the clearance between the link pin and link rod in accordance with TDI-SIM #349. This clearance should be zero, i.e.; no measurable clearance when the speci- fied bolt torque of 1050 ft-lbs is applied. This should be performed with the engine assembled after a major disassembly.						This recommendation is required one time only. Ref: Lead engine DR/QR Report #02-340A
		5. At major engine overhauls visually inspect the rack teeth surfaces for signs of fretting.				X		If fretting has occurred a further engineering evaluation will be necessary. Ref: DR/QR Report #02-340A

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PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
02-341A	Pistons	1. Inspect and measure skirt and piston pin.				X		Complete TDI Inspection and Maintenance Report Form No. 341-1-1, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values. To be performed in conjunction with piston pin inspection.
02-341B	Piston Rings	1. Inspect and measure replacement piston rings.				X		Complete TDI Inspection and Maintenance Record Form No. 341-2-1, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values. To be performed in conjunction with piston pin inspection.
		2. Visually inspect liners for wear. NOTE: Ring replacement and cylinder liner honing should be performed in accordance with TDI maintenance procedures.		X				Borescopic inspection is acceptable if heads are not removed. Complete TDI Inspection and Maintenance Record Form No. 315-1-1, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values. Ref: Lead engine DR/QR Report #02-341B (Items 2, 3, 4)

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
3.		135° fuel oil spray tips may be used if inspection results indicate a need for additional action to improve lubrication and reduce coke buildup.		X				Ref: 07/31/84 memo from L. Swanger to D. Pasquale
4.		When replacing engine oil use H.D. oil that exceeds series 3 standards. The base stock should be more resistant to thermal degradation and coke formation. The additive package should provide high detergent dispersant properties with high alkalinity and a high level of antiwear additive such as zinc dithiophosphate. Total Base Number (TBN) should be 12 to 15 for use with #2 fuel oil and a sulfated ash content of 1.5% to 2.0% is preferred. An engine oil with such properties, Mobilguard 412 or equivalent product may be used to ensure improved lubrication.		X				NOTE: Do not mix L.O. brands or types. When changing L.O. replace the entire L.O. charge. Ref: 08/14/84 letter to C. Ray from M. Lowrey

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PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
02-341C	Piston Pin Assembly	<p>1. Visually inspect all pins for chrome plate damage. Replace pins which show chipped or blistered chrome.</p> <p>NOTE: All new or replacement pins will be L.P. or M.P. inspected before installation in Owners Group engines.</p>				X		<p>Also to be performed whenever pistons are removed and disassembled to an extent that such inspection is possible.</p> <p>Ref: Lead engine DR/QR Report #02-341C (Items 1&2), For details on acceptance criteria, Ref: 08/22/84 memo from W. Littmann to D. Pasquale</p> <p>NOTE: This inspection is to be performed whenever the engine is sufficiently dismantled to allow this inspection.</p> <p>Ref: Lead engine DR/QR Report #02-341C</p>
		2. Inspect end plugs and reroll or replace any that are loose.				X		<p>NOTE: This inspection is to be performed whenever the engine is sufficiently dismantled to allow this inspection.</p>
02-345A	Intake and Exhaust Tappet Assembly	1. Inspect intake and exhaust tappet assembly condition.		X				<p>Complete TDI Inspection and Maintenance Report Form No. 345-1-1, TDI Instruction Manual, Volume I, Section 6.</p> <p>Ref: Lead engine DR/QR Report #02-345A</p>

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		2. Verify that cam rollers are free to rotate, and that there is no measurable clearance between the cam rollers and the roller pins.		X				Complete TDI Inspection and Maintenance Record Form No. 345-1-1 TDI Instruction Manual, Vol. I, Section 6. Ref: Lead engine DR/QR Report #02-345A
02-345B	Fuel Tappet Assembly	1. Inspect fuel assembly condition.		X				Complete TDI Inspection and Maintenance Report Form No. 345-1-1, TDI Instruction Manual, Volume I, Section 6. Ref: Lead engine DR/QR Report #02-345B
		2. Verify that cam rollers are free to rotate, and that there is no measurable clearance between the cam rollers and the roller pins.		X				Complete TDI Inspection and Maintenance Record Form No. 345-1-1 TDI Instruction Manual, Vol. I, Section 6. Ref: Lead engine DR/QR Report #02-345B
02-350A	Cam Shaft Assembly	1. Perform a visual inspection of all cam lobe surfaces for signs of cracking, pitting or spalling.		X				Any signs of cracking, pitting or spalling shall be followed by a detailed analysis to evaluate the expected life based on the size and extent of surface distress and any corrective measures shall be implemented as indicated by this analysis. Signs of

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
								spalling shall result in immediate replacement of the cam. Ref: Lead engine DR/QR Report #02-350A
02-350B	Cam Shaft Bearings	1. Inspect and measure cam shaft bearing shells.				X		Complete TDI Inspection and Maintenance Record Form No. 350-1-1, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values.
02-350C	Cam Gear	1. Visually inspect cam gear for chipped or broken teeth, pitting, excessive wear, or other abnormal conditions.		X				Ref: Memo from B. Bickford to E. Montgomery dated 6/23/84, Ref: Lead engine DR/QR Report #02-350C
		2. Measure gear back lash. NOTE - if cam gear hub is removed, it is ESSENTIAL that the nut be relocked at the position corresponding to the pre-scribed torque range of 70±10 ft-lbs. Insertion of the cotter pin must be accomplished at a torque > 50 ft-lbs force and < 90 ft-lbs force. If this is not possible another bolt,			X			Complete applicable sections of TDI Inspection and Maintenance Record, Form No. 355-1-1, TDI Instruction Manual, Volume I, Section 8, Appendix III-1 for clearance values. Ref: Lead engine DR/QR Report #02-350C

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		nut or washer should be used.						
02-355A	Crank to Pump Gear	1. Visually inspect crankshaft to lube oil pump gear for chipped or broken teeth, excessive wear, or progressive pitting or other abnormal conditions.		X				Any abnormal situations or indications of progressive pitting should be reported for an engineering evaluation. Ref: Perry DR/QR Report #02-355A Task Description.
		2. Measure gear backlash.			X			Complete applicable sections of TDI Inspection and Maintenance Record Form No. 355-1-1 TDI Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III-1 from clearance values. Ref: TDI Instruction Manual, Vol. I, Maintenance Schedule
02-355B	Idler Gear Assembly	1. Visually inspect idler gears for chipped or broken teeth, excessive wear pitting, or other abnormal conditions.		X				Any abnormal indications should be reported for an engineering evaluation. Ref: Lead engine DR/QR Report #02-355B

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		2. Measure gear backlash NOTE: If idler gear hub is removed, it is recommended that the nut be relocked at the position corresponding to the torque of 80 ±20 ft-lbs. Insertion of the cotter pin must be accomplished at a torque > 60 ft-lb and 100 ft-lbs. If this is not possible, another bolts, nut, or washer should be used.			X			Complete applicable sections of TDI Inspection and Maintenance Record Form No. 355-1-1, TDI Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III-1 for values. Ref: TDI Instruction Manual, Vol. I, Maintenance Schedule, Ref: Perry DR/QR Report #02-355B Task Description
		3. The mating surfaces between the idler gear and hub should be thoroughly cleaned with solvent prior to assembly to ensure that there is an adequate friction coefficient between the parts.						Ref: Perry DR/QR Report #02-355B Task Description.
02-359	Air Start Valves	1. Remove, clean and inspect air start valves. (Replace copper valve-to-head gasket)			X			Ensure valve installation includes retorquing requirements. Ref: DR/QR Report #02-359 (Items 1, 2, 3)

PERRY MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		2. Inspect the piston, cap, guide and housing sliding surfaces to evaluate wear or corrosion.		X				
		3. Ensure that the dryer between the air compressor after cooler and the air receivers is working properly by blowing down the air receivers daily and monitoring the moisture content.						To be performed daily. Ref: DR/QR Report #02-359
02-360A	Cylinder Head	1. Visually inspect cylinder heads (all cylinders).				X		Complete TDI Inspection and Maintenance Record Form No. 360-1-1, TDI Instruction Manual, Volume I, Section 6. One sheet for each head.
		2. Record cold compression pressures and maximum firing pressures.		X				If so indicated remove cylinder heads, grind valves and reseal. Ref: TDI Instruction Manual, Volume I, Section 6
		3. Blow-over the engine per TDI maintenance requirements, Volume I or at appropriate intervals after shutdown of the engine to ensure						In the event water is detected, the cylinder head should be replaced or returned to the vendor for repair. Ref: Lead engine DR/QR

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<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>Outage</u>	<u>Alt. Outage</u>	<u>5 Year</u>	<u>10 Year</u>	<u>Comments</u>
		against harmful effects of water leaks.						Report #02-360A
		4. Visually inspect the fuel injection port on each cylinder head "during" the normal monthly engine run for water leaks.	X					If water leakage is detected, the head(s) should be replaced. Ref: Lead engine DR/QR Report #02-360A
02-360B	Cylinder Head - Intake and Exhaust Valves	1. Visually inspect intake and exhaust valve, discs, stems and seats for wire drawing, pitting, distortion, concentricity, or any abnormal condition.				X		Complete the applicable sections of TDI Inspection and Maintenance Record Form 360-2-1.
		2. Visually inspect subcovers for evidence of valve guide blowby (Soot)						This is a one time only inspection to be performed after 500-600 hrs. of engine operation on new or reworked cylinder heads. Ref: Lead engine DR/QR Report #02-360B
		3. Measure intake and exhaust valves head thickness.				X		Complete applicable sections of TDI Inspection and Main- tenance Records Form 360-2-1, TDI Instruction Manual, Volume I, Section 6. One sheet for each cylinder. Use Section 8, Appendix III for clearance

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								values. (Items 3,4)
		4. Measure intake and exhaust valves - valve-to-guide clearances.				X		Complete applicable sections of TDI Inspection and Maintenance Record Form 360-2-1, TDI Instruction Manual, Volume I, Section 5. One sheet for each cylinder. Use Section 8, Appendix III for clearance values.
02-362A	Cylinder Head Covers - Subcover Assembly	1. Perform a liquid penetrant examination of the rocker arm pedestals top and vertical machined surfaces (connector pushrod side only) for signs of cracking at the counter bores.				X		This inspection is to be performed in conjunction with the rocker arm bushing inspections when the rocker arm shafts are removed from the subcovers (Ref: Lead engine DR/QR Report #02-390E) or when the rocker arm shaft assembly is removed. Subcovers with pedestal cracks that extend through the counter bore web down to the threads should be replaced. Ref: Lead engine DR/QR Report #02-362A

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02-365A	Fuel Injection Pumps	1. Visually check pressure bleed screws for erosion.		X				To be performed on all sixteen pumps.
		2. Tear down one pump for inspection.			X			Use representative pump to determine need to overhaul other pumps. Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
		3. Complete fuel injection pump inspection in accordance with TDI Instruction and Maintenance Manual, Volume I.			X			Based on inspection results and operating parameters. Complete TDI Instruction and Maintenance Record Form No. 365-1-1, Section 6 (Items 1, 2). Ref: TDI Instruction Manual, Volume I, Maintenance Schedule for Item 3, Ref: Lead engine DR/QR Report #02-365A (Items 2&3)
02-365B	Fuel Injection Nozzles	1. Remove, inspect and clean tips.		X				Ensure that a new copper gasket is used upon reinstallation of nozzle into head. Complete TDI Inspection and Maintenance Record Form 365-2-1 Instruction Manual, Volume I, Section 6.

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								Ref: TDI Instruction Manual, Vol. I Section 5 Maintenance Schedule, Ref: Lead engine DR/QR Report #02-365B (Items 1-4)
		2. Check nozzle pop pressure.		X				
		3. Check spray pattern.		X				
		4. Check assembly for leakage.	X					To be performed with the engine running during the monthly test run.
02-365C	Fuel Injection Tubing	1. Check tubing for leaks at compression fittings.	X					All fuel oil leak in- spections to be perform- ed while the engine is running or whenever the compression fittings have been disturbed. Ref: Lead engine DR/QR Report #02-365C
		2. Visually inspect tubing lengths for F.O. leaks or cracks.	X					Fitting inspection for leaks to be performed at first engine opera- tion following the installation of tubing. Subsequent inspections to be performed period- ically as indicated. Fuel oil leakage from shrouded fuel oil lines

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								can be detected at the leakoff ports in the base nuts, which are provided for this purpose. Ref: Letter from C.A. Malourh to V.A. Saleta dated 08/30/84.
02-365D	Fuel Oil Injection Lines: Supports	1. Visually inspect support elastomer inserts for deterioration or degradation.		X				Any inserts found to be unsatisfactory shall be replaced with new inserts prior to reassembly of F.O. lines. This inspection can be performed prior to reassembly of the F.O. lines in conjunction with the cylinder liner inspection. Ref: Lead engine DR/QR Report #02-315C Cylinder Liners, Ref: San Onofre DR/QR Report #02-365D Task Description.
02-371A	Fuel Pump Control Shaft	1. Check lube oil cups and fill as necessary.	X					Ref: Lead engine DR/QR Report #02-371A
02-371B	Fuel Pump Linkage Assembly and Bearings	1. Grease swivel link on F.O. pump assemblies, all cylinders.		X				

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02-375	Intake Manifold	1. Care should be exercised in assembly of cylinder heads onto the engine, to avoid cracking of the intake manifold elbows.						If required, other castings may be tried to achieve an acceptable fit, or bolt hole diameters may be increased to 1/8" oversize. Component should under no circumstances be jacked to fit. Ref: Lead engine DR/QR Report #02-375
02-380A	Exhaust Manifold	1. Visually and MT examine a sampling of circumferential pipe welds and corresponding heat affected zones. This examination is to be performed in accordance with Impell memo from G. Shears to J. Kammeyer dated 08/13/84.			X			To be performed during the first refueling outage and alternate outages thereafter. However, diesel operation should not exceed 200 hours between inspections. Ref: Lead engine DR/QR Report #02-380A
02-385A	Crankcase Relief Valve	1. Clean flame arrestors.			X			Ref: 3/26/84 IOC from M. Wehmeyer to J. Kammeyer
		2. Inspect seat and disc.			X			

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02-390E	Rocker Arm Bushings	1. Visually inspect and measure intake rocker arm bushings.						The visual and dimensional inspection of the rocker arm bushings should be conducted at the fuel outage which precedes 2300 hours of operation by at least the sum of expected hours of operation in a LOOP/LOCA event plus the expected hours of operation between outages. This inspection schedule may be revised after the first or subsequent inspections if the inspection results justify a longer period of engine operation between inspections. Ref: Lead engine DR/QR Report #02-390E (Items 1, 2, 3)
		2. Visually inspect and measure exhaust rocker arm bushings.						Not to exceed 1300 maximum hours of engine operation between inspections as described above.
		3. Visually inspect and measure intermediate rocker arm bushings.						Not to exceed 730 maximum hours of engine operation between inspection as described above.

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02-390F	Hydraulic Valve Lifters	1. Check valve lash.		X				
		2. Reinstall and adjust lifters - perform leak down test.		X				Ensure lifters are installed with the fill holes up. Verify condition of lifters via comparison of lifter leak down rate (actual) to specifications noted on TDI Maintenance Manual Ref: TDI Maintenance Manual Section 6-B-5, Ref: 04/16/84 letter to R. Johnson from R. Jaquinto
02-390G	Rocker Arm Capscrews, Drive Studs (Pop Rivets)	1. Verify capscrew torque values.		X				This inspection should be performed at each outage if the rocker arms are disassembled for inspection. Use TDI Instruction Manual, Volume I, Section 8, Appendix IV for proper torque values.
		2. Verify that rocker arm drive studs are intact and tight.		X				Ref: Lead engine DR/QR Report #02-390G (Items 1, 2)

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02-410A	Overspeed Trip Governor	1. Check trip set point - adjust as required.		X				<p>Modify the surveillance testing procedure to include verification that the overspeed trip is correctly set to an overspeed trip setting of 518 rpm $\pm 1\%$ every outage.</p> <p>Ensure that the electric governor and the mechanical backup governor setting are properly returned to their normal settings following the overspeed test. The test is to be performed with no load on the engine by increasing the normal governor speed setting(s) until a trip occurs.</p> <p>After several inspection periods, the history of the required adjustments should be reviewed to evaluate and possibly modify the testing interval.</p> <p>Ref: Lead engine DR/QR Report #02-410A</p>

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		Note: After setting the over- speed governor, the ad- justment screw settings should be marked with Torque Seal to reveal any unintended changes in the set positions.						
02-410B	Overspeed Trip Governor and Accessory Drive	1. Remove plugs from housing and check for magnetic particles.		X				Ref: IOC dated 03/27/84 from M. Weymeyer to N. Cooperrider.
		2. Check shafts for excessive radial and axial movement.		X				
		3. Visually inspect accessory drive gear for excessive wear.		X				
02-410C	Overspeed Trip Drive Couplings	1. Remove the present L-110 Lovejoy couplings and replace them with new units in accordance with SIM 363 and DR/QR Report recommendations.						To be completed at the first refueling outage.
		2. Verify that coupling is tight on shaft.		X				Ref: 6/24/84 memo from D. Limbert to E. Montgomery

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		3. Replace the Lovejoy coupling spiders or test coupling elastomer for hardness.		X				Replace elastomer if hardness is greater than 90 Shore A. Ref: Lead engine DR/QR Report #02-410C (Items 1,2,3)
02-4100	Overspeed Trip Vent Valve	1. Disassemble and replace "O" rings.				X		Ref: Lead engine DR/QR Report #02-4100
02-411A	Governor Drive - Governor and Tachometer Drive (and driven) Gears and Shaft	1. Visually inspect drive (and driven) gears and shaft for signs of wear.		X				Ref: TDI Instruction Manual, Vol. I, Section 5 Maintenance Schedule
02-411B	Governor Drive - Couplings, Pins and Keys	1. Check that coupling is tight on shaft.		X				If the coupling is found to be loose, it should be removed, all mating surfaces cleaned, and the unit reassembled using Loctite 609 or equivalent on the mating surfaces. Ref: Lead engine DR/QR Report #02-411B (Items 1, 2, 3)
		2. Replace present neoprene insert in the Koppers coupling.						To performed prior to placing the engine in the emergency standby mode.
		3. Replace elastomeric insert each refueling outage.		X				

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02-413A	Governor Linkage	1. Install positive locking hardware to the lever arm clamp bolt heads and shaft roll pins. NOTE: To be performed as necessary after tightening governor linkage hardware to design torque specifications.						
		2. Inspect for loose parts on the linkage assembly.	X					
		3. Lubricate cross shaft bearings cups.	X					Ref: Lead engine DR/QR Report #02-413A (Items 3&4)
		4. Grease the rod end fittings, especially those at the ends of the cross shaft.		X				
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	1. Check cylinder for extension and return.		X				To be accomplished during control system check.
		2. Check tailrod vent for air leakage.		X				To be accomplished during control system check. Items 1, 2; Ref: IOC dated 3/26/84 from M. Wehmeyer to R. Kaklec.

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02-415A	Woodward Governor	1. Drain, flush, refill and vent actuator oil system with new oil from a clean container ensuring the appropriate cleanliness procedures are followed.			X			NOTE: Venting the hydraulic actuator shall be performed per the Woodward manual if more than a half quart of oil is added. Ref: Lead engine DR/QR Report 02-415A
		2. Disassemble, clean and refurbish the actuator.				X		Items 1, 2, 3; Ref: 03/27/84 IOC from M. Wehmeyer to N. Cooperrider Ref: TDI Instruction Manual, Volume I, Section 5 Maintenance Schedule
		3. Replace flex element for governor drive coupling.		X				Ref: Lead engine DR/QR Report #02-411B Governor Drive Couplings
		4. Verify all governor control knob settings are in appropriate positions: LOAD - Maximum DROOP - Zero Speed - To provide mechanical governor control at 460 rpm.	X					All knob settings should be secured with a commercially available product such as Torque-Seal.

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5.	Modify the surveillance testing procedures to include an evaluation of the governor settings by means of the two test below:			X				NOTE: These tests shall include examinations of the engine speed transients during start and transient loading conditions. Included as part of the above tests is the verification that the engine set speed of 450 rpm is not exceeded by more than 7.5 percent (484 rpm max.) either during an engine start or during the largest single load reduction. Ref: Lead engine DR/QR Report #02-415A
	(a) Perform a test of the governor settings while under mechanical /electrical governor control, with the diesel generator off the grid in the isochronous mode.							
	(b) Perform a test of the governor settings while under mechanical (only) governor control, with the diesel generator off the grid in the isochronous mode.							
6.	Augment the setting adjustment procedures as described in the Woodward manuals, to include a test of the governor response, during an engine start to ensure agreement with the specification as detailed in Item #5 above.							Ref: Lead engine DR/QR Report #02-415A

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02-415B	Governor Booster Servomotor	1. Clean, inspect, and replace "O" rings and gaskets.				X		Ref: 3/27/84 IOC from M. Wehmeyer to J. Kammeier
02-415C	Governor Heat Exchanger	1. Clean and inspect.				X		
02-425A	Jacket Water Pump - Gear	1. Visually inspect jacket water pump gear for chipped or broken teeth, excessive wear, or potential/progressive pitting or other abnormal conditions.		X				Any abnormal situations or indications of progressive pitting should be reported for an engineering evaluation. Ref: Lead engine DR/QR Report #02-355B
		2. Check the key to keyway interface for a tight fit on both the pump shaft to impeller and the spline to pump shaft during pump reassembly.		X				This along with the drive fit of the impeller on to the pump shaft, will preclude past problems where relative motion between both the shaft and spline, and the spline and pump shaft caused fretting and upset of the keyway sides. Ref: DR/QR Report #02-425A
		3. It is recommended that the castle nut that drives the external spline on its taper, have minimum and maximum torque values of 120 ft-lbs and 660 ft-lbs respectively.						To be performed upon reassembly Ref: DR/QR Report #02-425A

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02-435A	Jacket Water Fittings- Pipe and Fittings (Small Bore Scope Only)	1. Visually inspect for leaks. X Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.						This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George.
02-437	Turbo Water Piping- Pipe and Fittings	1. Visually inspect for leaks. X Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.						This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George.
02-441A	Starting Air Manifold: Air Vent	1. Ensure that the starting air manifold vent is open and effective.	X					Ref: 08/27/84 Memo from W. Littmann to J. Cadogan, Ref: Lead engine DR/QR Report #02-442A (STAD)
02-441B	Air Filter to Starting Air Distributor	1. Inspect filter elements.	X					Ref: TDI Instruction Manual, Vol. I, Maintenance Schedule

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		2. Replace filter elements.						It is recommended that the filter be changed whenever the manufacturers recommended maximum differential pressure is achieved. Ref: Lead engine DR/QR Report #02-441B (Items 1&2)
	Strainer - Starting Air System	3. Blow down strainer DAILY.						Ref: Lead engine DR/QR Report #02-441B (Items 3&4)
		4. Clean and inspect strainer monthly.	X					If the strainer is excessively dirty, the frequency of cleaning and inspecting should be increased.
	Air Start Block Valves	5. Clean, refurbish valves -replace "O" rings and clean the screened fitting. Ensure leak tightness after reassembly.			X			Ref: Lead engine DR/QR Report #02-441B (Items 5, 6, 7)
		6. Inspect for tightness of fittings and bolts and apply locking compound, as required during reassembly of components.			X			

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		7. Replace "O" rings of the shuttle valve.		X				
	Starting Air Valves	8. Disassemble, clean, inspect and lubricate valves to prevent fouling. Test to assure leak tightness upon reasonably.		X				Ref: Lead engine DR/QR Report #02-441B.
02-455A	Fuel Oil Filter	1. Record filter d/p.	X					Change filter elements at or before the filter d/p reaches the manufacturers recommended maximum differential pressure. Purge entrapped air from the filter canister using the vent valve provided, and divert some fuel oil into the newly replaced cartridge. After air has been purged close vent valve and return handle to previous operating position. Ref: Lead engine DR/QR Report #02-455A
		2. Inspect canister gaskets and replace as necessary.		X				To be performed during change out of filter elements. Ref: 3/27/84 IOC from M. Wehmeyer to J. DiMare,

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		3. Inspect tubing and mechanical connections for tightness and/or leaks.	X					Ref: TDI Instruction Manual, Volume I
02-455B	Fuel Oil Strainers	1. Record strainer d/p.	X					Shift/clean element if manufacturers recommended maximum differential pressure is achieved. Bolt torques of 120-150 in-lbs should be utilized during reassembly. Ref: Lead engine DR/QR Report #02-455B (Items 1 & 2)
		2. Purge air from stand-by strainers						As required.
02-465A	Lube Oil Lines External: Tubing, Fitting and Couplings	1. Ensure that a minimum installation gap of 0.171 inches is maintained between pipe ends at the 12-inch Dresser coupling.						To be performed whenever piping is installed or reinstalled. Ref: DR/QR Report #02-465A
		2. Replace the 12-inch Dresser coupling gasket with a VITON gasket should leaks develop.						Ref: Shearon Harris DR/QR Report #02-465A Task Description.

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		3. Should a leak develop in a Style 90 small bore coupling, replace it with a style 90 coupling equipped with a viton gasket.						Ref: Perry DR/QR Report #02-465A (small bore).
02-467A	Turbocharger Lube Oil Fitting: Pipe, Tubing, Fittings, and Flexible Coupling (Small Bore Scope Only)	1. Visually inspect for leaks. X Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.						This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George.
02-475A,C	Turbocharger: Bracket Bolting and Gaskets	1. Each month for the first months of commercial operation these screws should be inspected to assure that no screw has loosened because of engine operating loads. If during these inspections none of the screws are found loosened or damaged, from then on inspections are to be conducted on a yearly basis (or during plant shutdown). But if any time						Refr: DR/QR Reports #02-475A,C

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		during inspection any screw is found loosened or damaged, it must then be replaced (if damaged) and all screws retorqued as follows; 125 ft-lbs for the bracket to engine screws and 75 ft-lbs for the bracket to turbo base screws. Note: To avoid damage to bracket to engine, and/or bracket to turbo, base screws, the proper torques as delineated above should be utilized for each respective bracket bolting application.						
02-475B	Air Butterfly Valve	1. Lube valve shaft via grease fittings.			X			Ref: IOC dated 3/28/84 from M. Wehmeyer to J. DiMare. If oil cups are used, this should be completed monthly.
		2. Check valve disc for freedom of movement.		X				Check by visually observing valve/actuator operation. Ref: 04/16/84 from R. Jaquinto to R. Johnson
		3. Verify that associated locking devices (jam nuts and lock washers) are tight.		X				Ref: DR/QR Report #02-475B

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02-500A	Engine Control Cabinet	1. Inspect interior of cabinet for cleanliness and clean as required.		X				Ref: 3/29/84 IOC from M. Wehmeyer to T. Jacobs for Items 1-5, Ref: 07/30/84 IOC from J. Cadogan to K. Horelik for Items 1-6
		2. Visually check wiring for insulation degradation.		X				
		3. Visually check instrument tubing for leaks.		X				
		4. Functionally check cabinet heater and calibration of thermostat.		X				
		5. Test pneumatic S/D board logic.		X				
		6. Replace "O" rings, gaskets and filter in pressure regulator.		X				
02-500C	Circuit Breakers and Contact Blocks	1. Check all terminals clean/tighten.		X				To be accomplished during panel clean/inspection.
		2. Visually check wiring insulation for degradation.		X				To be accomplished during panel clean/inspection.
		3. Trip check circuit breakers.		X				

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02-500G	Control Panel Valves	1. Inspect and clean control panel valves.		X				This recommendation interval should be reassessed depending on the degree of system fouling. Ref: Lead engine DR/QR Report #02-500G
		2. Inspect and clean the 200 mesh screen in the check valve.		X				Ref: Lead engine DR/QR Report #02-500G
02-500I	Control Panel Assembly: Relays	1. Inspect contacts and clean as required.		X				Ref: 08/10/84 IOC from K. Horelik to J. Cadogan
		2. Visually check condition of wiring and tightness of terminations.		X				
02-500M	Control Panel Switches Terminal Boards and Wiring	1. Clean terminal boards and switch contacts.		X				Ref: IOC dated 3/29/84 to J. Kammeyer from M. Wehmeyer for Items 1, 2, 3.
		2. Visually check wire insulation and terminals for tightness and degradation.		X				
		3. Inspect for arcing and overheating.		X				
02-525B	Barring Device Control Valve	1. Drain filter daily while barring device is in operation.						Ref: Lead engine DR/QR Report #02-525B (Items 1 & 2)

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		2. Replace regulator elastometric parts.			X			
02-550	Foundation Bolts	1. Visually inspect foundation for breaks in the bond between the sole plates and grout.		X				Ref: TDI Instruction Manual, Maintenance Schedule, Section 5
		2. Check foundation bolts for correct torque. Retorque as necessary then recheck crankshaft web deflection.		X				Use TDI Instruction Manual, Volume I, Section 8, Appendix IV for proper torque values.
		3. Generator foundation bolts are to be retorqued after a generator short circuit if the bolts were initially torqued to 480 ft-lbs. If initial bolt torque was 600 ft-lb no retorque is required.						Ref: Lead engine DR/QR Report #02-550
02-630D	Thermocouples	1. Check that thermocouple indicates ambient engine temperature when the engine is cold.		X				An inconsistent reading traced to thermocouple trouble should result in replacement of the thermocouple.

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		2. Clean and inspect thermocouples and thermocouple shields.			X			Indications of fatigue should result in replacement of the thermocouple and/or thermocouple shield. Ref: 7/31/84 Memo from S. Riess to W. Littmann
		3. Pyrometer wiring - check that terminations are tight.						To be accomplished during control panel check-out and initial operation inspection. Items 1, 2, 3; Ref: 07-30-84 IOC from J Cadogan to S. Riess
02-650A	Emergency Generator	1. Check operation of brushes and slip rings.	X					Ref. IOC dated 03/30/84 M. Wehmeyer to D. Mercaldi (Items 1-5).
		2. Clean/inspect all accessible parts of the generator.		X				
		3. Megger rotor and stator.		X				
		4. Verify operation of space heaters.	X					
		5. Measure vibration and check against base line data.		X				
02-650B	Emergency Generator Control Panel	1. Inspect panel for cleanliness and clean as required.		X				Items 1-5; Ref: 3/30/84 IOC from M. Wehmeyer to D. Mercaldi
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02-650C	Emergency Generator Pedestal Bearing	2. Check terminal boards for loose wiring.		X				
		3. Visually check condition of wire insulation for degradation.		X				
		4. Clean and inspect relay contacts.		X				
		5. Check meter calibrations.		X				
		1. Check ring oilers for proper operation and verify oil level.	X					To be accomplished during every test run of the engine. Ref: 3/30/84 IOC from M. Wehmeyer to N. Cooperrider (Items 1-4)
		2. Drain flush refill bearing housing.		X				
		3. Measure bearing housing insulation resistance.		X				
		4. Disassemble and inspect bearing and check clearances.				X		

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02-695B	Engine Control Air Pressure Regulator	1. Inspect and clean engine shutdown equipment.		Y				NOTE: This recommendation should be assessed depending on the degree of system fouling Ref: Lead engine DR/QR Report #02-695B (Items 1 & 2)
		2. Replace elastomeric parts and gaskets in the pressure regulator.		X				
02-695C	Engine Control Pneumatic Trip Switches	1. Check switch set points.		X				Pressure switches. Ref: 3/30/84 IOC from M. Wehmeyer to J. DiMare
		2. Replace elastomeric parts.				X		
02-700B	Jacket Water Standpipe: Valves	1. Replace elastomeric parts in circle seal valves.				X		Ref: Lead engine DR/QR Report #02-717B
02-717B	Auxiliary Sub-base & Oil & Water Piping - Jacket Water: Valves	1. Inspect the valves for packing leakage.	X					Replace as necessary. Ref: Lead engine DR/QR Report #02-717B

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02-717C	Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers (Small Bore Scope Only)	1. Visually inspect for leaks. X Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.						This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George.
02-717F	Auxiliary Sub-Base Lube Oil Pipe and Fittings	1. Visually inspect for leaks. X Note: In the event of a leak developing in the existing Dresser Style 65 couplings, these couplings should be replaced with Dresser Style 90 couplings equipped with Viton gaskets.						This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 is 212°F. Ref: Letter dated 12/13/84 from C L Ray to J George.
		2. Clean and inspect L.O. keep-warm pump suction strainer.			X			Complete when L.O. tank is drained. Ref: 04/16/84 letter from R. Jaquinto to R. Johnson

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02-717G	Auxiliary Sub-Base Lube Oil	1. Dissassemble, clean and check relief valve lift pressure.				X		Ref: 07/31/84 IOC to M. McGerigle from J. Cadogan, Ref: 08/16/84 IOC from M. McGerigle to J. Cadogan, Ref: Lead engine DR/QR Report #02-717G
02-717K	Auxiliary Sub-Base and Oil and Water Piping: Fuel Oil Valves	1. Dissassemble, lubricate, inspect and refurbish.		X				Ref: IOC dated 4/6/84 from M. Wehmeyer to J. DiMare. Ref: Lead engine DR/QR Report #02-717K
02-805B	Intake Air Filters	1. Inspect intake air distribution plate and change filter oil.		X				Ref: Perry DR/QR Report #02-805B
02-805D	Flex Connection	1. Visually inspect for evidence of cuts, holes, or dents.			X			
02-810B	Jacket Water Heat Exchanger	1. To avoid corrosion and fouling the jacket water heat exchanger and associated service water piping should be flushed on a periodic basis (continuous service flow is sufficient). Alternatively, service water chemistry control can be used to maintain heat exchanger performance and integrity.						Ref: Lead engine DR/QR Report #02-810C, Ref: 04/20/84 IOC from M. Wehmeyer to R. Kadlec

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2.	Perform a daily visual inspection for leakage at packing whenever the engine is in the emergency standby mode. Verify that no leakage is present through the leak-off ports of the lantern ring.							To be performed daily. Ref: 07/19/84 Telecon D. Pasquale and R. Chii
3.	Record heat exchanger performance by checking engine operating parameters.		X					Use for trend data
4.	Evaluate heat exchanger performance data.			X				
5.	Inspect tubes and tube sheet for fouling and erosion - remove entrance and exit channel covers.			X				Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
	Replace packing rings at floating tube sheet after tube inspection.							Ref: Lead engine DR/QR Report #02-810C
6.	Inspect and clean lantern ring. Verify leak-off holes are not plugged.			X				Replace/rework lantern ring as necessary to ensure concentricity prior to reinstallation.

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		7. Replace packing rings.						Replace packing when packing becomes hard or leakage at the packing is noted and cannot be stopped by tightening. Ref: Lead engine DR/QR Report #02-810C
02-810C	Thermostatic Valves	1. Replace thermal power elements.				X		Ref: Lead engine DR/QR Report #02-810D (Items 1, 2)
		2. Visually inspect valve body for evidence of leakage.	X					To be accomplished during monthly test run. Ensure that any replacement valves have cast steel valve bodies.
02-810D	Jacket Water Heaters	1. Measure heater insulation resistance.		X				Replace heater if degradation of insulation resistance is noted.
		2. Clean and inspect heater elements.		X				Ref: 5/10/84 IOC from M. McGerigle to W. Brown for Items 1, 2, 3
		3. Check calibration and inspect thermostat.		X				
02-820A	Lube Oil Sump Tank Heaters	1. Measure heater insulation resistance.		X				Replace heater if degradation of insulation resistance is noted.

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02-820B	Lube Oil Keep-Warm Pump	2. Inspect and clean heater elements.		X				To be accomplished during tank inspection.
		3. Check calibration and inspect condition of thermostat.		X				Ref: 05/10/84 IOC from M. McGerigle to W. Brown for Items 1, 2, 3
		1. Check operation of pump/motor bearings.	X					Items 1-5; Ref: 04/05/84 IOC from M. Wehmeyer to T. Fritsch
		2. Check mechanical seal leakage.	X					
		3. Record pump discharge pressure.	X					Use for trend data
		4. Measure unit vibration (pump/motor)		X				
		5. The pump should be inspected for signs of leakage and corrective modifications (addition of flexible piping connections) be implemented as required						To be performed daily Ref: DR/QR Report #02-820C
02-820C	Full Pressure Lube Oil Strainer	1. Record strainer d/p.	X					Use for trend data

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		2. Inspect and clean elements.						Inspect/clean when strainer differential pressure rises significantly. Ref: Lead engine DR/QR Report #02-800H, Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
		3. Lube oil strainer pressure gauge - calibration check.			X			
02-820D	Prelube Oil Pump Strainer	1. Check strainer differential pressure <u>DAILY</u> .						Clean and/or replace the element when the manufacturer's recommended maximum differential pressure is achieved. Ref: Shearon Harris DR/QR Report #02-465D Task Description.
02-820E	Oil Prelube Filter	1. Record filter d/p.		X				Ref: 04/05/84 IOC from M. Wehmeyer to J. DiMare
		2. Change filter elements.						To be performed before the filter d/p reaches the manufacturers recommended maximum differential pressure. Ref: Lead engine DR/QR Report #02-820E

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02-820F	Full Flow Lube Oil Filters	1. Record filter d/p.	X					Use for trend data, Ref: 04/02/84 IOC from M. Wehmeyer to J. DiMare, Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
		2. Drain water and/or sludge from lubri- cating oil full flow filter.	X					
		3. Replace filter cartridges and perform a visual inspection to determine the nature of the material caught in the filter.						To be performed before the filter d/p reaches the manufacturers recommended maximum differential pressure. Ref: 05/30/84 IOC from M. McGerigle to S. Brown, Ref: Lead engine DR/QR Report #02-820F, Ref: 07/31/84 IOC from J. Cadogan to M. McGerigle
		4. Lube oil filter gauge - calibra- tion check.		X				

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02-B20G	Lube Oil Heat Exchanger	1. Perform a daily visual inspection for leakage at packing. Verify that no leakage is present through the leak-off ports of the lantern ring.						Ref: Shoreham DR/QR Report #10-109, Ref: 06/12/84 IOC from R. Chii to P. Martia, Ref: 04/02/84 IOC from M. Wehmeyer to R. Kadlec
		2. Record heat exchanger performance by checking engine operating parameters.	X					Use for trend data
		3. Evaluate heat exchanger performance data.		X				
		4. Inspect tubes and tube sheet for erosion and fouling - remove entrance and exit channel covers.		X				Ref: TDI Instruction Manual, Volume I, Maintenance Schedule, Ref: 07/19/84 Telecon D. Pasquale and R. Chii
		5. Inspect and clean lantern ring. Verify leak-off holes are not plugged.		X				Replace/rework lantern ring as necessary to ensure concentricity.
		6. Replace packing rings at the floating tube sheet during reassembly after each inspection.		X				And/or packing becomes hard or leakage at the packing is noted and cannot be stopped by tightening.

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		7. Perform a spectro chemical analysis of the lube oil. Particular attention shall be given to percent moisture content.						To be performed at approximate quarterly intervals. Ref: Lead engine DR/QR Report #02-820G
02-835A	Air Dryers and Moisture Traps	1. Blow down trap sediment bowls.	X					Ref: 04/05/84 IOC from M. Wehmeyer to J. Kammeyer, Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
		2. Inspect and service moisture traps.			X			
		3. Check proper operation of desiccant dryer.	X					Replace desiccant charge as required. Ref: 04/16/84 letter from R. Jaquinto to R. Johnson
02-835B	Starting Air Tank	1. Drain air receiver float traps or drain valves DAILY and monitor the quantity of moisture produced at the float traps or drain valves.						If quantity of moisture is excessive correct immediately. Check air dryer operation. Ref: Lead engine DR/QR Report #02-835J
		2. Disassemble and clean the float trap.			X			Ref: IOC dated 05/08/84 from P. Titus to P. Martin (Items 1 & 2)

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		3. Starting air tank pressure gauges - calibration check.		X				
		4. Starting air tank pressure switches - calibration check.		X				
02-835D	Starting Air Compressors	1. Check lubricating oil level.	X					All items; Ref: 04/02/84 IOC with attached Maintenance Chart from M. Wehmeyer to J. Kammeyer.
		2. Overall visual inspection.	X					
		3. Clean fins on inter and after coolers.		X				
		4. Replace intake filter element.		X				
		5. Change compressor oil.		X				
		6. Check belt tension.		X				
		7. Check pulley clamp bolts/set screws tight.		X				
		8. Inspect filter felts on unloader system.		X				Replace as necessary.

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	Jacket Water System	1. Check pH. factor of jacket water and correct as recommended by chemical supplier.	X					Ref: TDI Instruction Manual, Volume I, Maintenance Schedule
		2. Replace elastomeric parts in jacket water valves.				X		
	Lube Oil System	1. Check lubricating oil with a viscosimeter for fuel oil dilution. Send a sample of oil to laboratory for analysis.	X					Ref: TDI Instruction Manual, Volume I, Maintenance Schedule, Items 1, 2
		2. Drain lubricating oil system and clean sump tank. Depending on the results of lube oil analysis, refill with new oil.		X				When replacing engine oil use H.D. oil that meets or exceeds series 3 standards. The base stock should be more resistant to thermal degradation and coke formation. The additive package should provide high detergent dispersant properties with high alkalinity and a high level of antiwear additive such as zinc dithiophosphate. Total Base Number (TBN) should be 12 to 15 for use with #2 fuel oil and a sulfated ash content of 1.5% to 2.0%

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								is preferred. An engine oil with such properties, Mobilguard 412 or equivalent product may be used to insure improved lubrication.
		3. Visually inspect lube oil sump tank level switch floats. Check switch set points.		X				To be performed after lube oil has been drained from sump.
		4. Perform a spectro-chemical analysis of the lube oil.						To be performed at approximately quarterly intervals. Ref: TDI Instruction Manual, Volume I, Maintenance Schedule.
	System Operation	1. Record all operating parameters. Compare with base line data to ensure engine is operating properly.	X					To be performed during monthly engine test run.
	Piping System	1. Conduct a detailed visual and audible inspection of all fuel, air, oil, and water piping and valves for leakage.	X					Tighten, repair or replace as required. Ref: TDI Instruction Manual, Volume I, Maintenance Schedule

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		2. Inspect, clean and as applicable, lubricate manual valves on skid.		X				
	Engine Internals	1. Remove alternate left side doors and examine the inside of the engine for any abnormal conditions. Check with a good light for evidence of babbitt flakes.		X				If excessive water, sludge or any indication of bearing failure is present, drain crankcase, determine cause, and take necessary action.
Miscellaneous	Engine Mounted Pressure Switches	1. Replace elastomeric parts.				X		
	Gear Train	1. Inspect gears for general condition.		X				
		2. Measure gear back lash on all gears.			X			Replace worn gears exceeding maximum clearance. Complete TDI Inspection and Maintenance Form No. 355-1-1 TDI Instruction Manual, Vol. I, Section 5. Use Vol. I, Section 8 Appendix III-1 for clearance values. Ref: 04/16/84 letter from R. Jaquinto to R. Johnston