

CATAWBA NUCLEAR STATION
DIESEL ENGINE 1A COMPONENT REVALIDATION INSPECTION
REPORT

PREPARED BY
DUKE POWER COMPANY

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Table of Contents

- 1.0 Introduction
- 2.0 Summary and Conclusions
 - 2.1 Overview of Inspection Results
 - 2.2 Piston Skirt Cracking
 - 2.3 Subcovers
 - 2.4 Cylinder Head Leaks
 - 2.5 Conclusions
- 3.0 Discussion of Inspection Results
 - 3.1 Inspections Related to TDI Generic Problems
 - 3.2 Inspections Related to Catawba Specific Problems
 - 3.3 General Inspections
- 4.0 References
- 5.0 Appendices
 - A. Inspection Reports
 - B. Engineering Validation Report

Figures

- 2-1 Cracked Type AN Piston Skirt
- 2-2 Cracked Subcover Castings
- 2-3 Crack in Cylinder Head

Table

- 2-1 Summary of Catawba Diesel 1A Post Extended Operation Test Results

This report describes the results of inspections and evaluations performed on the Catawba 1A diesel engine. These inspections were performed as part of an overall program to verify the reliability of Transamerica Delaval, Incorporated (TDI) diesel engines used for safety-grade power supplies at Catawba. The overall program is described in an April 5, 1984 letter to the NRC, reference 1. The scope of the inspections meets or exceeds the TDI Owners Group inspection program.

The inspections of the 1A diesel engine discussed herein were performed in April and May, 1984. The inspections involved extensive disassembly of the diesel and 100% inspection of parts for which there was a history of problems or other reasons for special concern. Substantial (e.g. 25%) sampling inspections were performed of other important parts where there was no history of problems. The scope of the inspections is essentially as described in reference 1, with the exception that all 16 pistons, connecting rods, and related parts were inspected on a 100% basis rather than on a sample basis. Also, one additional main bearing and two additional cylinder liners were added to the inspection plan.

The diesel disassembly, reassembly, and inspections are being performed in accordance with the Duke Power Quality Assurance Program. The assembly, disassembly and inspection work was largely performed by Duke Power personnel, with selected inspections performed by Failure Analysis Associates (FaAA) and Stone and Webster (S&W) personnel in conjunction with the TDI Owners Group program.

Detailed results of the inspections are contained in Section 5.0, Appendix A and are discussed in Section 3.0. Some parts which are important to diesel operability were not inspected since inspection is not called for by the TDI Owners Group program and there has been no history of problems. For such items an engineering evaluation of the operating and maintenance history of each of these parts was performed and is documented in Appendix B of Section 5.0.

This report is the initial report of the Catawba 1A diesel inspections. This report covers over 76% of the inspection plan which includes about 4200 separate inspections. Inspection results not covered in this report are as follows:

- Walkdowns of the jacket water, starting air, fuel oil, engine shutdown, engine conduit and exhaust manifold systems. These walkdowns can only be accomplished following reassembly of the engine.
- Visual inspections of turbocharger exhaust gas inlet bolts.
- Visual examination of some components within the overspeed trip and hardness and liquid penetrant (PT) tests of components of the accessory drive.

- PT test of components of the governor drive.
- Material comparator tests on valves, jacket water pump drive shaft, cylinder liners, and piston pins.
- Inspections of bearings and journals on #6 and #8 main bearings. Inspections of #4 and #5 main bearings have been completed.
- Eddy-current (ECT) test of fuel line tubing.
- X-ray acceptance of connecting rod shells.
- Review of cylinder heads to see if they have been repaired at the base of the fuel injector hole.
- Boroscope inspection of bore of injection pump valve holder.
- Visual and magnetic particle inspection (MT) of fuel injector nozzle holder studs.

A updated report incorporating the above inspection results, additional engineering evaluations, as well as the results of ongoing failure analysis work (reported in the body of this report) will be issued by June 29, 1984.

2.1 Overview of Inspection Results

In March 1984, the Catawba 1A diesel engine successfully completed (reference 1) its extended operation test which results in more than 800 total accumulated hours on the engine. This test confirmed the ability of the diesel to operate reliably for long periods of time at high power. Subsequent to the extended operation test, extensive disassembly and inspection of this diesel engine has been performed to confirm the satisfactory condition of various parts and to identify any parts requiring repair, replacement, and/or redesign to ensure highly reliable standby electric generator service.

The post extended operation test inspections are now nearly completed, with the only exceptions being as outlined in Section 1.0. The results of the inspections are summarized in Table 2-1. Initial engineering and quality assurance evaluation of the inspection results has been performed with final evaluation expected to be completed by June 29, 1984. Work performed to date is considered to have identified all significant conditions. These conditions are discussed below.

The most significant results of the Catawba 1A diesel engine post extended operation test inspections are as follows:

- Many of the major problems experienced with other TDI diesel engines did not occur in the Catawba 1A diesel engine. These problems include failed crankshafts, cracked connecting rod-crankpin bearing shells, connecting rod box cracks, and cracked cylinder blocks.
- One major problem was noted on the 1A diesel. Four of the type AN piston skirts used in the 1A diesel were found to have one or more cracks in the region where an internal circumferential reinforcing rib intersects the piston pin boss (Figure 2-1). This problem is discussed further in Section 2.2.
- The turbocharger thrust bearings were found to be severely worn, even though they had continued to function satisfactorily during the test. This condition was anticipated since similar problems have been experienced at other stations. As a result of this history, a redesigned lube oil system is being developed which is expected to prevent recurrence of the problem. It will be installed by September 1, 1984. In the meantime, the bearings are being replaced as necessary to ensure operability.
- Several other problems of potential significance to diesel operability were detected and are being further investigated as part of the TDI Owners Group program. These are:

- Two subcover castings were found to have cracks in an intake rocker arm pedestal (Figure 2-2). These cracks are discussed in Section 2.3.
- Two Catawba cylinder heads (one on diesel 1A and one on 1B) experienced small jacket water leaks into the fuel injector cavity. Recent metallographic examinations of the head removed from the 1A diesel indicates that the leak was due to a fatigue crack (Figure 2-3). This problem is discussed in Section 2.4.
- A small eddy-current test (ECT) indication was detected in crankpin to web fillet #7 (generator end) on the crankshaft. Metallurgical examination using replicas indicates that indication was due to two small (about .030 inch long) axial linear defects. ECT indicates that the defects are less than .020 inches deep. Preliminary evaluation is that these are not due to service but rather due to initial fabrication. Duke Power Co. is continuing to examine these indications metallographically by replication. These indications will be removed by polishing.
- A variety of routine minor conditions were noted, and are discussed in Section 3.0 and 5.0. None of these conditions impact the operability or structural integrity of the diesel. Typical conditions of this type include:
 - Chipped and cracked edges of rocker arm sockets. (Section 3.3.1)
 - Chipped and removed valve stem chrome plate. (Section 3.3.2)
 - Jammed air start valve adjusting nut. (Section 3.3.3)
 - Heads of small bolts broken off, due to under or over torquing. (Section 3.3.5)

2.2 Piston Skirt Cracking

Four type AN skirts were found to have cracks adjacent to piston pin bosses. (Figure 2-1) These cracks run approximately vertically, and appear to initiate on the inside of the skirt where a circumferential reinforcing rib intersects the piston pin boss. The largest crack, on skirt 3L, was through wall and was about 3 to 4 inches long on the outside.

It is understood from TDI that this type of crack has never before been reported to TDI for stress relieved piston skirts. However, similar cracks have occurred on non-stress relieved type AN skirts and, as a result, TDI recalled non-stress relieved skirts for stress relief. Those Catawba 1A skirts which had not been originally stress relieved were returned to TDI and stress relieved in 1983, prior to the extended operation test and other tests. Thus, the cracking of the Catawba 1A skirts indicates that this type of cracking is possible even with stress relieved type AN piston skirts.

An extensive failure analysis of the cracked Catawba type AN piston skirts is now being performed by Failure Analysis Associates (FaAA) as part of the TDI Owners Group program. This program includes determination of residual and applied stresses, fractography, and metallurgical evaluations. Operational tests of cracked piston skirts are also being considered to evaluate crack growth rates.

The cracked AN type piston skirts in the Catawba 1A diesel did not cause any operational problems, and 12 of the 16 skirts were free of cracks. Nevertheless, all the piston skirts will be replaced with improved design AE skirts. The AE skirts have been stress relieved and include improved design features such as a thicker reinforcing rib and better rib-piston boss intersection details. These improvements are expected to adequately reduce the stresses and propensity for cracking in the area which experienced cracking at Catawba. The FaAA/Owners Group program will quantify the benefits achieved by use of AE piston skirts. It is anticipated that this will show that no cracking is expected during the life of the Catawba diesels. The AE piston skirts also incorporate the latest improvements in the stud boss region, which has been a problem area in earlier piston designs at the skirt to head transition.

2.3 Subcovers

Two cast iron subcovers were found to have cracks in a pedestal where the intake rocker arm shaft is bolted to the subcover (Figure 2-2B). Prior to the extended operation test, another subcover was found to have a piece of this pedestal missing (Figure 2-2C). None of these cracks have affected diesel operability. However, since similar problems have been reported with other diesels, FaAA has initiated a failure analysis of a Catawba subcover. Preliminary thinking is that the cracks are due to installation tolerances between dowels, bushings, and the pedestal leading to excessive interference. Whether such excessive interference fits will be confirmed as the problem by the failure analysis being performed by FaAA is not yet known.

2.4 Cylinder Head Leaks

Two cylinder heads at Catawba, one on engine 1A and one on engine 1B, developed small jacket water leaks into the fuel injection cavity. The 1A leak developed during the extended operation test and the engine was shut down due to other problems three days after detection of the leak. The 1A leak did not affect engine operability. The leak on the 1B engine was of similar magnitude to that of 1A. The 1A cylinder head has recently been examined by FaAA. This investigation revealed that the leak was caused by a crack initiating from the corner of a welded-in plug where it was seated in the cylinder head (Figure 2-3). This welded-in plug is reported by TDI to have been used to repair the casting around the fuel injector hole.

The cause of crack propagation has not yet been determined. However, the cause is believed to be thermal/pressure fatigue at the sharp corner of the counter bore for the plug. FaAA will perform a failure analysis as part of the TDI Owners Group program to identify the cause. The leaks caused by the cracks have not affected diesel operability since they result in small amounts of water leaking into the fuel injector cavity and then off of the diesel. This does not affect diesel operation and the heads can be replaced at a convenient opportunity. For this reason, special inspections to check for this condition are not considered necessary. Nevertheless, cylinder heads at Catawba are currently being inspected to determine which ones have been repaired in the injector hole.

2.5 Conclusions

Almost all of the post extended operation test inspections of the critical areas of the diesel have been completed and over 76% of the total number of inspections have been completed. The extended operation test and the post test inspections have demonstrated that the Catawba 1A diesel will reliably provide standby electric generation. The inspections have indicated that the piston skirts must be replaced with improved type AE piston skirts and that a few minor damaged parts such as subcover castings with cracked pedestals should be replaced. In addition, the diesel engine preventative maintenance program will be re-evaluated based on the results of these inspections to determine whether additional periodic inspections are required. It is believed that completion of the Catawba 1A diesel inspection plan will not affect the above conclusions. Results of the additional inspections as well as ongoing engineering evaluations and failure analysis work will be the subject of a updated report on the Catawba 1A diesel to be submitted by June 29, 1984.

TABLE 2-1
SUMMARY OF CATANNA DIESEL 1A POST EXTENDED OPERATION TEST RESULTS

Part Name	Part No.	Class	Dimm.	Sample Size, Percent				Visual	S. NDE	V. NDE	Material	Hardness	Rng	By	Notes	Results (Ref. paragraph)
				Visual	S. NDE	V. NDE	Material									
Lube Oil Pressure Regulating Valve	00-420	A	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Jacket Water Standpipe, Flange, Gasket	00-700A	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Jacket Water Standpipe Valves	00-700B	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Jacket Water Standpipe Supports	00-700C	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Jacket Water Standpipe Switches	00-700E	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Jacket Water Standpipe Bolting Materials	00-700F	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Main Bearing Cap Base Assembly	02-305A	A	-	50	50	-	-	-	-	-	-	-	-	-	Satisfactory - Partially Complete (3.1.6)	
Main Bearing Studs and Nuts	02-305C	A	10	30	-	-	-	-	-	-	-	-	-	-	Satisfactory - Partially Complete	
Main Bearing Caps	02-305D	A	-	50	50	-	-	-	-	-	-	-	-	-	Satisfactory - Partially Complete	
Lube Oil Internal Headers	02-307A	A	-	100	-	-	-	-	-	-	-	-	-	-	Some discrepancies found, evaluation in progress.	
Lube Oil Tubing and Fittings-Internal	02-307B	A	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory (3.2.2)	
Lube Oil Line Supports-Internal	02-307D	B	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory except for some loose supports.	
Crankshaft	02-310A	A	100	100	38	-	-	-	-	-	-	-	-	3,4	Satisfactory except for one minor BCT indication (3.1.1)	
Crankshaft Bearing Shell	02-310B	A	50	50	-	-	-	-	-	-	-	-	-	-	Satisfactory - Partially Complete, some bolts had low torque	
Crankshaft Thrust Bearing Ring	02-310C	A	100	-	-	-	-	-	-	-	-	-	-	4	Pending	
Crankcase Assembly	02-311A	A	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Cam Bearing Caps and Dowels	02-311B	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Crankcase Mounting Hardware	02-311D	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Cylinder Block	02-315A	A	40	-	100	-	-	-	-	-	-	-	-	-	Satisfactory (3.1.5)	
Cylinder Liner	02-315C	A	100	100	-	-	20	20	-	-	-	-	-	-	Satisfactory (3.1.4)	
Cylinder Block Jacket Water Manifold	02-315D	B	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Cylinder Head Studs	02-315E	B	-	25	-	-	3	-	-	-	-	-	-	-	Satisfactory (3.1.7)	
Cyl. Block Jacket Wtr. Manifold Nuts	02-315F	B	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Cylinder Block Seals and Gaskets	02-315G	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Jacket Water Inlet Manifold Assembly	02-316A	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Jacket Water Inlet Manifold Coupling	02-316B	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Jacket Water Discharge Manifold	02-317A	B	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory - Partially Complete	
Jacket Water Disch. Manifold Coupling	02-317B	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Jacket Water Disch. Manifold Supports	02-317C	B	-	100	-	-	-	-	-	-	-	-	-	-	Pending	
Flywheel	02-330A	A	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Flywheel Bolting	02-330B	A	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Front Gear Case Bolting	02-335B	C	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Connecting Rods and Bushings	02-340A	A	100	100	100	-	25	25	-	-	-	-	-	-	Satisfactory except for one gauged bushing (3.3.4)	
Connecting Rod Bearing Shells	02-340B	A	100	100	100	100	-	-	-	-	-	-	-	-	Satisfactory except for some porosity (3.1.2), rest O.K.	
Piston	02-341A	A	100	100	100	-	-	-	-	-	-	-	-	5	Four cracked skirts (2.2, 3.1.3), all skirts replaced.	
Piston Rings	02-341B	A	25	100	-	-	25	-	-	-	-	-	-	-	Satisfactory - Partially Complete	
Piston Pin Assembly	02-341C	A	25	100	-	-	25	25	-	-	-	-	-	-	Satisfactory	
Intake Tappets	02-345A	A	-	25	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Fuel Tappets	02-345B	A	-	25	-	-	-	-	-	-	-	-	-	-	Satisfactory except for some minor scratches.	
Fuel Pump Base Assembly	02-345C	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	
Camsshaft Assembly	02-350A	A	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Camsshaft Bearing	02-350B	B	-	100	-	-	-	-	-	-	-	-	-	7	Satisfactory	
Camsshaft Supports, Bolting and Gear	02-350C	A	-	100	-	-	100	100	-	-	-	-	-	-	Satisfactory, Hardness pending	
Crankshaft Gear	02-355A	A	-	100	-	-	-	-	-	-	-	-	-	-	Satisfactory	
Idler Gear Assembly	02-355B	A	-	100	-	-	-	-	-	-	-	100	-	-	Satisfactory	
Air Start Valve	02-359	A	100	100	-	-	-	-	-	-	-	-	-	-	Sat. except for one jammed nut & missing pin (3.3.3, 3.1.13)	
Cylinder Head	02-360A	B	100	100	100	100	-	-	-	-	-	-	-	2	Satisfactory except for one leak (2.4, 3.1.17)	
Intake and Exhaust Valves	02-360B	B	25	100	-	-	25	-	-	-	-	-	-	-	Satisfactory, some valves have chipped chrome plating(3.3.2)	
Cylinder Head Bolting and Gaskets	02-360C	B	-	-	-	-	-	-	-	-	-	-	X	-	Satisfactory	
Valve Springs	02-360D	B	-	100	-	-	-	-	-	-	-	-	-	1	Satisfactory	
Subcover Assembly	02-362A	B	-	100	100	-	-	-	-	-	-	-	-	-	Satisfactory except for two cracked pedestals (2.3, 3.2.6)	
Fuel Injection Pump	02-365A	B	100	-	-	100	-	-	-	-	100	-	-	-	Satisfactory, boroscope inspection pending. (3.2.1)	
Fuel Injection Tips	02-365B	B	-	-	-	-	-	-	-	-	-	-	X	9	Satisfactory	

TABLE 2-1 (Continued)

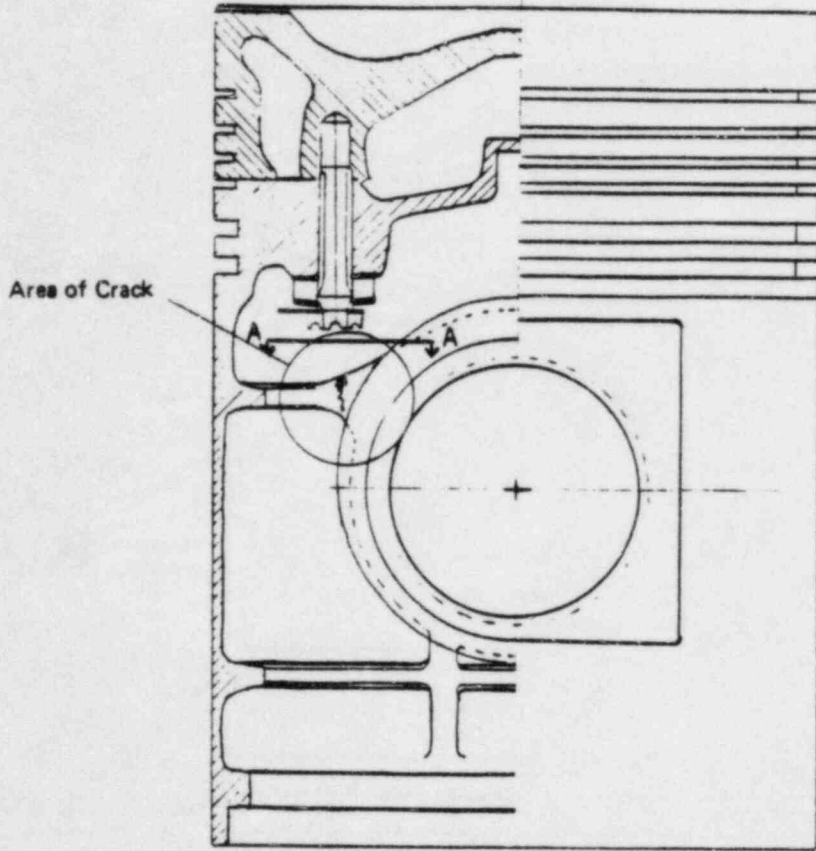
Part Name	Part No.	Class	Dimen.	Sample Size, Percent				Req	By	Notes	Results (Ref. paragraph)
				Visual	S. NDE	V. NDE	Material Hardness				
Fuel Injection Tubing	02-365C	B	-	100	100	-	-	-	8	Pending (3.1.11)	
Fuel Injection Tubing Supports	02-365D	B	-	100	-	-	-	-	-	Pending	
Fuel Pump Linkage and Control Shaft	02-371A	A	-	-	-	-	100	100	-	Satisfactory	
Fuel Pump, Linkage, Bearings and Shaft	02-371B	A	-	100	-	-	-	-	-	Satisfactory	
Intake Manifolds	02-375	B	-	100	-	-	-	-	-	Satisfactory	
Exhaust Manifold	02-380A	B	-	100	-	-	-	-	-	Satisfactory - Partially Complete	
Exhaust Manifold Bolting	02-380B	B	9	9	-	-	-	-	-	Satisfactory, manifold to turbo bolting pending. (3.2.8)	
Cylinder Block Cover, Gaskets and Bolts	02-385B	C	-	-	-	-	-	-	X 9	Satisfactory visual inspection of gaskets.	
Crankcase Cover Gaskets and Bolting	02-386B	C	-	100	-	-	-	-	-	Several bolt head failures (3.2.5)	
Intake & Intermediate Rocker Arm Assembly	02-390A	B	-	100	100	-	100	100	-	Satisfactory except two sockets had chipped lips. (3.3.1)	
Exhaust Rocker Arm Assembly	02-390B	B	-	100	100	-	100	100	-	Satisfactory (3.2.9)	
Intake and Exhaust Pushrods	02-390C	B	-	100	100	-	-	-	-	Satisfactory (3.1.14)	
Connector Pushrod	02-390D	B	-	100	100	-	-	-	-	Satisfactory	
Rocker Arm Bushings	02-390E	B	-	100	-	-	-	-	-	Satisfactory	
Rocker Arm Bolting	02-390G	B	-	100	100	-	100	100	-	Satisfactory (3.1.8)	
Over-speed Trip Governor	02-410A	A	-	-	-	-	-	-	X 9	Satisfactory	
Over-speed Trip & Accessory Drive	02-410B	A	-	100	100	-	100	100	-	Satisfactory - Partially Complete	
Over-speed Trip Couplings	02-410C	A	-	100	-	-	-	-	-	Satisfactory	
Over-speed Trip Vent Valve	02-410D	A	-	-	-	-	-	-	X 9	Satisfactory	
Speed Regulating Governor Drive	02-411A	A	-	100	100	-	100	100	-	Satisfactory	
Governor Drive Couplings	02-411B	A	-	100	-	-	100	-	-	Satisfactory	
Governor Linkage	02-413	A	-	100	-	-	-	-	-	Satisfactory	
Fuel Pump Linkage-Auto Shutdown Cylinder	02-413B	B	-	100	-	-	-	-	-	Satisfactory	
Speed Regulating Governor	02-415A	A	-	-	-	-	-	-	X 9	Satisfactory	
Governor Booster Servomotor	02-415B	B	-	-	-	-	-	-	X 9	Satisfactory	
Governor Heat Exchanger Assembly	02-415C	A	-	-	-	-	-	-	X 9	Satisfactory	
Lube Oil Pump	02-420	A	-	-	-	-	-	-	X 9	Satisfactory	
Jacket Water Pump	02-425A	A	-	100	-	-	100	100	-	Satisfactory, material compressor of shaft pending.	
Intercooler Piping-Coupling, Bolt, Gskt.	02-436B	A	-	100	-	-	-	-	-	Satisfactory	
Turbo Cooling Water Pipe and Fittings	02-437A	B	-	100	-	-	-	-	-	Pending	
Turbo Cooling Water Pipe Supports	02-437B	A	-	100	-	-	-	-	-	Pending	
Start Air Manifold Pipe, Tubing & Ftrng.	02-441A	A	-	100	-	-	-	-	-	Pending	
Start Air Manifold Vlv, Strners, Fltrs.	02-441B	A	-	-	-	-	-	-	X 9	Satisfactory	
Start Air Manifold Pipe Supports	02-441C	A	-	100	-	-	-	-	-	Pending	
Starting Air Distributor Assembly	02-442A	A	100	100	-	-	100	-	6	Satisfactory - Partially Complete	
Start Air Distributor Tag., Ftrg., Gskts.	02-442B	A	-	100	-	-	-	-	-	Pending	
Fuel Oil Booster Pump	02-445	A	-	-	-	-	-	-	X 9	Satisfactory	
Fuel Oil Piping and Tubing	02-450B	A	-	100	-	-	-	-	-	Pending (3.1.15)	
Fuel Oil Piping Supports	02-450D	A	-	100	-	-	-	-	-	Pending (3.3.5)	
Fuel Oil Filters	02-455A	B	-	-	-	-	-	-	X 9	Satisfactory	
Fuel Oil Strainers	02-455B	B	-	-	-	-	-	-	X 9	Satisfactory	
Fuel Oil Filter Mounting Hardware	02-455C	A	-	100	-	-	-	-	-	Satisfactory	
External Lube Oil Lines	02-465A	A	-	100	-	-	-	-	-	Satisfactory	
External Lube Oil Line Supports	02-465B	A	-	100	-	-	-	-	-	Triple header clamp bolt broken, otherwise satisfactory.	
External Lube Oil Valves	02-465C	A	-	-	-	-	-	-	X 9	Satisfactory	
Turbocharger Lube Oil Piping	02-467A	B	-	100	-	-	-	-	-	Pending (3.2.7)	
Turbocharger Lube Oil Piping Supports	02-467B	B	-	100	-	-	-	-	-	Pending	
Turbocharger Bracket	02-475A	B	-	100	-	-	-	-	-	Satisfactory	
Turbocharger Air Butterfly Valve	02-475B	A	-	100	-	-	100	100	-	Satisfactory	
Turbocharger Bracket Bolting	02-475D	B	-	8	-	-	8	-	-	Satisfactory	
Control Panel Cabinet	02-500A	A	-	-	-	-	-	-	X 9	Satisfactory	
Control Air Accumulator	02-500B	A	-	-	-	-	-	-	X 9	Satisfactory	
Control Air System Valves	02-500C	A	-	-	-	-	-	-	X 9	Satisfactory	

TABLE 2-1 (Continued)

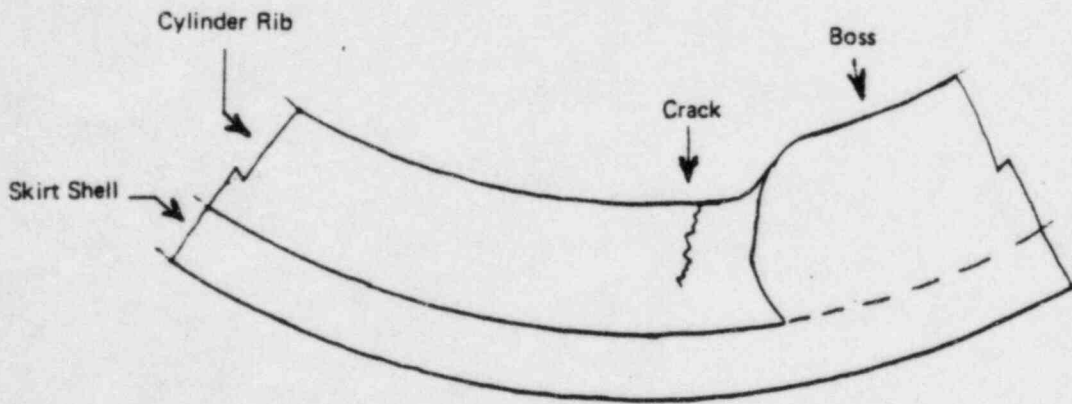
Part Name	Part No.	Class	Sample Size, Percent							Req	By	Notes	Results (Ref. paragraph)
			Visual	S.	HDE	V.	HDE	Material	Hardware				
Control Air System Pressure Switches	02-500H	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Control System Relays	02-500J	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Control System Solenoid Valves	02-500K	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Control Air System Piping, Tubing, Fittings	02-500M	B	-	100	-	-	-	-	-	-	-	Pending	
Control Panel Wiring	02-500N	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Lube Oil Pump Tank	02-540A	B	-	100	-	-	-	-	-	-	-	Set isfactory	
Lube Oil Pump Tank Bolting	02-540B	B	-	100	-	-	-	-	-	-	-	Set isfactory	
Lube Oil Pump Tank Mounting Hardware	02-540C	B	-	100	-	-	-	-	-	-	-	Set isfactory	
Foundation Bolts and Anchors	02-550	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Instrumentation Thermocouples	02-630D	B	-	-	-	-	-	-	-	X	9	Set isfactory (3.2.4)	
Engine & Auxiliary Module Wiring Conduit	02-688A	A	-	-	-	-	-	-	-	X	9	Set isfactory; S & W review still in process.	
Engine and Auxiliary Module Wiring	02-688B	A	-	-	-	-	-	-	-	X	9	Set isfactory (3.1.10)	
Engine and Auxiliary Module Wiring Boxes	02-688C	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Engine Alarm Sensors	02-690	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Off Engine Safety Alarm Sensors-Switches	02-691A	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Engine Shutdown Tubing and Fittings	02-695A	B	-	100	-	-	-	-	-	-	-	Pending	
Engine Shutdown Valves, Regs. & Orifices	02-695B	A	-	-	-	-	-	-	-	X	9	Set isfactory; air system cleanliness needs to be maintained.	
Engine Shutdown Trip Switches	02-695C	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Fuel Oil Duplex Strainer	02-825D	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Turbocharger Thrust Bearing Lube System	02-CFR	C	-	100	-	-	-	-	-	-	-	Pending	
Thermostatic Valve	C 136-40	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Intake Air Filter	CM-106	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Intake Air Silencer	CM-107	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Before and After Lube Oil Pump	CM-109	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Full Flow Lube Oil Filter	CM-110	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Lube Oil Heat Exchanger	CM-111	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Generator Shaft and Bearings	CM-119A	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Jacket Water Heat Exchanger	CM-120	B	-	-	-	-	-	-	-	X	9	Set isfactory	
Oil Pre-lube Filter	CM-122	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Lube Oil Keepdown Strainer	CM-131	A	-	-	-	-	-	-	-	X	9	Set isfactory	
Intercooler	F-068	A	-	100	100	-	-	-	-	-	-	Set isfactory	
Turbocharger	MF-022/3	A	100	100	-	-	-	-	-	-	-	Set isfactory except thrust bearings damaged (3.1.16)	
Lube Oil Full Pressure Strainer	SH-025	A	-	-	-	-	-	-	-	X	9	Set isfactory	

Notes To Table

1. Intake and exhaust valve springs have proper color code.
2. Ultrasonic wall thickness measurement of fire deck area and fuel nozzle area.
3. A torsionograph was developed of the crankshaft.
4. Crankshaft web deflections and thrust clearance was measured with the diesel hot and will be measured cold.
5. Measure torque on Belleville spring loaded bolts.
6. Hardness of the spools was not measured since excessive wear had not occurred.
7. Inspections of the camshaft bearings was not performed since an inspection of the camshaft lobes showed no abnormal wear.
8. ECT inspections were limited to both ends of all high pressure injection lines.
9. Engineering validation of part is to determine that the part is per bill of materials and a review of unscheduled maintenance reports associated with part.

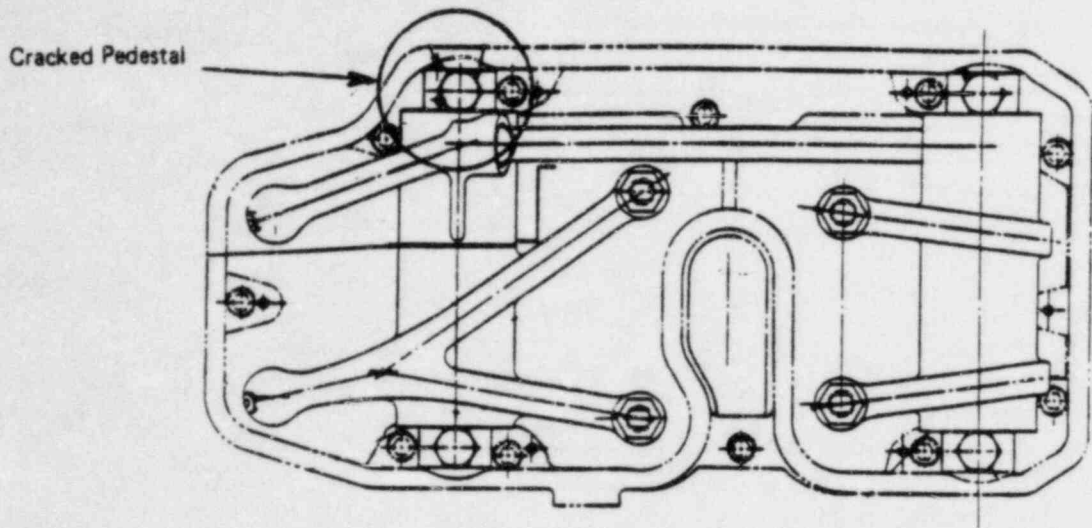


Elevation view of skirt

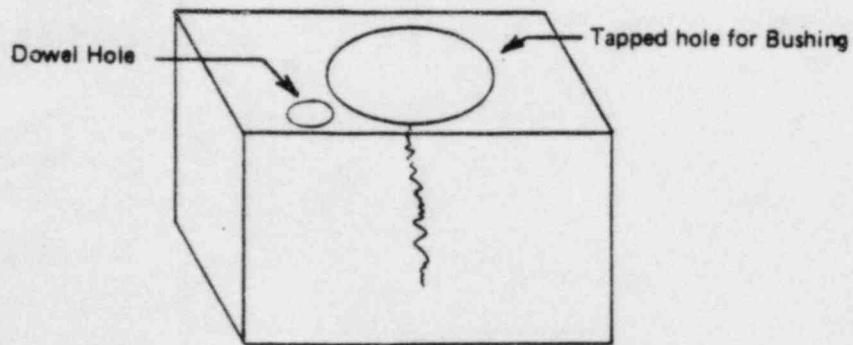


View A-A
Detail of crack initiation

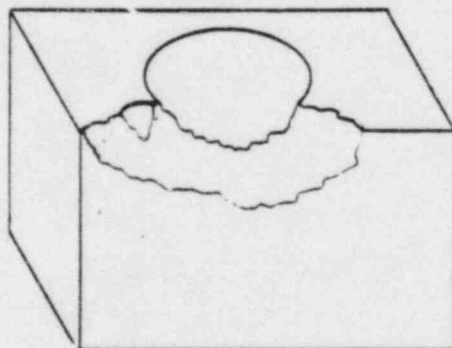
FIGURE 2-1
CRACKED TYPE AN PISTON SKIRT



A. Plan view of subcover



B. Crack in web between bolt hole and surface



C. Cracked off Edge of Pedestal

FIGURE 2-2
CRACKED SUBCOVER CASTINGS

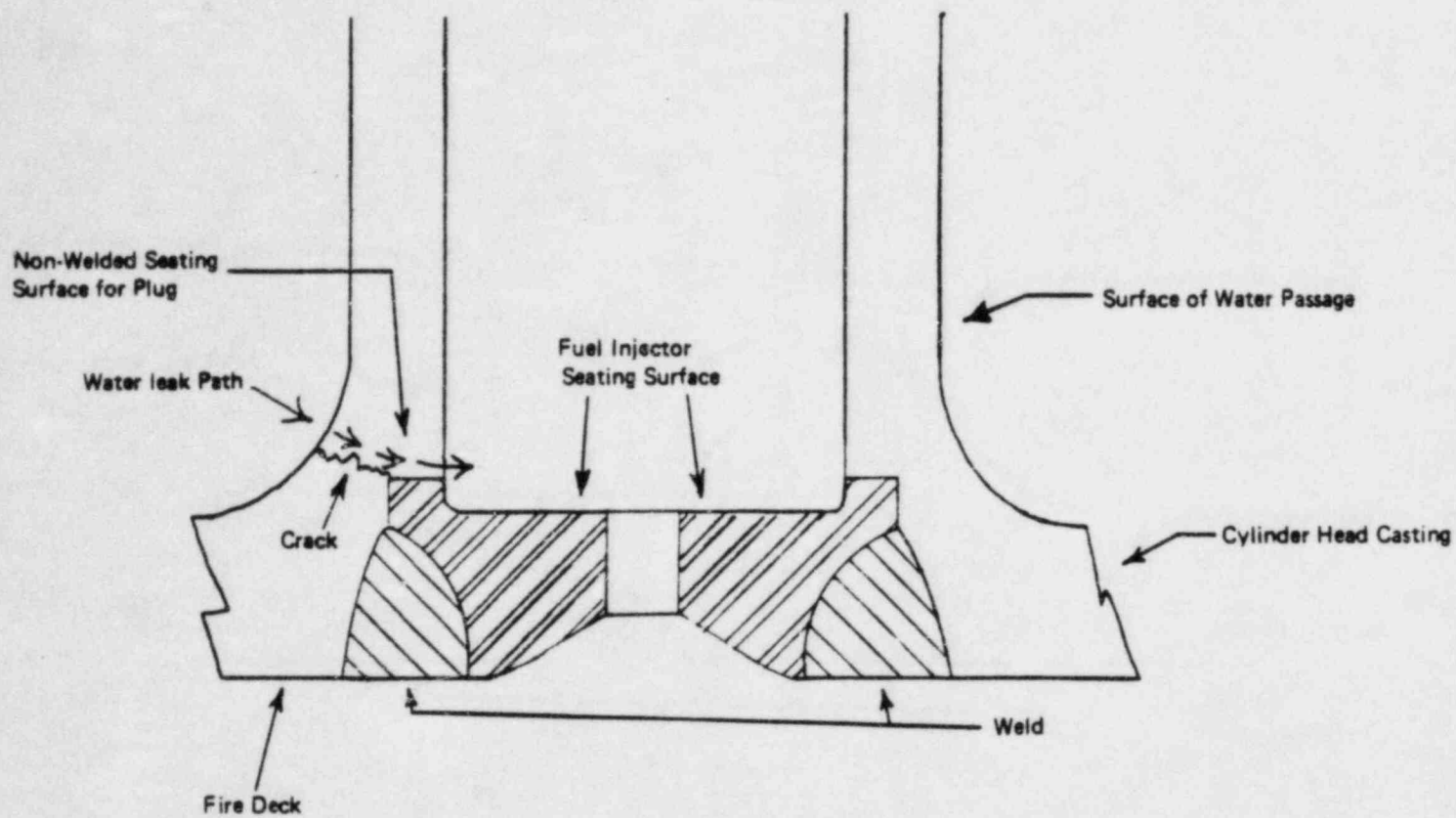


FIGURE 2-3
CRACK IN CYLINDER HEAD

This discussion of inspection results is contained in three parts. The first part (Section 3.1) covers inspections related to the 17 generic problems being addressed by the TDI Owners Group. The second part (Section 3.2) covers inspections performed to address concerns raised by specific problems which have been experienced with Catawba diesels. The third part (Section 3.3) covers significant inspection results not covered by the first two parts. All of these inspection results are documented in the Appendices, Section 5.0.

3.1 Inspections Related to TDI Generic Problems

The inspections related to TDI generic problems which were performed, and the results of these inspections, are described below.

3.1.1 Crankshaft (Part No. 02-310A)

PROBLEM:

A crankshaft failure occurred at Shoreham. The cause of the failure being high cycle fatigue cracks initiating from fillets in the crankshaft at the junction of a crankpin and web (reference 2). Similar cracks were found to exist on other crank-web fillets in all three diesels at Shoreham.

The Catawba crankshaft design differs from that originally used at Shoreham. The Catawba crankshaft has substantially lower stresses, which meet industry standards and are not expected to cause problems (references 3 and 12). Nevertheless, it was considered prudent to inspect a sample of crankpin-web and main bearing journal-web fillets.

SCOPE OF INSPECTIONS:

The crankshaft inspections consisted of:

- Web deflection measurements.
- Visual inspections of the crankpin journals and the fillets at either end of all eight crankpins.
- Eddy-current inspection of crankpin-web fillets for all crankpins except #2.
- Visual inspection of main bearing journals and journal to web fillets for main bearings #4, #5, #6, and #8.
- Fluorescent dye penetrant inspection of oil holes in main bearing journals #4, #6, and #8.
- Torsiograph tests.

RESULTS OF INSPECTIONS: (Through May 29, 1984; Main bearings 6 and 8 not yet inspected.)

No unusual or reportable conditions were noted, with one exception. A small indication was detected by ECT on the generator end crankpin-web fillet for crankpin #7. Detailed examination by polishing and taking of replicas indicates that the ECT indication was caused by two small axial linear defects, each about .030 inches long. These indications are currently being metallgraphically examined by replication techniques while being removed.

Torsiographic test results are still being reviewed by FaAA. Preliminary results, reference 16, indicate that torsional vibration frequencies and stresses were almost identical to the Grand Gulf tests and also that calculated by TDI. These stresses meet industry standards.

SUMMARY:

In summary, the inspections of the crankshaft to date indicate that it is free of significant defects and is not experiencing the type of problem experienced with the Shoreham crankshaft. One small indication was detected by ECT in a crankpin fillet. It is believed that this indication, owing to its orientation, was non service induced. The indication is due to axial defects whereas the service stresses would induce nonaxial cracks. The metallographic examination, still being conducted, will determine whether the defects are service induced.

3.1.2 Connecting Rod Bearings (Part No. 02-340B)

PROBLEM:

Several connecting rod bearing shells in the Shoreham diesel engine cracked. Analysis performed by Failure Analysis Associates (reference 4) indicates that stresses in the Catawba diesel engine bearing shells are about one half or less of those that were present in the original Shoreham engines. Thus, cracking of Catawba bearing shells was considered unlikely. Nevertheless, thorough inspections of the shells were performed to confirm freedom from problems.

SCOPE OF INSPECTIONS:

The bearing shell inspections consisted of:

- Visual inspection of bearing and back surfaces of all bearing shells.
- Measurement of the thickness of all bearing shells.

- PT examination of the bearing shells.
- X-ray examination of all bearing shells.

RESULTS OF INSPECTIONS:

No cracks were detected by visual, liquid penetrant or x-ray inspection. Visual and liquid penetrant inspections indicated babbitt fatigue in the area of link rod maximum bearing pressures. This has been evaluated and found to exist on all TDI vee block engines and not to affect bearing operation. Duke Power Co. is continuing to evaluate x-ray acceptance standards in order to determine realistically conservative acceptance criteria for the bearing shells. This work will be completed prior to engine reassembly.

SUMMARY:

Inspection results to date indicated that connecting rod bearing shells are acceptable for continued operation. Prior to reassembling the shells, a satisfactory acceptance standard for porosity will be determined and the shells evaluated to these acceptance standards.

3.1.3 Pistons (Part No. 02-341A)

PROBLEM:

Cracks were experienced at stud attachment bosses in "Modified AF" piston skirts at Shoreham (references 5 and 6). 23 out of 23 "Modified AF" skirts experienced such cracks, while one AN skirt did not (reference 6). TDI indicated that type AN skirts have been widely used and, if properly heat treated, would perform satisfactorily.

During the extended operation test, Catawba diesel 1A had type AN skirts which had been heat treated at the factory. Because of the freedom from reported problems with AN skirts, no problems were expected with the Catawba piston skirts, and inspections were originally planned on a sampling basis.

SCOPE OF INSPECTIONS:

The inspections of piston skirts listed below were directed at assessing their structural integrity. Some of these inspections were planned on a sample basis, however, as a result of cracks found near the piston pin bosses, 100% inspections were performed.

- Visual inspection of 100% of the pistons skirts.
- PT examination of stud bosses of 100% of the piston skirts.

- PT examination of piston pin bosses of 100% of the piston skirts.
- PT or MT examination of areas adjacent to piston pin bosses (these are the areas where several cracks were noted).
- Ultrasonic (UT) and radiography (RT) examinations were performed if PT or MT indications were observed.

RESULTS OF INSPECTIONS:

The most significant condition noted was the presence of cracks in four piston skirts adjacent to piston pin bosses. The largest crack was 3 or 4 inches long and was through the wall. The cracks appear to originate at the skirt ID, on the fillets where a reinforcing rib intersects the piston pin bosses, and to run in an approximately axial direction. The cause of the cracking is unknown at this time but is believed to be due to cyclic fatigue. Skirts have been sent to FaAA for failure analysis.

One small (1/2" long) linear indication was also noted in the bore of a piston pin boss. No indications were found at stud bosses.

SUMMARY:

Cracks were found to be present in piston skirts near piston pin bosses. As a result, all of the piston skirts will be replaced with type AE pistons. In addition, a detailed failure analysis has been initiated, as part of the TDI Owners Group program.

3.1.4 Cylinder Liners (Part No. 02-315C)

PROBLEM:

Severe grooving has been noted in at least one TDI nuclear diesel engine (reference 7). This grooving was attributed to debris that entered the diesel during assembly or initial startup.

SCOPE OF INSPECTIONS:

All of the cylinder liners were 100% inspected to check for the presence of grooves or other damage.

RESULTS OF INSPECTIONS:

No significant grooves approaching the 1/16" deep grooves seen in the Grand Gulf diesel were observed in the Catawba cylinder liners. Minor pitting and scratching were observed which is normal for a diesel which has seen substantial service. These pits and scratches are considered to have no effect on diesel operability.

SUMMARY:

The inspections indicate that the cylinder liners are in satisfactory condition.

3.1.5 Cylinder Block (Part No. 02-315A)

PROBLEM:

Cracks have been reported on cylinder blocks in the area of the cylinder liner landing and at cylinder head stud holes (reference 7).

SCOPE OF INSPECTIONS:

The cylinder block inspections included the following:

- The area between the cylinder studs and the liner and the area around the studs were PT examined for all cylinders.
- The cylinder liners were removed from seven cylinders (3, 4, 5 and 6 left; 3, 4 and 5 right) and the cylinder liner landing area within the block was PT examined.
- The stud holes were examined by ECT for the seven cylinders identified above.

RESULTS OF INSPECTIONS:

No significant indications were noted.

SUMMARY:

Cylinder block cracks were not detected on diesel engine 1A.

3.1.6 Engine Base (Part No. 02-305A)

PROBLEM:

Linear indications have been reported as emanating from main bearing stud holes in the engine base. These problems have been attributed to inadequate bearing cap stud preload (references 7 and 13).

SCOPE OF INSPECTIONS:

The main bearing saddle area around and between the stud holes is being PT examined for bearings 4, 5, 6, and 8. In addition, the stud tension required to permit removal of the nuts is being measured. This has been completed for bearings 4 and 5.

RESULTS OF INSPECTIONS:

No linear indications have been found, and stud tensions were in the normal range.

SUMMARY:

Inspections, to date, of one half of the planned sample indicates that this problem has not occurred in the Catawba 1A diesel.

3.1.7 Cylinder Head Studs (Part No. 02-315E)

PROBLEM:

Isolated failures of cylinder head studs have been reported as occurring in non-nuclear TDI diesels (reference 8). Also, improper torquing of these studs has been reported as contributing to the cylinder block cracking problem discussed in paragraph 3.1.5.

SCOPE OF INSPECTIONS:

Inspections of the cylinder head studs included the following:

- The breakaway torque was measured for the head studs of three cylinders (4L, 5L, and 6L).
- The removed studs from the three cylinders identified above were visually inspected.
- One stud from each of four cylinders was checked by material comparator and hardness measurement.

RESULTS OF INSPECTIONS:

Measured breakaway torques all were above 1100 ft-lbs. These torques indicate that required torque (1500 ft-lbs) was originally applied and that the torque has remained at acceptable values after extended operation.

No significant visual indications were noted.

Material comparator and hardness test results indicated that studs are made of acceptable material.

SUMMARY:

A sampling inspection of cylinder head studs indicates that they are acceptable and that they had been correctly torqued.

3.1.8 Rocker Arm Capscrews (Part No. 02-390G)

PROBLEM:

A fatigue failure is reported to have occurred with a rocker arm capscrew at Shoreham (reference 7). This failure was attributed to undertorquing. Reference 8 indicates that properly torqued capscrews have satisfactory fatigue resistance.

SCOPE OF INSPECTIONS:

Inspections of the rocker arm capscrews included the following:

- The breakaway torque of all the capscrews was measured.
- All capscrews were visually and MT examined.
- All the capscrews were checked by superficial hardness test methods and material comparator tests.

RESULTS OF INSPECTIONS:

The breakaway torques of the intake/intermediate capscrews varied between 276 and 336 ft.-lbs., and the torques of the exhaust capscrews ranged between 324 and 498 ft.-lbs. These values indicate that the required torque of 365 ft.-lbs. had been originally applied and that acceptable torque values were still present after extended service.

No indications were noted in the visual or MT examination.

The material comparator and hardness tests indicate that the capscrews material is satisfactory.

SUMMARY:

The diesel engine 1A capscrews were found to be satisfactory and to have been properly torqued.

3.1.9 Connecting Rods (Part No. 02-340A)

PROBLEM:

Cracking of connecting rods is reported to have occurred, apparently due to relative motion between the two halves of the connecting rod at the "rack-teeth" joint (reference 7).

SCOPE OF INSPECTIONS:

The inspections of the connecting rods included the following:

- Breakaway torque was measured on the connecting rod bolts for all eight master/link rod/rod box assemblies.
- The threaded holes on the rod boxes of all connecting rod assemblies were ECT inspected.
- The areas of the rod box which have been reported as being subject to cracking were LP examined.
- Material comparator and hardness tests were performed on master rod, rod box, and link rod for four connecting rod assemblies.
- Areas of the connecting rod which would be subject to fretting or wear if looseness developed were visually inspected (rack-teeth, washers, seating surfaces) on all connecting rod assemblies.

RESULTS OF INSPECTIONS:

Normal torque values were found, and no significant indications were detected. Material properties were acceptable, and no signs of joint looseness or fretting were seen.

SUMMARY:

The Catawba 1A connecting rods are considered to be satisfactory.

3.1.10 Electrical Cables (Part No. 02-688B)

PROBLEM:

A number of electrical cables used by TDI have been identified as either failing insulation flame test requirements or not having sufficiently high temperature ratings (references 7 and 14).

SCOPE OF INSPECTION:

Stone and Webster, as part of TDI Owners Group activities, reviewed the Catawba electrical cable installation.

RESULTS OF INSPECTION:

The results of Stone & Webster inspections are not yet available and are expected about June 15, 1984.

SUMMARY:

The electrical cables have been inspected but the results of the inspections are not yet available.

3.1.11 Fuel Injection Lines (Part No. 02-365C)

PROBLEM:

Several cases of failure of high pressure fuel injection lines have occurred. These failures have been attributed to a fatigue crack initiating at pre-existing .006" draw seam at the tubing ID. (reference 10).

SCOPE OF INSPECTIONS:

All of the high pressure fuel injection lines will be inspected using ECT methods in early June.

RESULTS OF INSPECTIONS:

The inspections have not yet been performed.

SUMMARY:

The fuel lines have operated for over 10 million cycles without problem and are thus considered to be satisfactory. In addition, ECT inspections will be performed to confirm their satisfactory condition.

3.1.12 Jacket Water Pumps (Part No. 02-425A)

PROBLEM:

Several jacket water pump shaft failures occurred at Shoreham (reference 11). The Catawba jacket water pumps are of a different design than the Shoreham pumps. However, even though the problems experienced at Shoreham are not expected to apply to the Catawba diesels, detailed inspections were performed of the Catawba jacket water pumps.

SCOPE OF INSPECTIONS:

The engine driven jacket water pump inspections included the following:

- Visual and PT examination of coupling.
- Visual inspection of clearance ring.
- Verification of shaft material by material comparator and hardness checks.
- PT and RT of pump impeller.

RESULTS OF INSPECTIONS:

All planned testing with the exception of a material comparator test of the shaft has been completed. The only significant condition noted was some porosity in the impeller casting. Based on RT examination, the porosity was evaluated as acceptable.

SUMMARY:

To date, the jacket water pump was inspected and found to be satisfactory. Material comparator tests of the shaft are still to be performed.

3.1.13 Air Start Valve Capscrews (Part No. 02-359)

PROBLEM:

Capscrew bottoming out due to insufficient hole depth for the capscrew length can lead to insufficient clamping force (reference 7). TDI recommended reducing capscrew length to prevent this problem. Catawba diesel capscrews were modified prior to the extended operation test.

SCOPE OF INSPECTION:

The inspections for the capscrews included the following:

- Measure breakaway torque on all capscrews.
- Measure length of capscrews for 4 valves.

RESULTS OF INSPECTIONS:

Breakaway torques and capscrew lengths were acceptable, and the valves showed no signs of insufficient clamping force.

SUMMARY:

There appear to be no problems with airstart valve capscrew bottoming out in the Catawba 1A diesel.

3.1.14 Push Rods (Part No. 02-390C)

PROBLEM:

Originally supplied pushrods experienced cracking of the welds joining the rod to their rod ends. New design push rods with friction welds were installed in the Catawba diesels during the extended operation test and accumulated about 400 hours of operation.

SCOPE OF INSPECTIONS:

The inspections of the new design push rods included the following:

- Visual inspection of the shaft end welds to verify that the desired new type of friction welds were used.
- PT examination of all the welds.

RESULTS OF INSPECTIONS:

All the push rods were confirmed as having the correct type of weld and were found to be free of defects.

SUMMARY:

The Catawba diesel engine push rods are considered to be satisfactory.

3.1.15 Fuel Line Fittings (Part No. 02-450B)

PROBLEM:

Failures have been reported as occurring at Swagelock fittings, apparently as a result of vibration induced fatigue due to the absence of the supports required by the TDI drawing (reference 7). One fuel line had to be replaced on the Catawba 1A diesel due to leakage. However, inspection of the fuel line indicated that it was improperly swaged rather than failing from fatigue. A flat spot in the cone portion of the tube had been eroded away causing the leakage.

SCOPE OF INSPECTIONS:

The inspections of the fuel lines will include a walk down inspection to verify that the piping is installed per the applicable design drawing.

RESULTS OF INSPECTIONS:

This inspection will be performed after the engine is reassembled.

SUMMARY:

This inspection has not yet been performed; it will be performed when the engine is reassembled. Reassembly procedures will use Duke Power Co. special fitting installation instructions to guard against improper swaging.

3.1.16 Turbocharger Bearings (Part No. MP-022/23; 02-CFR)

PROBLEM:

Severe wear of the bearings has been reported, apparently due to inadequate lubrication during diesel starts (reference 7). An improved lube oil supply system is being developed for Catawba, with installation by September 1, 1984.

SCOPE OF INSPECTION:

- The bearings were visually and dimensionally inspected.

RESULTS OF INSPECTIONS:

The thrust faces of the turbocharger bearings were found to be severely worn. It should be noted that this wear had not affected turbocharger operation during the extended operation test.

SUMMARY:

The turbocharger bearings are being replaced with new parts, and are expected to operate as well as the original bearings, which caused no operational problems for several hundred hours. Until the new lube oil system is installed, the bearings will be inspected as necessary to ensure that they remain in operable condition.

3.1.17 Cylinder Heads (Part No. 02-360A)

PROBLEM:

Two small jacket water leaks have been experienced at Catawba resulting in water leaking into the fuel injector nozzle cavity. Failure analysis of one of the leaking heads has been partially completed. The leak was due to cracks propagating from a corner where a welded plug was installed in the fuel injector nozzle seating area. This welded plug was used to repair the injector bore during manufacture. (Figure 2-3)

SCOPE OF INSPECTION:

The inspections performed of the cylinder head included:

- PT examination of valve seats in cylinder heads.
- UT examination of fire deck thickness at selected locations.
- UT examinations of wall thickness at selected locations of the fuel injector well.

RESULTS OF INSPECTIONS:

No cracks were detected and all thicknesses were acceptable.

SUMMARY:

The currently installed heads in the 1A diesel engine are considered to be satisfactory since they were not leaking when last used and exhibit no cracks in inspectable areas. While the inspections performed were not directed at detecting cracks of the type which caused the earlier leak at Catawba, the type of leaks caused by these cracks do not affect diesel operation and are not significant. Heads will be inspected to determine if they have been repaired in the area where leaks have been encountered.

3.2 Catawba Specific Problems

3.2.1 Fuel Injection Pump (Part No. 02-365A)

PROBLEM:

A fuel injection pump nozzle valve holder at Catawba cracked as a result of a material defect (reference 1).

SCOPE OF INSPECTIONS:

The inspections performed to date related to the problem included:

- Measuring the hardness of each valve holder.
- Performing a UT examination of each fuel pump valve holder.

RESULTS OF INSPECTIONS:

All the fuel pump valve holders were found to be acceptable. However, the UT inspection procedure used may not have completely checked all possible defect locations. Hence, additional borescope inspections are planned.

SUMMARY:

The valve holder failure is believed to have been due to an isolated material defect. All of the currently installed valve holders have been checked to above scope of inspections and found to be free of such defects. However to provide additional assurance, a borescope inspection of the bore of the valve holder will be accomplished to assure that there are no voids.

3.2.2 Turbocharger Prelube Oil Lines (Part No. 02-307B)

PROBLEM:

Two failures of the prelube oil lines occurred during the 1A extended operation test, due to fatigue cracking at compression fittings. The lines have been replaced using an improved procedure, using additional clamps, vibration dampening devices, improved compression fittings and heavier wall stainless steel tubing. A further improved prelube system will be installed to correct turbocharger bearing lubrication problems.

SCOPE OF INSPECTIONS:

The piping will be visually inspected to verify that it has been installed in accordance with the latest approved drawings, and to verify that there is no evidence of vibration induced damage (fretting, etc.).

RESULTS OF INSPECTIONS:

Inspection of this piping has not yet been performed.

SUMMARY:

After the diesel is reassembled, the system will be inspected to verify that it is properly installed so as to prevent vibration problems.

3.2.3 Turbocharger Adaptor (Part No. 00-495A)

PROBLEM:

A turbocharger to intercooler adaptor cracked at a flange weld. This is assumed to have been caused by poor flange alignment with mismatched bolt holes. Catawba now uses improved alignment practices when torquing turbocharger flange bolts (reference 1).

SCOPE OF INSPECTIONS:

The adaptor weld joints were visually and MT examined.

RESULTS OF INSPECTIONS:

No defects were noted.

SUMMARY:

These welds are considered to be satisfactory.

3.2.4 Lube Oil and Jacket Water Thermocouples (Part No. 02-630D)

PROBLEM:

Several failures have occurred with these thermocouples as a result of intermittent shorts (reference 1).

SCOPE OF INSPECTIONS:

Inspections of thermocouples are not considered useful.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Occasional thermocouple failures are a normal occurrence and do not affect diesel operability under emergency run conditions. Failed thermocouples are repaired or replaced at the first opportunity.

3.2.5 Crankcase and Camshaft Cover Capscrews (Part No. 02-386B)

PROBLEM:

Occasional failures of these capscrews has occurred, apparently due to overtorquing (reference 1).

SCOPE OF INSPECTIONS:

All of these capscrews are being replaced with capscrews of known chemical and physical properties. Accordingly, inspection is not applicable.

SUMMARY:

This problem has been resolved by replacement of the capscrews using capscrews of appropriate quality and by revising installation procedures to control torques to appropriate values.

3.2.6 Rocker Box (Subcover) Subassembly (Part No. 02-362A)

PROBLEM:

Two types of problems have been experienced with these bosses. The first type was reported in reference 1 and involves fracturing off of a piece of the boss (also called a pedestal), apparently due to installation with a misaligned dowel pin. The second type of problem was detected in the post extended operation test inspections, and involves tight cracks running down the boss in the web between the bolt hole and the boss surface. The cause of the second type of problem has not been firmly established but may be due to installation tolerances between bushings or dowels and the pedestal leading to excessive interference fits.

SCOPE OF INSPECTION:

- All of the bosses on all of subcover assemblies were PT examined.

RESULTS OF INSPECTIONS:

Two subcovers were found to have cracked bosses following the extended operation test. All of the others were free of defects.

SUMMARY:

Several cracked bosses were found and the affected subcover assemblies have been replaced. These cracks have not caused a loss of operability of the engines. A failure analysis will be performed by FaAA under TDI Owners Group direction. Until the cause of failure and the frequency of cracking are better established, the Catawba subcovers will be inspected as necessary to verify that additional cracking has not occurred.

3.2.7 Turbocharger Lube Oil Drain Line (Part No. 02-467A)

PROBLEM:

A temporary drain line on diesel 1A leaked during the extended operation test due to fatigue. It is being replaced with an improved design as part of the diesel reassembly.

SCOPE OF INSPECTION:

Not applicable.

SUMMARY:

This problem is being resolved by incorporation of an improved design.

3.2.8 Turbocharger Exhaust Gas Inlet Bolts (Part No. 02-380B)

PROBLEM:

Four 1/2 inch stainless mounting bolts were found broken (reference 1). The cause of the failure has not yet been firmly established, but failure analysis indicates that one bolt to have failed from creep rupture while the others failed from torsional overload.

SCOPE OF INSPECTION:

All of the intact bolts and those replaced are being inspected by visual methods at a magnification of 5x to assure that no new cracks have initiated.

RESULTS OF INSPECTION:

The bolt inspections have not yet been performed.

SUMMARY:

Preliminary failure analysis indicated that one bolt failed due to creep rupture with others failing due to overload. Use of a more creep resistant alloy will be evaluated. In addition, bolt installation procedures have been revised to insure that proper preloads are applied.

3.2.9 Exhaust Valve Tappet (Rocker Arm Adjusting Screw Swivel Pad) (Part No. 02-390B)

PROBLEM:

One of the swivel pads was found cracked on diesel 1B. Failure analysis indicates that the cracking occurred due to a one time overload. It is believed that the swivel pad cracked due to improper swaging at the factory during manufacture.

SCOPE OF INSPECTIONS:

All swivel pads were visually and liquid penetrant inspected on diesel 1A.

RESULTS OF INSPECTIONS:

No defects were found and the sockets were found to be correctly swaged.

SUMMARY:

The swivel pads are considered to be in satisfactory condition.

3.3 General Inspection

In addition to inspections related to TDI generic problems and to Catawba specific problems, inspections have been performed of numerous other parts in order to verify the operability of the Catawba 1A diesel engine. The results of these inspections showed that the 1A diesel engine was in excellent condition, with a few relatively minor problems in addition to the problems discussed in sections 3.1 and 3.2 above. The only additional problems noted were as follows:

- Two intermediate rocker arm sockets had chipped or cracked edges.
- Nine valve stems had chipped or removed chrome plate.
- One air start valve had a jammed spring retaining nut and another had a missing roll pin.
- One rod box bushing was found to have a heavy circumferential gouge in it.
- Several bolts and capscrews were found to have missing heads or cracks.

These problems are discussed below.

3.3.1 Cracked Intermediate Rocker Arm Sockets (Part No. 02-390A)

PROBLEM:

Two sockets were found to have chipped and/or cracked lips. These chips and cracks did not affect functioning of the sockets since the push rods seat further in the socket, well inside the area with chips or cracks. The chips and cracks show no evidence of propagating into the functioning part of the socket. The problem is believed to be due to improper installation of the rocker arm prior to valve adjustment, such that excessive clearance existed, allowing pushrods to move sideways and contact the lips.

SCOPE OF INSPECTION:

All of the sockets were visually examined.

RESULTS OF INSPECTIONS:

The two sockets mentioned above were found to be chipped and/or cracked. No other problems were noted.

SUMMARY:

The chipped and cracked sockets are considered to be a cosmetic problem and to not affect diesel operability. The affected socket lips will be ground smooth. In addition, procedure changes are being made to ensure that excessive clearance does not exist in the rocker arm at assembly; this is expected to preclude recurrence of this problem.

3.3.2 Valve Stem (Part No. 02-360B)

PROBLEM:

Nine exhaust valve stems had areas with chipped or removed chrome plate. This occurred at about 6 to 8 inches above the valve seat, at a location corresponding to where the stem enters the valve guide. The chrome plate chipping had no affect on diesel operability, and caused no observable damage to the valve guides.

SCOPE OF INSPECTIONS:

All valve stems were visually inspected.

RESULTS OF INSPECTIONS:

As discussed above, 9 exhaust valve stems had chipped or removed chrome plating in areas about 6 to 8 inches above the valve seat. No structural damage was observed.

SUMMARY:

Valve stem chrome plate chipping of a cosmetic nature occurred. The affected valve stems are being replaced. This condition will be monitored in the future during routine maintenance inspections.

3.3.3 Spring Retaining Nut and Roll Pin on Air Start Valves
(Part No. 02-359)

PROBLEM:

The spring retaining nut on an air start valve was found to be jammed due to galled threads. A spring retaining nut roll pin was found to be missing on another valve. The galled threads and missing roll pin had not affected diesel operability.

SCOPE OF INSPECTIONS:

All of the air start valves were disassembled and visually inspected.

RESULTS OF INSPECTIONS:

The one jammed nut and one missing roll pin were the only inspection deficiencies found.

SUMMARY:

The jammed nut and missing roll pin are believed to be due to installation errors. These items have been replaced. Current installation procedures provide assurance that these problems will not recur.

3.3.4 Rod Box Bushing (Part No. 02-340A)

PROBLEM:

A rod box bushing (1L) was found to have a circumferential gouge over about 1/3 of the circumference, with a depth of 1/16 inch.

SCOPE OF INSPECTIONS:

All of the rod box bushings were visually and PT examined.

RESULTS OF INSPECTIONS:

The only problem noted was the one gouge described above.

SUMMARY:

The gouged rod box bushing is being replaced, even though the gouge did not affect operability. This problem is considered to have been an isolated case of damage by a piece of debris.

3.3.5 Clamp Bolts (Part No. 02-450D)

PROBLEM:

Several bolts on the fuel/lube oil tripple clamp were found to have heads broken off or cracks.

SCOPE OF INSPECTIONS:

These bolts are being replaced and inspection is therefore not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Failure analysis of these bolts indicates that they failed due to fatigue as a result of under or overtorquing. The bolts are being replaced using new bolts of increased fatigue resistance. Reinstallation procedures include the provision to assure that under and overtorquing do not occur.

3.3.6 Fuel Injector Nozzle Holder Studs (Item 3, TDI dwg. 03-360-08)

PROBLEM:

While removing a cylinder head (7L) with the pulling fixture, the nozzle holder studs sheared off. During disassembly these studs hold the pulling fixture to the head. The pulling fixture is used both for reacting cylinder head stud torquing/untorquing loads and to lift the head. Investigation indicates that these capscrews were bent during untorquing of the heads leading to failure when the head weight was put on them during head removal. The reason the studs were bent is that the head was not cleaned properly prior to seating the handling fixtures so that the handling fixture rocked on the head.

SCOPE OF INSPECTIONS:

- Visual inspection of studs to determine if they are bent.
- Magnetic particle of studs to determine if they are cracked.

RESULTS OF INSPECTIONS:

Inspections have not been completed.

SUMMARY:

Inspections have not been completed. No summary is available at this time.

3.3.7 Turbocharger Bolting (Item 7, TDI dwg. 02-475-22)

PROBLEM:

One turbocharger to bracket, 5/8 x 11 NC x 2 long capscrew failed on diesel 1B. Preliminary failure analysis of the capscrew indicated fatigue failure.

SCOPE OF INSPECTIONS:

These bolts are being replaced on diesel 1A and inspections are therefore not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Failure analysis of the capscrew indicated that it failed due to fatigue. All capscrews are being replaced with new material of increased fatigue resistance. Reassembly procedures have been revised to assure that proper preloads are applied.

References

1. Duke Power Co. letter dated April 5, 1984 to H.R. Denton, NRC, with attached document entitled "Catawba Nuclear Station Extended Operation Tests and Inspections of Diesel Generators".
2. IE Information Notice No. 83-58, "Transamerica Delaval Diesel Generator Crankshaft Failure", NRC, August 30, 1983.
3. Bechtel Power Corporation, "Evaluation of Crankshaft Stresses for Duke Power Corporation, Catawba Nuclear Station", March 19, 1984.
4. Failure Analysis Associates, "Design Review of Connecting Rod Bearing Shells for Transamerica Delaval Enterprise Engines", March 12, 1984.
5. Delaval minutes of November 30, 1983 meeting with TDI Owners Group.
6. Failure Analysis Associates, "Investigation of Types AF and AE Piston Skirts", May 27, 1984.
7. Mississippi Power & Light Co., "Comprehensive report on Standby Diesel Generators -Significant Activities to Enhance and Verify Reliability", February 1984 transmittal to NRC by letter dated February 20, 1984.
8. Stone and Webster Engineering Corporation, "Emergency Diesel Generator Cylinder Head cap stud Stress Analysis", March 1984.
9. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Rocker Arm Capscrew, Stress Analysis", dated March 1984, and Supplement dated April 1984.
10. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Fuel Oil Injection Tubing, Qualification Analysis", April 1984.
11. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Engine Driven Jacket Water Pump, Design Review", April 1984.
12. Failure Analysis Associates, "Evaluation of Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Stations", April 19, 1984.
13. Failure Analysis Associates, "Design Review of Engine Base and Bearing Caps for Transamerica Delaval Diesel Engine", April 1984.
14. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Auxiliary Module Control Wiring and Termination, Qualification Review", April 1984.
15. Stone and Webster Engineering Corporation, "Emergency Diesel Generator Air Start Valve Capscrew, Dimension and Stress Analysis", March 1984 and Supplement, April 1984.
16. Failure Analysis Associates letter of April 12, 1984 to G.W. Hallman (Duke Power Co.) from T.M. Thomas.

5.0

Appendices

APPENDIX A
INSPECTION REPORTS

Table of Contents

<u>Procedure No.</u>	<u>Part No.</u>	<u>Part Name</u>	<u>Class</u>
01	02-385B	Cylinder Block Cover Gaskets and Bolts	C
04	02-390D	Connector Pushrods	B
01/04	02-390G	Rocker Arm Bolting	B
04	02-390C	Pushrods	B
04	02-390A	Rocker Arm Assembly	B
04	02-390B	Exhaust Rocker Arm Assembly	B
04	02-390E	Rocker Arm Bushings	B
04	02-360B	Intake and Exhaust Valves	B
04	02-360A	Cylinder Head	B
04	02-360D	Valve Springs	B
04/01	02-362A	Subcover Assembly	B
04/01	02-359	Air Start Valve	A
05/02	02-340A	Connecting Rods and Bushings	A
05	02-340B	Connecting Rod Bearing Shells	A
05	02-341A	Piston	A
05	02-341C	Piston Pin Assembly	A
05	02-341B	Piston Rings	A
06	02-310C	Crankshaft Thrust Bearing Ring	A
06	02-305D	Main Bearing Caps	A
06	02-305A	Main Bearing Cap and Base Assembly	A
06/03	02-310B	Crankshaft Bearing Shells	A
06	02-311A	Crankcase Assembly	A
06/03	02-386B	Crankcase Covers Gaskets and Bolting	C
06/03	02-305C	Main Bearing Caps and Studs	A
06	02-310A	Crankshaft and Turning Gear	A
07	02-355A	Crankshaft Gear	A
07	02-355B	Idler Gear Assembly	A
08	02-395B	Gear Case Covers Gaskets and Bolting	C
08	02-325B	Front Gear Case Bolting	C
09	02-365A	Fuel Injection Pump	B
09/27	02-455C	Fuel Oil Filter Mounting Hardware	A
09	02-371A	Fuel Pump Control Shaft	A
09	02-371B	Fuel Pump Linkage Bearings and Shaft	A
10	02-307B	Lube Oil Tubing and Fittings	A
10	02-465B	External Lube Oil Supports	A
10	02-465A	External Lube Oil Lines	A
10	02-307D	Lube Oil Line Supports	B
10	02-307A	Lube Oil Internal Headers	A
10	02-540A	Lube Oil Sump Tank	B
10	02-540C	Lube Oil Sump Tank Mounting Hardware	B
10	02-540B	Lube Oil Sump Tank Bolting	B
11/01	02-315E	Cylinder Head Studs	B
11	02-315D	Cylinder Block Jacket Water Manifold	A
11/25	02-317A	Jacket Water Discharge Manifold	B
11	02-315F	Cyl. Block Jacket Water Manifold Nuts	B
11	02-315A	Cylinder Block	A
11	02-315C	Cylinder Liner	A
12	02-442A	Starting Air Distributor Assembly	A
13	02-425A	Jacket Water Pump	A
14	02-350B	Camshaft Bearing	A
14	02-350A	Camshaft Assembly	A

Table of Contents

<u>Procedure No.</u>	<u>Part No.</u>	<u>Part Name</u>	<u>Class</u>
14	02-350C	Camshaft Supports, Bolting and Gear	A
14	02-345B	Fuel Tappets	A
14	02-345A	Intake Tappets	A
15/28	02-380A	Exhaust Manifolds	B
15	02-375	Intake Manifolds	B
15	02-380E	Exhaust Manifold Bolting	B
16	02-410B	Overspeed Trip and Accessory Drives	A
16	02-411A	Speed Regulating Governor Drive	A
16	02-413B	Fuel Pump Linkage and Shutdown Cylinder	B
16	02-411B	Speed Reg. Gov. Drive Coupling	A
16	02-410C	Overspeed Trip Drive Couplings	A
16	02-415C	Governor Heat Exchanger Assembly	A
16	02-413A	Speed Regulating Gov. Linkage	A
17	02-330B	Flywheel Bolting	A
18	02-436B	Intercooler Piping Coup., Bolts, Gskts.	A
18	MP/022/3	Turbocharger	A
18	02-475B	Turbocharger Air Butterfly Valve	A
18	02-475A	Turbocharger Bracket	B
18	02-475D	Turbocharger Bracket Bolting	B
18	F-086	Intercooler	B

Additional Inspections To Be Performed After Diesel Reassembly

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Block Cover, Gskts. and Bolts Class: C

Part No.: 02-385B

Work Request No.: 0772 MNT

No. of Separate Inspections: 16

Attributes Verified and Sample Size

1. Visual inspect gaskets per 11.2.2, ref. 1, 16 insp.

References

1. MP/O/A/1000/01 Diesel Engine Cylinder Head Removal and Disassembly

Inspection Results

1. Gaskets were inspected and found to be in satisfactory condition.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Connector Pushrod

Class: B

Part No.: 02-390D

Work Request No.: 0772 MNT

No. of Separate Inspections: 80

Attributes Verified and Sample Size

1. Visual inspect connector pushrods per 11.10.2, ref.1, 16 insp.
2. Liquid penetrant exam friction welds per 11.10.3, ref.1, 32 insp.
3. Visual inspect special surfaces per 11.10.4, ref.1, 32 insp.

References

1. MP/O/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection

Inspection Results

1. Visual inspection of pushrods - No significant conditions noted.
2. PT of friction welds - No indications were noted.
3. Visual inspection of spherical surfaces - No significant conditions were noted (3 pushrod spherical surfaces had light scratches or grooves, which are considered normal and not deleterious).

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Rocker Arm Bolting

Class: B

Part No.: 02-390G

Work Request No.: 0772 MNT

No. of Separate Inspections: 320

Attributes Verified and Sample Size

1. Measure breakaway torque per 11.2.7, ref.1, 64 insp.
2. Perform material comparator test per 11.11.2, ref. 2, 64 insp.
3. Measure superficial hardness per 11.11.3, ref. 2, 64 insp.
4. Magnetic particle test per 11.11.4, ref.2, 64 insp.
5. Visual inspect capscrews per 11.11.5 ref.2, 64 insp.

References

1. MP/0/A/1000/01 Diesel Engine Cylinder Head Removal and Disassembly
2. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts

Inspection Results

1. Bolt torques - Intermediate/intake assembly - bolt torque ranged between 276 and 336 ft-lbs. Exhaust assembly - bolt torque ranged between 324 and 336 ft-lbs. These values are considered acceptable.
2. Material comparator - All results were acceptable.
3. Hardness ranged from Rockwell C 20 to 28
4. Magnetic Particle - No indications were noted.
5. Visual Inspection - No indications were noted.

Disposition of Inspection Findings

3. The specified hardness for the rocker arm bolts is Rockwell C 25 to 30. The results are considered acceptable within the limits of accuracy of the measuring device. This is further evidenced by the satisfactory operation of the bolting for extended periods.

Catawba Diesel 1A Inspection Report

Part Name: Pushrods

Class: B

Part No.: 02-390C

Work Request No.: 0772 MNT

No. of Separate Inspections: 192

Attributes Verified and Sample Size

1. Visual inspect intake and exhaust pushrods per 11.9.2, ref.1, 64 insp.
2. Liquid penetrant exam friction welds per 11.9.3, ref.1, 64 insp.
3. Visual inspect special surfaces per 11.9.4, ref.1, 64 insp.

References

1. MP/O/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection

Inspection Results

1. Visual inspection of pushrods - No significant conditions noted.
2. PT of friction welds - No indications were noted.
3. Visual inspection of spherical surfaces - No significant conditions were noted (some light scratches were noted on 3L intake pushrod; these are considered normal).

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Rocker Arm Assembly

Class: B

Part No.: 02-390A

Work Request No.: 0772 MNT

No. of Separate Inspections: 224

Attributes Verified and Sample Size

1. Visual inspect intake and int. rocker shaft assembly per 11.7.2, ref. 1, 16 insp.
2. Visual inspect intake and int. rocker arm lips per 11.7.3, ref. 1, 48 insp.
3. Measure distance lip to push rod socket per 11.7.4, ref. 1, 48 insp.
4. Visual inspect push rod sockets per 11.7.5, ref. 1, 48 insp.
5. PT exam adjusting screw swivel pads per 11.7.6, ref. 1, 32 insp.
6. Perform material comparator test per 11.7.8, ref. 1, 16 insp.
7. Measure superficial hardness per 11.7.9, ref. 1, 16 insp.

References

1. MP/O/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection

Inspection Results

1. Visual inspection of shaft assembly - No significant conditions were noted (some minor pitting was noted on 7R, which was judged to be of no consequence).
2. Visual inspection of rocker arm lips - No significant conditions were noted.
3. Measurement of distance from lip to socket, if ground - None were measured since none were ground.
4. Visual inspection of intermediate rocker arm sockets - Edges of sockets on 4R and 6L were chipped and cracked.
5. PT of swivel pads - No indications were noted.
6. Material comparator check of shafts - All shafts were acceptable.
7. Hardness check of shafts - Shaft hardness ranged from BHN 253 to 299.

Disposition of Inspection Findings

4. Chipped and cracked socket lips have no affect on diesel operation, but will be ground smooth for cosmetic reasons.
7. The specified hardness for the rocker arm shafts is BHN 260-331. The test results are considered acceptable within the limits of accuracy of the testing device.

Catwba Diesel IA Inspection Report

Part Name: Exhaust Rocker Arm Assembly Class: B
Part No.: 02-390B Work Request No.: 0772 MNT
No. of Separate Inspections: 112

Attributes Verified and Sample Size

1. Visual inspect exhaust rocker arm shaft per 11.8.2, ref. 1, 16 insp.
2. Visual inspect exhaust rocker arm lips per 11.8.3, ref. 1, 16 insp.
3. Measure distance lip to push rod socket per 11.8.4, ref. 1, 16 insp.
4. Visual inspect push rod sockets per 11.8.5, ref. 1, 16 insp.
5. PT exam adjusting screw swivel pads per 11.8.6, ref. 1, 32 insp.
6. Perform material comparitor test per 11.8.7, ref. 1, 16 insp.

References

1. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection

Inspection Results

1. Visual inspection of shaft assembly - No significant conditions were noted (some machine marks were noted around the socket of IR; these were judged to be of no consequence).
2. Visual inspection of rocker arm lips - No significant conditions were noted.
3. Measurement of distance from lip to socket, if ground - None were measured since none were ground.
4. Visual inspection of sockets - No significant conditions were noted.
5. PT of swivel pads - No indications were noted.
6. Material comparitor check of shafts - All shafts were acceptable.
7. Hardness of shafts - Shaft hardness ranged from BHN 241 to 311.

Disposition of Inspection Findings

7. Although no hardness testing was required by the procedure, the hardness results are considered acceptable. (See Rocker Arm Assembly Part #02-390A)

Catawba Diesel 1A Inspection Report

Part Name: Rocker Arm Bushings

Class: B

Part No.: 02-390E

Work Request No.: 0772 MNT

No. of Separate Inspections:

Attributes Verified and Sample Size

1. Visual inspect Rocker Arm bushings per 11.7.7 and 11.8.7, ref. 1, 48 insp.

References

1. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection

Inspection Results

1. Visual inspection of rocker arm bushings showed no significant indications.

Disposition of Inspection Findings

There were no significant findings

concern. However, valves with peeling chrome plate are being replaced.

- d. Top of Valve Stem - The scratches, grooves, etc., in the top of the valve stem are considered normal and have not had any effect on diesel operation. The valve stems will be used as-is.

Catawba Diesel 1A Inspection Report

Part Name: Intake and Exhaust Valves

Class: B

Part Number: 02-360B

Work Request No. 0722 MNT

No. of Separate Inspections: 360

Attributes Verified and Sample Size

1. Visual inspections on seat area, valve guides, valve stem surface and top per 11.4.2,3,4,6 ref.1, 256 insp.
2. Measure valve stem length per 11.4.5 ref. 1*, 16 insp.
3. Visual exam of valve head weld per 11.4.7 ref. 1*, 8 insp.
4. PT exam of valve head radius per 11.4.7.1 ref. 1, 64 insp.
5. Perform material comparator test per 11.4.10, ref. 1*, 16 insp.

* 25% sample - valves from 4 cylinders

References

1. MP/O/A/1000/04 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. a. Seat Areas - Minor pitting was present in many seats; there was one large pit in the right intake of 7R.
b. Valve Guides - No significant conditions were observed.
c. Valve stems - The chrome plate had peeled off at spots located 6" to 8" above the valve seat for 9 exhaust valves. The chrome plate also exhibited a dull color in this area. Miscellaneous scratches were observed in the chrome plate.
d. Top of Stem - A variety of scratches, pits, grooves, etc., were observed.
2. Valve stem length - These results were obtained for information purposes.
3. Visual exam of valve head weld - No significant conditions were observed.
4. PT exam of valve head radius - No rejectable indications observed.
5. Material comparator tests - (later)

Disposition of Inspection Findings

1. a. Valve seat pitting - The minor pitting of the valves seat areas is normal and the valves will be reused as-is. The 7R intake valve with a large pit was still functional (the pit spanned less than 50% of the land width), but is being replaced because of chrome plate peeling (see 1. c. below).
c. Valve Stems - The peeling chrome plate has not caused any operational problems, and is not considered to be a cause for

concern. However, valves with peeling chrome plate are being replaced.

- d. Top of Valve Stem - The scratches, grooves, etc., in the top of the valve stem are considered normal and have not had any effect on diesel operation. The valve stems will be used as-is.

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Head

Class: E

Part Number: 02-360A

Work Request No. 0772 MNT

No. of Separate Inspections: 240

Attributes Verified and Sample Size

1. Visual inspect intake and exhaust valve seats per 11.5.2, ref. 1, 64 insp.
2. Perform PT exam of intake & exhaust valve seats and fire deck area per 11.5.4, ref. 1, 80 insp
3. Perform ultrasonic thickness measurement of fire deck per 11.5.5, ref. 1, 96 insp.
4. Perform ultrasonic thickness measurement of fuel nozzle cavity per 11.5.6, ref. 1, 32 insp.

References

1. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

- 1&2 Valve seats - minor pitting observed in many seats. One large pit observed in the intake valve seat for 7R. No rejectable PT indications were observed.
3. Fire deck thickness - thickness ranged from 0.460" to 0.939".
4. Fuel nozzle cavity thickness - thickness ranged from 0.440" to 0.560".

Disposition of Inspection Findings

1. Valve seats - The minor pitting observed in many seats is considered normal and the seats can be used as-is. The large pit in 7R spans less than 50% of the land width and can be used as-is; it should be observed at the next routine maintenance period.
- 3&4. Wall thickness - No unusually thin wall thicknesses were observed and all of the wall thicknesses are therefore considered to be acceptable.

Catawba Diesel IA Inspection Report

Part Name: Valve Springs

Class: B

Part Number: 02-360D

Work Request No. 0772 MNT

No. of Separate Inspections: 128

Attributes Verified and Sample Size

1. Check spring color code per 11.4.8, ref. 1, 64 insp.
2. Visual check intake and exhaust valve spring per 11.4.9, ref. 1, 64 insp.

References

1. MP/O/A/1000/04 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Spring color code - Springs for seven right cylinders have a yellow rather than white stripe.
2. Visual check - No cracks or other defects were detected.

Disposition of Inspection Results

1. TDI indicates that only springs painted grey with a brown stripe are unacceptable. Springs with a yellow stripe were supplied by an alternate acceptable vendor.

Catawba Diesel 1A Inspection Report

Part Name: Subcover Assembly

Class: B

Part Number: 02-362A

Work Request No. 0772 MNT

No. of Separate Inspections: 256

Attributes Verified and Sample Size

1. Visual inspect subcover per 11.6.2, ref. 1, 16 insp.
2. PT exam on each subcover per 11.6.3, ref. 1, 64 insp.
3. Record as found torques per 11.2.8, ref. 2, 176 insp.

References

1. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts
Special Inspection
2. MP/0/A/1000/01 Diesel Engine Cylinder Head Removal, Disassembly
Inspection and Reassembly

Inspection Results

1. Visual inspection - No visual defects were observed.
2. PT of pedestals - Subcovers 3L and 6L had 1" and 1 1/4" long cracks in the thin web between the bolt hole in the pedestal and the side surface.
3. Subcover bolt torques ranged from 30 to 194 ft-lbs.

Disposition of Inspection Findings

2. PT of pedestals - The two cracked subcovers will be replaced. These cracks are also discussed in Section 3.
3. The bolt torques are considered acceptable. These bolts have been removed and reinstalled numerous times, using torque wrenches during reinstallation. There have been no problems as a result of low torque values. The bolts will be reinstalled, again using torque wrenches in order to assure that proper torques are used.

Catawba Diesel 1A Inspection Report

Part Name: Air Start Valve

Class: A

Part Number: 02-359

Work Request No. 0772 MNT

No. of Separate Inspections: 72

Attributes Verified and Sample Size

1. Measure as found torque of air start cap screws per 11.3.11, ref. 2, 32 insp.
2. Measure length air start valve cap screws per 11.3.2, ref. 1, 8 insp.
3. Visual inspect valve seat area each valve per 11.3.3, ref. 1, 16 insp.
4. Visual inspect valve internal surfaces per 11.3.4, ref. 1, 16 insp.

References

1. MP/0/A/1000/04 Diesel Engine Cylinder Head and Associated Parts Special Inspection
2. MP/0/A/1000/01 Diesel Engine Cylinder Head Removal, Disassembly. Inspection and Reassembly

Inspection Results

1. Capscrew as found torques - values ranged between 45-134 ft.-lbs.
2. Capscrew length - all capscrews met tolerance limits.
3. Valve seat area - several nicks and grooves were observed.
4. Valve internals - several valve stems were discolored or had slight carbon buildup on them. The spring retaining nut on one valve was galled.

Disposition of Inspection Findings

1. Capscrew as found torques - the observed values are acceptable
3. Valve seats - The observed seat conditions are considered normal considering the number of starts. The worst seat will be reground.
4. Valve internals - The amount of carbon buildup is normal considering the amount of operation. The galled spring retaining nut was replaced.

Catawba Diesel 1A Inspection Report

Part Name: Connecting Rods and Bushings

Class: A

Part Number: 02-340A

Work Request No. 0773 MNT

No. of Separate Inspections: 340

Attributes Verified and Sample Size 100% inspection except where noted

1. Visual inspect per 11.3.2, ref.1, 24 insp.
2. Measure rod dimensions per 11.3.3, ref. 1+, 168 insp.
3. Perform material comparator test per 11.3.5, ref. 1*, 16 insp.
4. Perform hardness test per 11.3.6, ref. 1*, 12 insp.
5. Perform PT test per 11.3.7, ref. 1, 8 insp.
6. Eddy current test per 11.3.4, ref. 1, 16 insp.
7. Measure breakaway torques per 11.3.5 and 11.5.1, ref 2, 80 insp.
8. Inspect connecting rod oil passages per 11.3.13, and 11.4.7, ref. 2, 16 insp.

* 25% sample basis inspection

+ 25% sample basis for piston pin bushing

References

1. MP/0/A/1000/05 Diesel Engine Piston, Rod, Bushing and Shells
Special Inspection
2. MP/0/A/1000/02 Diesel Engine Piston Rod and Liner Disassembly

Inspection Results

1. Visual inspection of connecting rod boxes, master rods and link rods show several instances of scratching and pitting.
2. Measurement of piston pin bushings shows three bushings out of tolerance by .002".
3. Results of the material comparator test of the connecting rod components were acceptable
4. Hardness test results ranged from BHN 241 to 291.
5. All PT tests results were satisfactory.
6. Eddy current tests of the rod box bolt holes showed no indications
7. Master rod breakaway torques ranged from 1260 to 2150 ft-lbs. One lock wire was found loose on cylinder #3. Link rod torques ranged from 880 to 1470 ft-lbs.
8. All connecting rod oil passages were found to be satisfactory.

Disposition of Inspection Findings

1. Visual inspection of connecting rod boxes, master rods, and link rods- these small pits and scratches are normal and have no adverse effects.

2. Piston pin bushings - The tolerance limits used for the inspection were for new parts. The small deviations noted are normal for parts that have been in service and have no effect on diesel operation.
7. The lockwire found on disassembly inspection had been loosened before final inspection and is not considered significant.

Catawba Diesel IA Inspection Report

Part Name: Connecting Rod Bearing Shells

Class: A

Part Number: 02-340B

Work Request No. 0773 MNT

No. of Separate Inspections: 308

Attributes Verified and Sample Size 100% inspection except where noted

1. Visual inspect crankpin shells per 11.5.2, ref. 1, 20 insp.
2. Measure crankpin shells per 11.5.3, ref. 1, 160 insp.
3. Liquid penetrant inspect per 11.5.4, ref. 1 *, 32 insp.
4. X-ray inspection per 11.5.5, ref. 1, 8 insp.
5. Eddy current inspection per 11.5.6, ref. 1, 8 insp.
6. Inspect connecting rod bolt contact surfaces per 11.4, ref. 1, 40 insp.
7. Mag. partical inspect connecting rod bolts per 11.4.2, ref. 1, 40 insp.

* 25% sample basis inspection for link rod end

References

1. MP/O/A/1000/05 Diesel Engine Piston, Rod, Bushing and Shell Special Inspection

Inspection Results

1. Results of the visual inspection shows one scratch in bearing shell 1L; otherwise, the inspection was within normal limits.
2. Measurement of crankpin shell - All measurements of crankpin shells meet acceptance standards.
3. PT exam of shells - The exam revealed one 1 1/4" long scratch on link rod bushing 1L. This is thought to have been caused during manufacture and is not considered a problem.
4. Radiography of the bearing shells showed no linear indications. Several shells had porosity that exceeded acceptance standards; however, RT standards are still being evaluated.
5. Eddy current inspection was not required as no crack-like indications appeared on radiography.
6. Visual inspection of the connecting rod contact surfaces demonstrated galling under the bolt heads.
7. Magnetic particle examinations of connector rod bolts found no rejectable indications.

Disposition of Inspection Findings

4. The bearing shells with rejectable conditions will be replaced.
6. The extent of the observed bolt contact surface galling is believed to have been caused by torquing the bolts and is considered normal and acceptable.

Catawba Diesel 1A Inspection Report

Part Name: Piston

Class: A

Part Number: 02-341A

Work Request No. 0773 MNT

No. of Separate Inspections: 560

Attributes Verified and Sample Size

1. Visual inspect fitup of crown to skirt per 11.6.2, ref. 1, 16 insp.
2. Inspect rings in grooves and measure axial clearance per 11.6.3, ref. 1, 288 insp.
3. Visually inspect pistons and piston rings for normal wear per 11.6.4, ref. 1, 16 insp.
4. Liquid penetrant inspect stud bosses in crown and skirt area and piston pin bosses on skirt per 11.6.5, ref. 1, 160 insp.
5. UT piston skirts per 11.9.2 if unsat. results from 11.9.1
6. PT/MT exam piston skirt per 11.9.3, ref.1, 16 insp.
7. Measure crown to skirt bolt breakaway torque per 11.7.3, ref. 2, 64 insp.

References

1. MP/O/A/1000/05 Diesel Engine Piston, Rod, Bushing and Shells
Special Inspection
2. MP/O/A/1000/02 Diesel Engine Piston, Rod and Cylinder Liner
Disassembly

Inspection Results

1. All visual inspections of crown to skirt fitups were satisfactory.
2. Axial clearance of piston rings in grooves were measured. Twenty rings out of 96 were out of tolerance by as much as .006".
3. Eight of sixteen piston assemblies demonstrated pitting or scratching on visual inspection.
4. PT exam of piston crown showed no indications. One 1/2" linear indication was found on piston skirt pin boss #1L.
5. UT not necessary as skirts will be replaced.
6. PT/MT exam demonstrated cracks in four of the piston skirts.
7. Torques of piston crown to skirt bolts ranged from 80 to 200 foot-pounds

Disposition of Inspection Findings

2. Axial clearance of piston rings in grooves - The tolerance used for this inspection were for new parts. The small deviations noted are normal for parts which have seen service and are considered acceptable.
3. Visual inspection of pistons and rings - The small scratches and pits observed are normal for parts which have seen service, have no effect on diesel operability, and are considered acceptable.
- 4,5,6. The piston skirts are to be replaced.

Catawba Diesel IA Inspection Report

Part Name: Piston Pin Assembly

Class: A

Part Number: 02-341C

Work Request No. 0773 MNT

No. of Separate Inspections: 28

Attributes Verified and Sample Size 25% sample size except where noted

1. Visual inspect per 11.7.2, ref. 1*, 16 insp.
2. Dimensional inspect per 11.7.3, ref. 1, 4 insp.
3. Materials verification test per 11.7.4, ref. 1, 4 insp.
4. Hardness test per 11.7.4, ref. 1, 4 insp.

* 100% inspection

References

1. MP/O/A/1000/05 Diesel Engine Piston, Rod, Bushings and Shells
Special Inspection

Inspection Results

1. Results of the visual inspection of the piston pins were satisfactory.
2. Dimensional inspection shows all dimensions satisfactory.
3. (later)
4. Hardness test results for the piston pins were within the range of Rockwell C 54 to 58.

Disposition of Inspection Findings

4. The specified hardness is Rockwell C 57 to 60. The measured hardness is considered acceptable within the limits of accuracy of the testing device

Catawba Diesel 1A Inspection Report

Part Name: Piston Rings

Class: A

Part Number: 02-341B

Work Request No. 0773 MNT

No. of Separate Inspections: 102 25% sample basis inspection

Attributes Verified and Sample Size

1. Install rings in cylinders & measure butt gap per 11.8.2, ref. 1, 96 insp.
2. Perform material comparator test per 11.8.3, ref. 1, 6 insp.

References

1. MP/0/A/1000/05 Diesel Engine Piston, Rod, Bushing and Shells
Special Inspection

Inspection Results

1. 56 piston rings were found to have a butt gap out of tolerance.
2. (later)

Disposition of Inspection Findings

1. The tolerances used for the inspection were for new rings and pistons. The small deviations from these will not adversely affect the engine. However, the piston rings will be replaced before reassembly for other reasons.
2. (later)

Catawba Diesel 1A Inspection Report

Part Name: Crankshaft Thrust Bearing Ring

Class: A

Part Number: 02-310C

Work Request No. 0774 MNT

No. of Separate Inspections: 9

Attributes Verified and Sample Size

1. Measure thrust clearance per 11.3.1, ref. 1, 1 insp.
2. Measure web clearance per 11.3.2, ref. 1, 8 insp.

References

1. MP/0/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

- 1&2 Hot inspections have been performed, with satisfactory results. The cold inspections will be done later.

Disposition of Inspection Findings

- 1&2 There have been no significant findings to date, the cold inspections will follow.

Catawba Diesel 1A Inspection Report

Part Name: Main Bearing Caps

Class: A

Part Number: 02-305D

Work Request No. 0774 MNT

No. of Separate Inspections: 8

Attributes Verified and Sample Size

1. Visual inspect main bearing cap #4,5,6,8 per 11.4.1, ref. 1, 4 insp.
2. Liquid penetrant main bearing cap #4,5,6,8 per 11.4.2, ref. 1, 4 insp.

References

1. MP/O/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1&2 Inspections of main bearing cap 4&5 are satisfactory. Inspections of # 6&8 are not yet complete.

Disposition of Inspection Findings

1&2 (later)

Catawba Diesel 1A Inspection Report

Part Name: Main Bearing Cap & Base Assembly Class: A

Part Number: 02-305A Work Request No. 0774 MNT

No. of Separate Inspections: 8

Attributes Verified and Sample Size

1. Visual inspect main bearing base around main bearings 4,5,6,8 per 11.4.1, ref. 1, 4 insp.
2. Liquid penetrant examine base material around main bearings 4,5,6,8 per 11.4.4, ref. 1, 4 insp.

References

1. MP/0/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1&2 Inspections of main bearing bases 4&5 were satisfactory. Inspections on bearing bases 6&8 are not yet complete.

Disposition of Inspection Findings

1&2 (later)

Catawba Diesel 1A Inspection Report

Part Name: Crankshaft Bearing Shell

Class: A

Part Number: 02-310B

Work Request No. 0774 MNT

No. of Separate Inspections: 90

Attributes Verified and Sample Size

1. Measure breakaway torque of upper bearing shell capscrews per 11.3.1, ref.2,48 insp.
2. Visual inspect bearings 4,5,6,8 per 11.5.1, ref.1,
 - a. Upper main bearing shell, 4 insp.
 - b. Lower main bearing shell, 4 insp.
 - c. Crankshaft journal, 4 insp.
3. Measure thickness of lower main bearing shell #4,5,6,8 per 11.5.2, ref. 1, 30 insp.

References

1. MP/O/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection
2. MP/O/A/1000/03 Diesel Engine Main Bearing Disassembly for Special Inspection and Reassembly

Inspection Results

1. Breakaway torque for bearing 5 shell capscrews was zero.
- 2&3 Inspections of main bearing shell #5 are satisfactory. Inspections of the other 3 main bearing shells are not yet complete.

Disposition of Inspection Findings

1. Cause of low breakaway torque is not known. Capscrews only serve to hold shell in place during assembly, and low torque does not affect diesel operability. The reassembly procedure assures that the proper torque is applied.

Catawba Diesel 1A Inspection Report

Part Name: Crankcase Assembly

Class: A

Part Number: Q2-311A

Work Request No. 0774 MNT

No. of Separate Inspections: 18

Attributes Verified and Sample Size

1. Visual inspect area between machined bolt hole surfaces and cast surfaces for smooth radii per 11.7.1, ref. 1, 18 insp.

References

1. MP/O/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1. Results of the visual inspection of the crankcase assembly surface were satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel IA Inspection Report

Part Name: Crankcase Covers Gaskets and Bolting Class: C

Part No.: 02-386B

Work Request No.: 0774 MNT

No. of Separate Inspections: 208

Attributes Verified and Sample Size

1. Measure breakaway torque per 11.2.2, ref. 2, 192 insp.
2. Visual inspect crankcase covers per 11.7.2, ref 1, 16 insp.

References

1. MP/0/A/1000/06 Diesel Engine Crankcase and Turning Gear, Gear Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection
2. MP/0/A/1000/03 Diesel Engine Piston Rod and Cylinder Liner Removal, Disassembly, Reassembly and Replacement

Inspection Results

1. The torque measurements were not done as the hot alignment testing took precedence
2. The results of the visual inspection of the crankcase cover bolt holes were satisfactory

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name Main Bearing Cap Studs and Nuts Class: A

Part Number: 02-305C Work Request No. 0774 MNT

No. of Separate Inspections: 57

Attributes Verified and Sample Size

1. Measure breakaway hydraulic pressure per 11.2.7, ref 2, 42 insp.
2. Visual inspect main bearing nuts for forging laps per 11.8.1, ref. 1, 12 insp.
3. Measure length one stud M.B. 5 per 11.8.2, ref.1, 1 insp.
4. Measure height of cap where stud passes through per 11.8.2, ref. 1, 2 insp.

References

1. MP/O/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankshaft Assembly and Crankcase Covers Special Inspection
2. MP/O/A/1000/03 Diesel Engine Main Bearing Disassembly for Special Inspection and Reassembly

Inspection Results

- 1&2 Results for M.B. 4 & 5 are as follows (M.B. 6 & 8 are not yet completed):
1. Breakaway hydraulic pressure was within normal limits
 2. Visual inspection of the nuts was acceptable
- 3&4 Stud length and cap height measurements are satisfactory

Disposition of Inspection Findings

There have been no significant findings to date

Catawba Diesel 1A Inspection Report

Part Name: Crankshaft and Turning Gear

Class: A

Part Number: 02-310A

Work Request No. 0774 MNT

No. of Separate Inspections: 23

Attributes Verified and Sample Size

1. Visual inspect crankpins 1-8 bearing surfaces and crankpin fillets per 11.6.1, ref. 1, 8 insp.
2. Eddy current test crankpins fillets between crankpin journals and webbing per 11.6.2, ref. 1, 12 insp.
3. Sensitive PT test oil holes on main bearing journals #4,6,8 with supplemental eddy current and visual exams as necessary per 11.6.3 and 11.6.4, ref.1, 3 insp.

References

1. MP/O/A/1000/06 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly, and Crankcase Covers Special Inspection

Inspection Results

1. Visual inspection of the crankpin fillets was satisfactory
2. One indication was found on the generator end of rod journal #7 by eddy current testing; otherwise, no relevant indications were found.
3. Fluorescent PT inspection of oil hole on #4 bearing showed no indications. Bearings 6 and 8 have not yet been inspected.

Disposition of Inspection Findings

2. The indication demonstrated by eddy current testing will be ground out in .005 inch increments with metallographic replicas taken at each stage. The replicas will be used to confirm that the indication was not service induced.

Catawba Diesel 1A Inspection Report

Part Name: Crankshaft Gear Class: A
Part Number: 02-355A Work Request No. 0778MNT
No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect crankshaft gear per 11.2.2, ref.1, 1 insp.
2. Visual inspect pump drive gear per 11.2.4, ref. 1, 1 insp.

References

1. MP/O/A/1000/07 Diesel Engine Idler Gears and Pump Drive Gears Inspections and Adjustments

Inspection Results

1. The crankshaft gear was visually inspected and found to be in satisfactory condition.
2. The pump drive gear was visually inspected and found to be in satisfactory condition.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Idler Gear Assembly

Class: A

Part Number: 02-355B

Work Request No. 0778MNT

No. of Separate Inspections: 15

Attributes Verified and Sample Size

1. Visual inspect idler gears per 11.2.3, ref. 1, 2 insp.
2. Measure superficial hardness of idler gears per 11.2.5, ref. 1, 6 insp.
3. Perform material comparator test on idler gears per 11.2.6, ref. 1, 2 insp.
4. Measure backlash of assembly per 11.3, ref. 1, 7 insp.

References

1. MP/O/A/1000/07 Diesel Engine Idler Gears and Pump Drive Gears Inspections and Adjustments

Inspection Results

1. The left and right idler gears were found to be in satisfactory condition.
2. The hardness of the gears was found to be BHN 320 - 360
3. Material comparator exam results were satisfactory.
4. The backlash was found to range from .004" to .014".

Disposition of Inspection Results

2. The specified hardness for the idler gears is BHN 380 - 405. The test result is considered acceptable within the limits of accuracy of the testing device.

All other results showed no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Gear Case Covers/Gaskets and Bolting Class: C

Part No.: 02-395B Work Request No.: 0778MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect for oil leakage per 11.1, ref. 1, 1 insp.
2. Visual inspect capscrews per 11.2, ref. 1, 1 insp.

References

1. MP/O/A/1000/08 Diesel Engine Gear Case Gaskets and Bolting
Special Inspection

Inspection Results

1. No significant leakage around the gear case covers was found on visual inspection.
2. All gear case cover capscrews were found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Front Gear Case Bolting

Class: C

Part Number: 02-325B

Work Request No. 0778MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Examine periphery for oil leakage per 11.1, ref. 1, 1 insp.
2. Visual inspect gear case capscrews per 11.2, ref. 1, 1 insp.

References

1. MP/O/A/1000/8 Diesel Engine Gear Case Gaskets and Bolting
Special Inspection

Inspection Results

1. No significant gear case cover leakage was found on visual inspection.
2. All gear case cover capscrews were found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Fuel Injection Pump

Class: B

Part No.: 02-365A

Work Request No.: 0842 MNT

No. of Separate Inspections: 32

Attributes Verified and Sample Size

1. Measure superficial hardness of each fuel pump valve holder per 11.4.2, ref. 1, 16 insp.
2. Perform UT inspection each fuel pump valve holder per 11.4.3, ref. 1, 16 insp.

References

1. MP/0/A/1000/09 Diesel Engine Fuel Pump and Linkage
Special Inspection

Inspection Results

1. Hardness test results ranged from Rockwell C 31 - 34.5.
2. Ultrasonic testing of the fuel pump valve holders was satisfactory

Disposition of Inspection Findings

There were no significant findings. The hardness results agree with those included in the B&W failure analysis report for the cracked valve holder dated March 1, 1984; therefore, they are considered acceptable.

Catawba Diesel 1A Inspection Report

Part Name: Fuel Oil Filter Mounting Hardware Class: A

Part No.: 02-455C Work Request No.: 0842 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect mounting hardware per 11.4, ref. 1, 1 insp.
2. Measure or verify torque of bolt holding filter to side of engine per 11.5.1. ref. 2. 1 insp.

References

1. MP/0/A/1000/27 Diesel Engine Fuel Piping System Special Inspection
2. MP/0/A/1000/09 Diesel Engine Fuel Pump and Linkage Special Inspection

Inspection Results

1. (later)
2. The fuel oil filter mounting bolt torque was verified as correct.

Disposition of Inspection Findings

There are no significant findings to date

Catawba Diesel 1A Inspection Report

Part Name: Fuel Pump Control Shaft

Class: A

Part No.: 02-371A

Work Request No.: 0842 MNT

No. of Separate Inspections: 4

Attributes Verified and Sample Size

1. Measure superficial hardness both shafts per 11.2.2, ref. 1, 2 insp.
2. Perform material comparator test per 11.2.3, ref. 1, 2 insp.

References

1. MP/0/A/1000/09 Diesel Engine Fuel Pump and Linkage - Special Inspection

Inspection Results

1. Hardness test results ranged from BHN 216 to 229.
2. Material comparator examination results were satisfactory.

Disposition of Inspection Findings

1. The measured hardness corresponds to a tensile strength of about 105 ksi. There were no specific acceptance standards available, however this strength is considered acceptable for the 4140 steel used.

Catawba Diesel IA Inspection Report

Part Name: Fuel Pump Linkage, Bearings and Shaft Class: A

Part No.: 02-371B

Work Request No.: 0842 MNT

No. of Separate Inspections: 3

Attributes Verified and Sample Size

1. Visual inspect fuel pump linkage per 11.3.2, ref. 1, 2 insp.
2. Check site documentation to ensure adequate lubrication per 11.3.3, ref 1, 1 insp.

References

1. MP/O/A/1000/09 Diesel Engine Fuel Pump and Linkage - Special Inspection

Inspection Results

1. Visual inspection of fuel pump linkage was satisfactory.
2. An adequate lubrication schedule was found to be established.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Tubing and Fittings Class: A

Part No.: 02-307B

Work Request No.: 0832 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect internal lube oil system piping, tubing and fittings per 11.3, ref. 1, 1 insp.
2. Visual inspect external lube oil system piping, tubing and fittings per 11.4.1, ref.1, 1 insp.

References

1. MP/O/A/1000/10 Diesel Engine Lube Oil System Piping and Supports
Special Inspection

Inspection Results

1&2 The visual examination of the internal and external lube oil tubing and fittings was satisfactory

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: External Lube Oil Supports Class: A
Part No.: 02-465B Work Request No.: 0832 MNT
No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect supports per 11.4, ref. 1, 1 insp.

References

1. MP/0/A/1000/10 Diesel Engine Lube Oil System Piping and Sump
Special Inspection

Inspection Results

1. Visual examination of the external lube oil supports was satisfactory with the exception of the triple header clamp bolts on cylinders 8R and 1R. Some of these bolts were found broken off.

Disposition of Inspection Findings

1. All triple header clamp bolts were replaced with higher quality bolts and retorqued to specifications. Also, the associated pipe lines will be reinspected to verify proper support to prevent excessive vibration.

Catawba Diesel 1A Inspection Report

Part Name: External Lube Oil Lines

Class: A

Part No.: J2-465A

Work Request No.: 0832 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect lube oil lines per 11.4, ref. 1, 1 insp.

References

1. MP/O/A/1000/10 Diesel Engine Lube Oil System Piping and Sump
Special Inspection

Inspection Results

1. Visual examination of the external lube oil lines was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Line Supports Class: B
Part No.: 02-307D Work Request No.: 0832 MNT
No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect supports per 11.3, ref. 1, 1 insp.

References

1. MP/0/A/1000/10 Diesel Engine Lube Oil System Piping and Sump
Special Inspection

Inspection Results

1. Visual inspection of the lube oil line supports demonstrated two supports that were loose. Otherwise, the examination was within normal limits.

Disposition of Inspection Findings

1. The loose supports will be retorqued using torque wrenches to prevent reoccurrence.

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Internal Headers Class: A

Part No.: 02-307A Work Request No.: 0832 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect headers per 11.3, ref. 1, 1 insp.

References

1. MP/0/A/1000/10 Diesel Engine Lube Oil System Piping and Sump
Special Inspection

Inspection Results

1. Visual examination of the lube oil internal headers showed some minor disagreement with the Owners Group isometric drawings.

Disposition of Inspection Findings

1. Plant-specific isometric drawings are being obtained to determine if the discrepancies with the general isometrics are specific to the Catawaba station. Any nonconformances with these drawings will be subject to engineering evaluation.

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Sump Tank

Class: B

Part No.: 02-540A

Work Request No.: 0832 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect lube oil sump per 11.4.2, ref. 1, 1 insp.

References

1. MP/O/A/1000/10 Diesel Engine Lube Oil System Piping and Sump -
Special Inspection

Inspection Results

1. Visual inspection of the lube oil sump tank was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Sump Tank Mounting Hardware Class: B

Part No.: 02-540C

Work Request No.: 0832 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect sump tank supports per 11.4.1, ref. 1, 1 insp.

References

1. MP/0/A/1000/10 Diesel Engine Lube Oil System Piping and Sump -
Special Inspection

Inspection Results

1. Visual inspection of the lube oil sump tank mounting hardware was satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Lube Oil Sump Tank Bolting

Class: B

Part No.: 02-540B

Work Request No.: 0832 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Verify mounting bolt torque per 11.4.2, ref.2, 1 insp.

References

1. MP/0/A/1000/10 Diesel Engine Lube Oil System Piping and Sump -
Special Inspection

Inspection Results

1. The lube oil sump tank mounting bolts were verified from existing documentation as having the correct applied torque.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Head Studs

Class: B

Part Number: 02-315E

Work Request No. 0773MNT

No. of Separate Inspections: 332

Attributes Verified and Sample Size

1. Record breakaway torque cylinder head nuts per 11.2.12, ref. 1, 128 insp.
2. Record breakaway torque cylinder head studs per 11.2.14, ref. 1, 32 insp.
3. Inspect head studs for ID marks per 11.4.1, ref. 2, 32 insp.
4. Visual inspect head studs per 11.4.2, ref. 2, 32 insp.
5. Perform material test comp. per 11.4.3, ref. 2, 4 insp.
6. Perform superficial hardness test per 11.4.3, ref. 2, 4 insp.

References

1. MP/0/A/1000/01 Diesel Engine Cylinder Head Removal and Disassembly
2. MP/0/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. The breakaway torque of the cylinder head nuts was measured and found to range from 2780 to 4190 ft-lbs.
2. The breakaway torque of the cylinder head studs was measured and found to range from 1100 to 1930 ft-lbs.
3. The head stud ID numbers were inspected and found satisfactory.
4. Nine studs showed pitted areas, One stud had a nick in the threads.
5. The material comparator test results were satisfactory.
6. Hardness test results ranged from Rockwell C 29 to 30

Disposition of Inspection Findings

4. The indications described above were determined to have resulted from normal service and to not affect stud integrity; the studs will be reused.
6. The hardness results are within normal limits.

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Block Jacket Water Manifold

Class: A

Part Number: 02-315D

Work Request No. 0773 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect water manifold and piping per 11.5.4, ref. 1, 1 insp.

References

1. MP/0/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. The jacket water manifold and piping were inspected and found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report>

Part Name: Jacket Water Discharge Manifold

Class: B

Part Number: 02-317A

Work Request No. 0773MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect jacket water manifold per 11.5.4, ref. 1, 1 insp
2. Visual inspect manifold per 11.5, ref. 2, 1 insp.

References

1. MP/0/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection
2. MP/0/A/1000/25 Diesel Engine Jacket Water System Piping Standpipe and Manifold Special Inspection

Inspection Results

- 1 Visual inspection of the jacket water manifold was satisfactory.
2. (later)

Disposition of Inspection Findings

There are no significant findings to date.

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Block Jacket Water Manifold Nuts Class: B

Part Number: 02-315F Work Request No. 0773 MNT

No. of Separate Inspections: 26

Attributes Verified and Sample Size

1. Visual inspect all 5/8" nuts per 11.5.1, ref. 1, 22 insp.
2. Visual inspect 25% water manifold nuts per 11.5.2, ref. 1, 4 insp.

References

1. MP/O/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1&2. Visual inspections of the jacket water manifold nuts were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Block

Class: A

Part Number: 02-315A

Work Request No. 0773 MNT

No. of Separate Inspections: 127

Attributes Verified and Sample Size

1. Liquid penetrant inspect cylinder block top per 11.2.1, ref. 1, 16 insp.
2. Eddy current inspect cylinder block holes per 11.2.2, ref. 1, 32 insp.
3. UT inspect cylinders per 11.2.3, ref. 1, 16 insp.
4. Dimensional inspect cylinder liner landing area per 11.6.1, ref. 1, 56 insp.
5. PT inspect cylinder liner landing area per 11.6.2, ref. 1, 7 insp.

References

1. MP/O/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspections

Inspection Results

1. The PT examination of cylinder block top was satisfactory.
2. Eddy current exam of the cylinder head stud holes showed no indications.
3. Ultrasonic exam was not required due to satisfactory ECT and PT exams.
4. Dimensions of the liner landing areas were taken and will be forwarded to the Owners' Group.
5. The PT examination of the liner landing area were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Cylinder Liner

Class: A

Part Number: 02-315C

Work Request No. 0773 MNT

No. of Separate Inspections: 226

Attributes Verified and Sample Size

1. Visual inspect cylinder liner per 11.3.1, ref. 1, 16 insp.
2. Measure bore per 11.3.2, ref. 1, 120 insp.
3. Perform Materials Comparator Test per 11.3.3, ref. 1, 6 insp.
4. Perform hardness test per 11.3.3, ref. 1, 6 insp.
5. Measure dist. cylinders protrude above block per 11.3.4, ref. 1, 64 insp.
6. Supplement visual inspect liner per 11.6.3, ref. 1, 7 insp.
7. Dimensional insp. cylinder liner per 11.6.4, ref. 1, 7 insp.

References

1. MP/0/A/1000/11 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. All cylinders have ring scuffing and scratching. Seven cylinders showed polish lines.
2. Twenty eight of 120 measurements of cylinder liner bore were not to specification. The dimensions ranged from 16.994" to 17.009".
3. (later)
4. Hardness test results ranged from BHN 241 to 275.
5. Twenty one of 64 measurements of liner protrusion were not to specifications. The protrusions ranged from .003" to .009".
6. The supplemental visual inspection of cylinder liners were satisfactory.
7. The dimensional inspections yielded the following results: O.D. Lip - 19.494"-19.498", O.D. Seat Surf. - 18.991"-18.998", Height 1.505"-1.506".

Disposition of Inspection Findings

1. The various scratches and marks are the results of normal wear and are not a problem.
- 2&5. The specifications were for new parts. The small discrepancies are considered normal for parts that has seen service and are acceptable.
3. (later)
4. The hardness is considered acceptable within the limits of accuracy of the measuring device.

Catawba Diesel 1A Inspection Report

Part Name: Starting Air Distributor Assembly Class: A

Part No.: 02-442A Work Request No.: 0778 MNT

No. of Separate Inspections: 48

Attributes Verified and Sample Size

1. Visual inspect each spool per 11.7, ref. 1, 16 insp.
2. Measure smallest diameter of each spool per 11.10, ref. 1, 16 insp.
3. Measure superficial hardness of each spool per 11.11, ref. 1, if diameter ratios are not within specifications

References

1. MP/O/A/1000/12 Diesel Engine Starting Air Distributor Disassembly and Special Inspection

Inspection Results

1. Visual inspection of the spools was satisfactory.
2. All spool diameter ratios are within specified limits.
3. Hardness not required since diameter ratios were satisfactory.

Disposition of Inspection Findings

1. There were no significant findings.

Catawba Diesel IA Inspection Report

Part Name: Jacket Water Pump

Class: A

Part No.: 02-425A

Work Request No.: 0776 MNT

No. of Separate Inspections: 10

Attributes Verified and Sample Size

1. Visual inspect gear carrier assembly per 11.2, ref. 1, 1 insp.
2. Visual inspect driven gear, coupling and spline per 11.3.1, ref.1, 1 insp.
3. PT coupling and external spline per 11.3.2, ref.1, 1 insp.
4. Visual inspect volute wear ring per 11.4.1; ref.1, 1 insp.
5. Visual inspect and PT inspect shaft per 11.4.2, ref.1, 2 insp.
6. Perform material comparitor test per 11.4.3, ref. 1, 2 insp.
7. Perform superficial hardness test per 11.4.3, ref.1, 2 insp.

References

1. MP/0/A/1000/i3 Diesel Engine Jacket Water Pump - Special Inspection

Inspection Results

1. (later)
2. Visual inspection of the driven gear, coupling and external spline was satisfactory.
3. (later)
4. Visual inspection of the volute wear ring was satisfactory.
5. Visual inspection of the impeller shaft was satisfactory.
6. (later)
7. (later)

Disposition of Inspection Findings

There are no significant findings to date.

Catawba Diesel 1A Inspection Report

Part Name: Camshaft Bearing

Class: A

Part Number: 02-350B

Work Request No. 0777 MNT

No. of Separate Inspections: 4

Attributes Verified and Sample Size

1. Visual inspect left and right outboard support bushings per 11.4.2, ref.1, 4 insp.

References

1. MP/0/A/1000/14 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the outboard support bushings was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Camshaft Assembly

Class: A

Part Number: 02-350A

Work Request No. 0777 MNT

No. of Separate Inspections: 50

Attributes Verified and Sample Size

1. Visual inspect camshaft lobes per 11.3, ref. 1, 48 insp.
2. Inspect locking clips both camshafts per 11.4.3, ref. 1, 2 insp.

References

1. MP/O/A/1000/14 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. The visual inspection of the camshaft was satisfactory with the exception of two small pits in one lobe, which are not significant.
2. Visual inspection of the locking clips showed the locking clips to be in place.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Camshaft Supports, Bolting and Gear Class: A

Part Number: 02-350C Work Request No. 0777 MNT

No. of Separate Inspections: 51

Attributes Verified and Sample Size

1. Record breakaway torque per 11.2.2, ref. 1, 42 insp.
2. Inspect gasket for damage per 11.2.4, ref. 1, 1 insp.
3. Visual inspect left and right camshaft gears per 11.5.4, ref. 1, 2 insp.
4. Perform Material Comparator Test camshaft gear per 11.5.5, ref. 1, 2 insp.
5. Perform hardness test camshaft gear per 11.3.5, ref. 1, 2 insp.
6. Reassemble supports and torque per 11.5.1, ref. 1, 2 insp.

References

1. MP/0/A/1000/14 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Cam cover bolt breakaway torques ranged from 0 to 86 ft-lbs. Cam gear cover torque ranged from 9 to 42 ft-lbs.
2. Visual inspection of all eight cam cover gaskets showed no signs of leaks or damage.
3. Visual inspection of camshaft gears show only a slight amount of pitting in the gear contact surface.
4. The results of the material comparator test are acceptable.
5. Hardness (later)
6. The cam gear support was reassembled according to procedure.

Disposition of Nonconformances

1. The cam and cam gear cover bolting is being replaced with higher strength bolts and will be reinstalled to specified torques.
5. (later)

Catawba Diesel 1A Inspection Report

Part Name: Fuel Tappets

Class: A

Part Number: 02-345B

Work Request No. 0777 MNT

No. of Separate Inspections: 12

Attributes Verified and Sample Size

1. Visual inspect tappet rollers per 11.4.1, ref. 1, 12 insp.

References

1. MP/O/A/1000/14 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the fuel tappet rollers showed one scratch in the 8L roller, otherwise they were satisfactory.

Disposition of Inspection Findings

1. The scratch was evaluated as being the result of normal service and the tappet roller was evaluated as being acceptable.

Catawba Diesel IA Inspection Report

Part Name: Intake Tappets

Class: A

Part Number: 02-345A

Work Request No. 0777 MNT

No. of Separate Inspections: 12

Attributes Verified and Sample Size

1. Visual inspect tappet rollers per 11.6.1, ref. 1, 12 insp.

References

1. MP/O/A/1000/14 Diesel Engine Camshaft, Camshaft gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the intake and exhaust tappet rollers was satisfactory.

Disposition of Inspection Findings

There were no significant indications

Catawba Diesel 1A Inspection Report

Part Name: Exhaust Manifold

Class: B

Part No.: 02-380A

Work Request No.: 0772 MNT

No. of Separate Inspections: 17

Attributes Verified and Sample Size

1. Visual inspect exhaust manifold to flange weld per 11.3.4, ref.1, 1 insp.
2. Visual inspect exhaust manifold per 11.3, ref. 2, 1 insp.

References

1. MP/O/A/1000/15 Diesel Engine Intake and Exhaust Manifolds - Special Inspection
2. MP/O/A/1000/28 Diesel Engine Exhaust Manifold - Special Inspection

Inspection Results

1. Visual inspection of the exhaust manifold to flange welds was satisfactory.
2. (later)

Disposition of Inspection Findings

There are no significant findings to date.

Catawba Diesel 1A Inspection Report

Part Name: Intake Manifolds

Class: B

Part No.: 02-375

Work Request No.: 0772 MNT

No. of Separate Inspections: 32

Attributes Verified and Sample Size

1. Visual inspect surfaces and bolt holes per 11.2.2, ref. 1, 32 insp.

References

1. MP/0/A/1000/15 Diesel Engine Intake and Exhaust Manifolds
Special Inspection

Inspection Results

1. Visual inspection of the manifold surfaces and bolt holes was satisfactory.

Disposal of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Exhaust Manifold Bolting Class: B

Part No.: 02-380B

Work Request No.: 0772 MNT

No. of Separate Inspections: 6

Attributes Verified and Sample Size

1. Visual inspect capscrews per 11.3.2, ref.1, 3 insp.
2. Measure depth of capscrew hole and flange thickness per 11.3.3, ref.1, 3 insp.

References

1. MP/0/A/1000/15 Diesel Engine Intake and Exhaust Manifolds Special Inspection

Inspection Results

1. Visual inspection of the capscrews was satisfactory.
2. The depth of the flanges plus the capscrew holes in the exhaust manifolds were satisfactory.

Disposal of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Overspeed Trip and Accessory Drives Class: A

Part No.: 02-410B Work Request No.: 0841 MNT

No. of Separate Inspections: 34

Attributes Verified and Sample Size

1. Remove drive assembly per 11.2, ref. 1, 13 insp.
2. Disassemble overspeed trip drive per 11.3, ref.1, 3 insp.
3. Visual inspect O.S. trip drive drive shaft for deterioration per 11.3.10.1 ref.1, 1 insp.
4. Perform material comparitor on O.S. trip drive drive shaft per 11.3.10.2, 1 insp.
5. PT inspect O.S. trip drive drive shaft per 11.3.10.3, ref.1, 1 insp.
6. Visual inspect O.S. trip drive drive shaft per 11.3.10.4, ref.1, 1 insp.
7. Perform material comparitor test on O.S. trip drive driven shaft per 11.3.10.5, ref. 1, 1 insp.
8. PT inspect O.S. trip drive driven shaft per 11.3.10.6, ref.1, 1 insp.
9. Visual inspect O.S. trip drive drive gear per 11.3.10.7, ref.1, 1 insp.
10. Perform material comparitor test on O.S. trip drive drive gear per 11.3.10.8, ref.1, 1 insp.
11. Perform hardness test on O.S. trip drive drive gear per 11.3.10.9, ref. 1, 1 insp.
12. Visual inspect O.S. trip drive driven gear per 11.3 10.10, ref.1, 1 insp.
13. Perform material comparitor on O.S. trip drive driven gear per 11.3.10.11, ref. 1, 1 insp.
14. Perform hardness test on O.S. trip drive driven gear per 11.3.10.12, ref.1, 1 insp.
15. Visual inspect O.S. drive antifriction bearings per 11.3.10.13, ref.1, 1 insp.
16. Measure end play of accessory drive drive shaft per 11.4.2, ref. 1, 1 insp.
17. Visual inspect accessory drive shaft per 11.4.5.1, ref. 1, 1 insp.
18. Perform material comparitor test on accessory drive shaft per 11.4.5.2, ref. 1, 1 insp.
19. PT inspect accessory drive shaft per 11.4.5.3, ref. 1, 1 insp.
20. Visual inspect accessory drive gear per 11.4.5.4, ref. 1, 1 insp.
21. Perform material comparitor on accessory drive gear per 11.4.5.5, ref. 1, 1 insp.
22. Perform hardness test on accessory drive gear per 11.4.5.6, ref. 1, 1 insp.

References

1. MP/0/A/1000/16 Diesel Engine Governor and Overspeed Trip Accessory Drives - Disassembly, Inspection, and Reassembly

Inspection Results

1. The drive assembly was removed according to procedure.
2. The overspeed trip drive was disassembled according to procedure.
3. The visual inspection of the OS trip drive shaft was satisfactory.
4. The material comparator results on the OS trip drive were satisfactory.
5. The PT inspection of the OS trip drive was satisfactory.
6. Visual inspection OS trip driven shaft (later)
7. The material comp. results of the OS trip driven shaft were satisfactory.
8. The PT inspections of the OS trip driven shaft were satisfactory.
9. Visual inspections of the OS trip drive gear were satisfactory.
10. Material comp. results of the OS trip drive gear were satisfactory.
11. The hardness of the OS trip drive gear was BHN 252 (UTS about 124 ksi.)
12. Visual inspection of the OS trip driven gear was satisfactory.
13. Material comp. results for the OS trip driven gear were satisfactory.
14. The hardness test result for the OS trip driven gear was BHN 218 (UTS about 106 ksi.)
15. Visual inspection of the OS trip drive antifriction bearings showed a rough spot in the bearing.
16. Visual inspection accessory drive shaft (later)
17. The end play of the accessory drive shaft was satisfactory.
18. Material comp. results for the accessory drive shaft were satisfactory.
19. The PT inspection of the accessory drive shaft was satisfactory.
20. Visual inspection accessory drive gear (later)
21. Material comp. inspection results of the accessory drive gear were satisfactory.
22. Hardness of the accessory drive gear (later)

Disposition of Inspection Findings

6,16,20,22 - (later)

- 11&14 Expected hardness values for these gears are not yet available; this information will be requested from the Owners Group and/or TDI.
15. The damage to the bearing occurred during disassembly. The bearing has been replaced.

Catawba Diesel 1A Inspection Report

Part Name: Speed Regulating Governor Drive Gear/Shaft Class: A

Part No.: 02-411A

Work Request No.: 0841 NMT

No. of Separate Inspections: 13

Attributes Verified and Sample Size

1. Measure end play of horizontal shaft per 11.6.4, ref. 1, 1 insp.
2. Visual inspect larger horizontal shaft drive gear per 11.6.7.1, ref. 1, 1 insp.
3. Perform material comparitor test on larger horizontal shaft drive gear per 11.6.7.2, ref. 1, 1 insp.
4. Perform hardness test on larger horizontal shaft drive gear per 11.6.7.3, 1 insp.
5. Visual inspect small horizontal shaft drive gear per 11.6.7.4, ref. 1, 1 insp.
6. Perform material comparitor test on small horizontal shaft drive gear per 11.6.7.5, ref.1, 1 insp.
7. Perform hardness test on small horizontal shaft drive gear per 11.6.7.6, ref.1, 1 insp.
8. Visual inspect horizontal shaft per 11.6.7.7, ref.1, 1 insp.
9. Perform material comparitor test on horizontal shaft per 11.6.7.8, ref. 1, 1 insp.
10. PT exam horizontal shaft per 11.6.7.7, ref. 1, 1 insp.
11. Visual inspect vertical shaft per 11.6.7.10, ref. 1, 1 insp.
12. Perform material comparitor test on vertical shaft per 11.6.7.11, ref. 1, 1 insp.
13. PT exam vertical shaft per 11.7.7.12, ref. 1, 1 insp.

References

1. MP/0/A/1000/16 Diesel Engine Governor and Overspeed Trip Accessory Drive-Disassembly, Inspection, and Reassembly

Inspection Results

1. The end play of the horizontal shaft was satisfactory.
2. The visual inspection of the large horizontal shaft drive gear was satisfactory.
3. Material comparitor results for the large horizontal shaft drive gear were satisfactory.
4. The hardness of the large horizontal shaft drive gear was BHN 468-472 (UTS of about 240 ksi) vs. an expected hardness of Rockwell A 76-79 (UTS of about 250 to 300 ksi)
5. Visual inspection of the small, horizontal shaft drive gear was satisfactory.

6. Material comp. test results for the small horizontal shaft drive gear were acceptable.
7. The hardness of the small horizontal shaft drive gear was BHN 457 to 460 (UTS of about 235 ksi) vs. an expected Rockwell A hardness of 76-79 (UTS of about 250 - 300 ksi.)
8. The visual inspection of the horizontal shaft was satisfactory.
9. Material comp. test results for the shaft were satisfactory.
10. PT exam results of the horizontal shaft were satisfactory.
11. Visual inspection of the vertical shaft was satisfactory.
12. Material comp. test results for the vertical shaft were satisfactory.
13. The PT inspection of the vertical shaft was satisfactory.

Disposition of Inspection Findings

- 4&7 The measured hardness is considered acceptable within the limits of accuracy of the measuring device.

Catawba Diesel 1A Inspection Report

Part Name: Fuel Pump Linkage and Shutdown Cylinder Class: B

Part No.: 02-413B

Work Request No.: 0841 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Check linkage action per 11.7.1, ref. 1, 1 insp.
2. Visual inspect cross shaft assembly per 11.7.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/16 Diesel Engine Governor and Overspeed Trip Accessory Drives - Disassembly, Inspection, and Reassembly

Inspection Results

1. The linkage action was inspected and found to be satisfactory.
2. The visual inspection of the cross shaft assembly was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Speed Regulation Gov. Drive Coupling Class: A

Part No.: 02-411B

Work Request No.: 0841MNT

No. of Separate Inspections: 3

Attributes Verified and Sample Size

1. Visual inspect coupling halves, shaft ends and spacers per 11.6.7.13, ref. 1, 2 insp.
2. Visual inspect female drive coupling per 11.6.7.14. ref.1, 1 insp.

References

1. MP/O/A/1000/16 Diesel Engine Governor and Overspeed Trip Accessory Drives Disassembly Inspection and Reassembly.

Inspection Results

1&2 Visual inspections of the governor drive couplings and related hardware were satisfactory.

Disposal of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Overspeed Trip Drive Couplings Class: A

Part No.: 02-410C

Work Request No.: 084 MNT

No. of Separate Inspections: 4

Attributes Verified and Sample Size

1. Verify coupling halves are snug against spider per 11.2.7, ref.1, 1 insp.
2. Check both couplings to ensure tapered pin is tight per 11.3.1.1, ref 1, 2 insp.
3. Note condition of elastomer piece per 11.3.1.4, ref. 1, 1 insp.

References

1. MP/0/A/1000/16 Diesel Engine Governor and Overspeed Trip Accessory Drives Disassembly Inspection and Reassembly

Inspection Results

1. The coupling snugness was checked and found to be satisfactory.
2. The tapered pin was found to be satisfactory.
3. The elastomer piece was found to have small indentations.

Disposal of Inspection Findings

3. The indentations in the elastomer piece do not affect the operability of the engine. However, it will be replaced as part of routine annual maintenance.

Catawba Diesel 1A Inspection Report

Part Name: Governor Heat Exchanger Assembly Class: A

Part No.: 02-415C

Work Request No.: 0841MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Verify oil cooler is mounted below oil level per 11.5.1, ref.1, 1 insp.

References

1. MP/0/A/1000/16 Diesel Engine Governor and Overspeed Trip
Accessory Drives Disassembly Inspection and
Reassembly

Inspection Results

1. The location of the oil cooler was inspected and found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name:Speed Regulating Gov. Linkage Class:A

Part No.: 02-413A

Work Request No.:0841MNT

No. of Separate Inspections:2

Attributes Verified and Sample Size

1. Check Linkage Action per 11.7.1., ref. 1, 1 insp.
2. Visual inspect cross shaft per 11.7.2., ref. 1, 1 insp.

References

1. MP/O/A/1000/16 Diesel Engine Governor and Overspeed Trip
Accessory Drives Disassembly Inspection and
Reassembly

Inspection Results

1. The linkage was inspected and found to be acceptable.
2. The visual inspection of the cross shaft assembly was satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Flywheel Bolting

Class: A

Part Number: 02-330B

Work Request No. 0841MNT

No. of Separate Inspections: 24

Attributes Verified and Sample Size

1. Visual inspect for loose roll pins per 11.2.1, ref. 1, 12 insp.
2. Torque test per 11.2.3, ref. 1, if correct torque was not previously documented, 12 insp.

References

1. MP/0/A/1000/17 Diesel Engine Flywheel Bolting Special Inspection

Inspection Results

1. Visual inspections of the roll pins were satisfactory.
2. Documented torque values were located in documentation of previous work with the minimum torque being 4500 foot-pounds.

Disposition of Nonconformances

There were no specific findings

Catawba Diesel 1A Inspection Report

Part Name: Intercooler Piping Coupling, Bolting/Gasket Class: A

Part No.: 02-436B

Work Request No.: 0775 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Check dresser coupling on piping per 11.6.4, ref. 1, 1 insp.

References

1. MP/O/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Dresser coupling found on inspection was a 90 degree elbow straight coupling. This information will be forwarded to the Owners Group.

Disposition of Inspection Findings

1. There were no significant findings.

Catawba Diesel IA Inspection Report

Part Name: Turbocharger

Class: A

Part No.: MP/022/3

Work Request No.: 0775 MNT

No. of Separate Inspections: 14

Attributes Verified and Sample Size

1. Visual inspect assembly per 11.2.2, ref. 1, 6 insp.
2. Visual inspect journal bearings per 11.2.3, ref. 1, 4 insp.
3. Measure ID of journal bearings per 11.2.4, ref. 1, 4 insp.
4. Visual inspect turbo exhaust gas inlet bolts per 11.7.1, ref.1, 16 insp.

References

1. MP/0/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. The right nozzle of the right bank turbocharger has a chipped spot, otherwise the visual exam is satisfactory.
2. The right journal bearing has a chip in it and the left journal bearing is satisfactory. The thrust bearings are severely worn and damaged.
3. The I.D. of the journals was measured with satisfactory results.
4. (later)

Disposition of Inspection Findings

1. The chip on the nozzle was evaluated as not being significant.
2. New bearings will be installed. In addition, a new lubrication system will be installed to prevent recurrence of this problem.

Catawba Diesel 1A Inspection Report

Part Name: Turbocharger Air Butterfly Valve Class: A

Part No.: 02-475B

Work Request No.: 0775 MNT

No. of Separate Inspections: 14

Attributes Verified and Sample Size

1. Perform disassembly inspection per 11.3, ref. 2, 2 insp.
2. Visual inspect roll pins per 11.3.2, ref. 1, 8 insp.
3. Visual inspect valve shaft per 11.3.3, ref. 1, 2 insp.
4. Check to ensure no cold springing required on reassembly per 11.3.4, ref. 1, 2 insp.

References

1. MP/0/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection
2. MP/0/A/1000/22 Diesel Engine Air Butterfly Valve Removal Disassembly, Reassembly and Inspection

Inspection Results

1. Disassembly of the butterfly valve was done according to procedure, and revealed no problems
2. Visual inspections of roll pins were satisfactory.
3. Visual inspections of the shafts indicated they were satisfactory.
4. Checks of cold spring indicated that the piping was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1A Inspection Report

Part Name: Turbocharger Bracket

Class: B

Part No.: 02-475A

Work Request No.: 0775 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visually inspect support bracket per 11.4.2, ref.1, 1 insp.

References

1. MP/0/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Visual inspection of turbocharger bracket shows no signs of distress or distortion.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1A Inspection Report

Part Name: Turbocharger Bracket Bolting

Class: B

Part No.: 02-475D

Work Request No.: 0775 MNT

No. of Separate Inspections: 20

Attributes Verified and Sample Size

1. Measure breakaway torque per 11.5.2, ref. 1, 6 insp.
2. Material comparator test per 11.5.3, ref. 1, 6 insp.
3. Visual inspect bolted joint per 11.5.4, ref. 1, 2 insp.
4. Check torque on reassembly per 11.5.5, ref. 1, 6 insp.

References

1. MP/0/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Breakaway torque of turbocharger bracket bolts ranged from 0 to 250 ft-lbs.
2. Material comparator test of turbocharger bracket bolts were acceptable.
3. Visual inspection of the bolt joint was satisfactory.
4. The turbo bracket bolts were reinstalled according to procedure.

Disposition of Inspection Findings

1. Several of the bracket bolts were found to have low torques. All of the bolts will be checked and bolts with low torques will be retorqued using a torque wrench and loctite.

Catawba Diesel IA Inspection Report

Part Name: Intercooler

Class: B

Part No.: F-086

Work Request No.: 0775 MNT

No. of Separate Inspections: 8

Attributes Verified and Sample Size

1. Visual inspection of intercooler and inlet and outlet adaptors per 11.6.2, ref. 1, 6 insp.
2. Perform PT or MT exam of each intercooler inlet adaptor flange weld per 11.6.3, ref. 1, 2 insp.

References

1. MP/0/A/1000/18 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Visual inspection of the intercooler was satisfactory.
2. MT examination of the weld was satisfactory

Disposition of Inspection Findings

There were no significant findings

Catawaba Diesel 1A Inspection Report

Additional Inspections to be Performed After Diesel Reassembly

<u>Part No.</u>	<u>Part Name</u>	<u>Proc.No.</u>	<u>Inspection to be perf.</u>	<u>#insp.</u>
00-700A	Jacket water stdpipe fittings and gasket	25	Visual inspect system	1
00-700C	Jacket water stdpipe supports	25	Visual inspect supports	1
02-316A	Jacket water manifold assembly	25	Visual inspect system	1
00-700F	Jacket water stdpipe bolting materials	25	Visual inspect bolting	1
02-316B	Jacket water inlet manifolds	25	Visual inspect coupling	1
02-317C	Jacket water discharge manifolds	25	Visual inspect supports	1
02-317B	Jacket water manifold coupling	25	Visual inspect coupling	1
02-437A	Turbo cooling water pipe and fittings	25	Visual inspect system	1
02-437B	Turbo cooling water supports	25	Visual inspect supports	1
02-441A	Start air manifold tubing and fittings	26	Visual inspect system	1
02-441C	Start air manifold pipe supports	26	Visual inspect supports	1
02-442B	Start air distributor tubing, fitngs & gskts	26	Visual inspect tubing	1
02-450B	Fuel oil piping and tubing	27	Visual inspect system ECT inspect HP lines	1 16
02-450D	Fuel oil piping supp	27	Visual inspect supports	1
02-455C	Fuel oil filter mounting hrdwre	27	Visual insp. mntg hardware	1
02-688A	Engine and aux mod wiring conduit	29	Visual insp conduit	1
02-695A	Engine shutdown tbng and fittings	29	Visual insp engine mounted tubing	1
02-467A	Turbo L.O.piping	10	Visual inspect piping	1
02-467B	Turbo L.O.supports	10	Visual inspect supports	1
02-CFR	Turbo thrust bearing L.O. system	10	Visual inspect system	1

* Nos. shown are the last two digits of procedure MP/0/A/1000/XX

APPENDIX B

ENGINEERING VALIDATION REPORT

SELECTED CATAWBA 1A DIESEL PARTS

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>
B1.0	Introduction
B2.0	Identification of Parts
B3.0	Detailed Review of Part Validation
B4.0	References

Tables

B2-1	List of Parts Covered by Engineering Validation Review
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The purpose of this report is to document the results of the engineering validation performed for selected parts of the Catawba 1A Diesel. The parts were selected for this review if their quality was not being verified by detailed inspections. This validation was performed for the parts listed in Table B2-1; Information for the validation was obtained by visual observation of the parts, review of test results, review of maintenance records, and discussions with operating and maintenance personnel regarding performance of the parts. An engineering evaluation was then performed of this information to assess the condition and quality of the parts.

The detailed results of this review are presented in Section B3.0.

Identification of Parts

The parts covered by this review are listed in Table B2-1. Parts were listed in Table B2-1 if they met the following criteria:

- * The parts are identified as category A or B per reference 1 (or approved modifications); and
- * The quality of the parts is not being verified as part of detailed inspections (e.g., per Catawba Special Inspection Procedures MP/0/A/1000/01 through 18); and
- * The quality of the parts is not being verified as part of piping installation checks covered by Catawba Special Inspection Procedures MP/0/A/1000/25 through 29).

In essence, the parts listed in Table B2-1 are intended to cover items important to operability of the diesels but which have not been covered by detailed inspections because no specific need for inspection was developed owing to failure history or general diesel experience.

TABLE B2-1

List of Parts Covered by Engineering Validation Review

<u>Part No.</u>	<u>Part Name</u>	<u>Class</u>
00-420	LUBE OIL PRESSURE REGULATING VALVE	A
00-700B	JACKET WATER STANDPIPE VALVES	B
00-700E	JACKET WATER STANDPIPE SWITCHES	B
02-311D	CRANKCASE MOUNTING HARDWARE	B
02-315B	CAM BEARING CAPS AND DOWELS	B
02-315E	CYLINDER BLOCK STRUCTURAL BOLTS	B
02-315G	CYLINDER BLOCK SEALS AND GASKETS	B
02-330A	FLYWHEEL	A
02-345C	FUEL PUMP BASE	B
02-360C	CYLINDER HEAD BOLTING AND GASKETS	B
02-365A	FUEL INJECTION PUMP	B
02-365B	FUEL INJECTION TIPS	B
02-410A	GOVERNOR - OVERSPEED TRIP	A
02-410D	OVERSPEED TRIP VENT VALVES	A
02-415A	SPEED REGULATING GOVERNOR	A
02-415B	GOVERNOR BOOSTER SERVOMOTOR	B
02-420	LUBE OIL PUMP	A
02-441B	START AIR MANIFOLD VALVES, STRAINERS, FILTERS	A
02-445	FUEL OIL BOOSTER PUMP	A
02-455A	FUEL OIL FILTERS	B
02-455B	FUEL OIL STRAINERS	B
02-465C	EXTERNAL LUBE OIL VALVES	A
02-500A	CONTROL PANEL CABINET	A
02-500F	CONTROL AIR ACCUMULATOR	A
02-500G	CONTROL AIR SYSTEM VALVES	A
02-500H	CONTROL AIR SYSTEM PRESSURE SWITCHES	B
02-500J	CONTROL SYSTEM RELAYS	A
02-500K	CONTROL SYSTEM SOLENOID VALVES	A
02-500N	CONTROL PANEL WIRING	A
02-550	FOUNDATION BOLTS AND ANCHORS	B
02-630D	INSTRUMENTATION THERMOCOUPLES	B
02-688B	ENGINE AND AUX MODULE WIRING	A
02-688C	ENGINE AND AUX MODULE WIRING BOXES	A
02-689	OFF ENGINE SAFETY ALARM SENSORS-WIRING	B
02-690	ENGINE ALARM SENSORS	B
02-691A	OFF ENGINE SAFETY ALARM SENSORS-SWITCHES	B
02-695B	ENGINE SHUTDOWN VALVES, REGULATORS, ORIFICES	A
02-695C	ENGINE SHUTDOWN TRIP SWITCHES	A
02-825D	FUEL OIL DUPLEX STRAINER	B

Table B2-1 cont.

C 136/40	THERMOSTATIC VALVE	B
CN-106	INTAKE AIR FILTER	B
CN-107	INTAKE AIR SILENCER	B
CN-109	BEFORE AND AFTER LUBE OIL PUMP	A
CN-110	FUEL FLOW LUBE OIL FILTER	A
CN-111	LUBE OIL HEAT EXCHANGER	B
CN-119A	GENERATOR SHAFT AND BEARINGS	A
CN-120	JACKET WATER HEAT EXCHANGER	B
CN-122	OIL PRELUBE FILTER	A
CN-131	LUBE OIL KEEPWARM STRAINER	A
F-068	INTERCOOLER	B
SE-025	LUBE OIL FULL PRESSURE STRAINER	A

83.0

Detailed Review of Part Validation

This section contains the results, detailed review and engineering validation of the quality of parts indentified as requiring quality validation per Section 1.0.

It should be noted that the "visual observation" listed in this section was not done using detailed checklists and quantified acceptance criteria. Rather, it was a brief qualitative engineering scan directed at detecting obvious abnormalities.

B3.1

Part No.: 00-420

Part Name: Lube Oil Pressure Regulating Valve

Function: This valve controls lube oil pressure.

Drawings: TDI Drawing 00-420-01, Valve Assembly-Pressure Regulator

Operating History: This valve has performed satisfactorily with no reported problems.

Maintenance History: Valve was disassembled and adjusted prior to initial diesel operation at Catawba per recommendations of TDI representative. No unscheduled maintenance has been required.

Visual Observation: The valve was visually observed by J. Gorman on May 10, 1984 and found to be of the type shown on TDI drawing 00-420-01. No abnormal conditions were noted.

Conclusions: Pressure regulating valve 00-420 is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.2

Part No.: 00-700B

Part Name: Jacket Water Standpipe Valves

Function: These valves serve to isolate the jacket water standpipe when needed.

Drawings: TDI drawing 100546, Jacket Water Piping Schematic

Operating History: These valves have performed satisfactorily with no reported problems.

Maintenance History: No maintenance has been performed on these valves.

Visual Observation: The valve installations were observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusions: The valves are considered to be satisfactory as demonstrated by the absence of any reported problems and the satisfactory operating history of the jacket water system for extended periods of operation.

B3.3

Part No.: 00-700E

Part Name: Jacket Water Standpipe Switches

Function: The jacket water standpipe is a pressure switch which indicates a low level of water in the jacket water standpipe.

Drawings: TDI drawing No. 09-691-75017

Operating History: Tubing to the switch has clogged several times due to precipitation of chromates. The tubing is not considered part of the jacket water standpipe switch, and was supplied by Duke Power Company. Periodic inspection and maintenance has corrected this situation.

Visual Observations: Since no problems with the switch itself have been reported, observation of this device is not considered appropriate.

Conclusions: The jacket water standpipe switch, Part No. 00-700E, is considered to be satisfactory for its intended service by the absence of any reported problems with the switch and its satisfactory performance for extended periods of operation.

B3.4

Part No.: 02-311D

Part Name: Crankcase Mounting Hardware

Function: This hardware consists of the main crankcase studs, nuts and washers (parts 19, 20, 21, 22, 23, and 29 on TDI drawing 02-311-03) and capscrews (part 18 on TDI drawing 02-311-03). The main studs serve to hold the crankcase to the base, while the capscrews serve to clamp the crankcase seal.

Drawings: TDI drawing 02-0311-03 , Crankcase Assembly

Operating History: This hardware has performed satisfactorily without adjustment since initial delivery from TDI.

Maintenance History: No maintenance has been performed on this hardware. No adjustment has been required since initial delivery from TDI.

Visual Observation: The hardware was visually observed on May 2, 1984 by J. Gorman, and was found to all be properly in place and of the type shown on the drawing.

Conclusion: The crankcase mounting hardware is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

Part No.: 02-315B

Part Name: Cam Bearing Caps and Dowels

Function: This hardware consists of the bearing assemblies used to position the camshafts in the crankcase assembly.

Drawings: TDI Drawing 02-311-03, Crankcase Assembly

Operating History: This hardware has performed satisfactorily since initial delivery as evidenced by inspection of the camshafts after 810 hours of operation. Camshafts showed no wear of cam lobes, hence cam bearings are fulfilling their function.

Maintenance History: No maintenance has been performed or required on this hardware.

Visual Observation: Due to camshaft inspection results, no visual observation of the cam bearings is required.

Conclusions: The cam bearing caps and dowels are considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.6

Part No.: 02-315E, 02-315G

Part Name: Cylinder Block Seals, Gaskets and Structural Bolts

Function: The cylinder block seals and gaskets provide:

1. An oil seal between the cylinder block and crankcase (part 8 of TDI drawing 02-315-04)
2. A water seal between the cylinder block and cylinder liner (part 6 of TDI drawing 02-315-5001); and
3. A seal between the cylinder block and water manifold (part 14 of TDI drawing 02-315-5001).
4. The bolts serve as structural bolting holding the cylinder block to the crankcase. (Part 10 of TDI drawing 02-315-04)

Drawings: TDI drawings 02-315-04, Cylinder Block Assembly, and 02-315-5001, Cylinder Block and Liner Assembly.

Operating History: The cylinder block to crankcase bolts and oil seal have performed satisfactorily without any evidence of oil leakage. The water seals are hydrostatically tested after each reassembly to ensure that there is no water leakage. All o-rings and gaskets are replaced each time the joint is disassembled.

Maintenance History: No corrective maintenance has been performed on any of the joints. The cylinder block to crankcase oil seal and bolts have not been disturbed since shipment in the assembled condition from TDI. As stated above the o-rings and gaskets are replaced each time a water joint is disassembled.

Visual Observation: These parts are inaccessible for visual observation.

Conclusions: The cylinder block bolts, seals and gaskets are considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.7

Part No.: 02-330A

Part Name: Flywheel

Function: The flywheel provides rotating momentum for smooth operation of the diesel engine.

Drawings: TDI drawing 101505, Flywheel Assembly

Operating History: The flywheel has performed satisfactorily during engine operation.

Maintenance History: No maintenance has been performed on this part.

Visual Observation: The flywheel was visually observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusion: The flywheel is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.8

Part No.: 02-345C

Part Name: Fuel Pump Base Assembly

Function: This assembly provides a base to which the fuel injection pump is attached.

Drawings: TDI drawings 02-345-05, Tappets and Guides; and 02-345-3443, Base Assembly-Fuel Pump.

Operating History: The fuel pump base assemblies have performed satisfactorily as evidenced by the satisfactory operation of the fuel injection pumps during engine operation. No problems have been reported for this part.

Maintenance History: No maintenance has been performed on the fuel pump base assemblies. The assemblies have not been disturbed since initial delivery from TDI.

Visual Observation: A sample of bases was visually observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusions: The fuel pump base assemblies are considered to be satisfactory as demonstrated by satisfactory performance of the fuel injection pumps for extended periods of operation.

B3.9

Part No.: 02-360C

Part Name: Cylinder Head Bolting

Function: This bolting attaches the subcover assemblies to the cylinder heads.

Drawings: TDI drawing 02-362-04, Covers Assembly-Cylinder Head

Operating History: The cylinder head bolting has performed satisfactorily as evidenced by the satisfactory functioning of the intake valves, exhaust valves, and rocker arms that attach to the subcover assemblies.

Maintenance History: No maintenance has been performed on the cylinder head bolting. No cylinder head bolting has been replaced.

Visual Observation: A sample of this bolting was visually observed on May 11, 1984, by J. Gorman and appeared normal.

Conclusion: The cylinder head bolting is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.10

Part No.: 02-365A

Part Name: Fuel Injection Pump

Function: The fuel injection pump increases fuel oil pressure to inject it into the cylinder. It is operated by tappet motion induced by camshaft rotation.

Drawings: TDI drawing 02-365-01, Fuel Injection Equipment

Operating History: The valve holder of one fuel injection pump cracked. Consequently, the valve holder of each pump was ultrasonically inspected and tested for hardness as part of the inspection program. Otherwise, the fuel injection pumps have operated satisfactorily with no other problems reported.

Maintenance History: The only maintenance performed on the fuel injection pumps has consisted of:

1. Replacement of the pump with the cracked valve holder as identified above, and
2. disassembly of all 16 pumps prior to engine operation to ensure that the pumps were free from gummy fuel oil residues after long periods (well over one year) of inoperation.

Visual Observations: Several pumps were visually observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusions: The fuel injection pumps are considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.11 Part No.: 02-365B

Part Name: Fuel Injection Tips

Function: The fuel injection tips spray high pressure fuel oil into the cylinders.

Drawings: TDI drawing 02-365-01, Fuel Injection Equipment

Operating History: These tips have performed satisfactorily with no problems.

Maintenance History: The tips have been periodically removed for routine cleaning.

Visual Observation: One tip was visually observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusion: The tips are considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.12

Part No.: 02-410A

Part Name: Governor - Overspeed Trip

Function: The overspeed trip governor senses engine speed (revolutions) by direct mechanical coupling to the drive train of the engine. When the engine speed exceeds the setting on the device, the centrifugal force of the internal flyweights actuate a lever which causes a vent valve to open in the control air system, and shutdown the engine via the auto shutdown cylinder.

Drawings: Woodward Bulletin No. 04026A

Operating History: The overspeed trip governor has demonstrated satisfactory performance since initial adjustments were made during startup. No further adjustments have been required.

Maintenance History: No maintenance has been performed or been required on the overspeed trip governor since initial adjustments were made during startup.

Visual Observations: The overspeed trip governor has been completely removed from the engine for the inspection of the drive mechanism as required by Special Inspection Procedure No. MP/O/A/1000/16. No abnormal conditions have been reported.

Conclusions: The overspeed trip governor is considered to be satisfactory as demonstrated by its satisfactory performance during extended periods of operation.

B3.13

Part No.: 02-410D

Part Name: Overspeed Trip Vent Valves

Function: Upon actuation by the governor overspeed trip mechanism (Woodward Governor), the overspeed trip vent valves vent the control air thus causing actuation of the fuel shutdown cylinder, tripping the engine.

Drawings: Amot Controls Corp. Form 675, Rev. 1, Model 4095B Vent valve.

Operating History: This vent valve has performed satisfactorily with no reported problems.

Maintenance History: No maintenance has been performed on these vent valves.

Visual Observation: No visual observation of these valves have been made.

Conclusion: The overspeed trip vent valves are considered to be satisfactory for intended service as demonstrated by satisfactory performance for extended periods of operation.

B3.14

Part No.: 02-415A

Part Name: Speed Regulating Governor

Function: The speed regulating governor controls the engine speed by regulating the fuel supply based on load demand on the generator (via an electrohydraulic actuator) and current engine speed (via direct mechanical coupling to the drive train and internal flyweights).

Drawings: Woodward Bulletin No. 25004H

Operating History: Over all, the speed regulating governor has performed satisfactorily. An adjustment to set droop at 5 % was made by the Woodward factory service representative during the extended run test (2-21-84). No other adjustments have been required since startup.

Maintenance History: No maintenance has been performed on the speed regulating governor other than the factory representative adjustment described above.

Visual Observation: The speed regulating governor has been disassembled to the extent necessary to perform the inspection on the drives as required by Special Inspection Procedure MP/O/A/1000/16. No abnormalities have been reported.

Conclusions: The speed regulating governor is considered to be satisfactory as demonstrated by its satisfactory performance for extended operating periods.

B3.15

Part No.: 02-415B

Part Name: Governor Booster Servomotor

Function: The governor booster servomotor aids in starting the engine by using starting air to increase governor oil pressure which in turn results in the governor engine going to the full fuel on position.

Drawings: Woodward Service Bulletin 36684 B and TDI dwg. 101414

Operating History: This servomotor has performed satisfactorily with no reported problems.

Maintenance History: No maintenance has been performed on this part.

Visual Observation: No visual observations have been accomplished.

Conclusion: The governor booster servomotor is considered to be satisfactory for its intended service as demonstrated by satisfactory performance for extended periods of operation.

B3.16

Part No.: 02-420

Part Name: Lube Oil Pump

Function: This pump is a diesel engine attached pump that supplies engine lube oil during engine operation.

Drawings: TDI drawings 02-420-2674, Pump Assembly-Lube Oil, and Figure titled "Model 35K-437 IMO Lube Oil Pump" in Volume III of the TDI diesel manual.

Operating History: The lube oil pump has performed satisfactorily as evidenced by the satisfactory operation of the lube oil system. No engine bearings show degradation resulting from a lack of lube oil during diesel operation.

Maintenance History: No maintenance has been performed on the lube oil pump.

Visual Observation: The lube oil pump was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusion: The lube oil pump is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

Part No.: 02-441B

Part Name: Starting Air Manifold Valves, Strainers and Filters

Function: Starting air is used to turn the engine during startup. The starting air system is comprised of the starting air manifolds, manifold valves, strainers and filters, starting air distributors, piping from the distributors to the air start valves and the air starting valves. Inspections for various parts of the starting air system are as follows: Starting Air Manifold and Distributor Piping (Procedure MP 0/A/1000/26); Air Starting Valves (Procedure MP 0/A/1000/04); and Starting Air Distributor (Procedure MP 0/A/1000/12). Hence, this engineering validation is limited to the manifold valves, strainer, and fillets.

Drawings: TDI drawing 101815, Starting Air Manifold (Valves and Strainers), and TDI drawing 51825, Tubing Arrangement Starting Air Distributor (Filter).

Operating History: The starting air manifold valves, strainers and filters have performed satisfactorily with no problems.

Maintenance History: No maintenance other than periodic cleaning as part of routine maintenance procedures have been performed on these items.

Visual Observation: The components listed on the attachment were observed by R. Reyns on May 23, 1984 with the results indicated on the attachment.

Conclusion: The starting air manifold valves, strainers, and filters are considered to be satisfactory as demonstrated by extended periods of satisfactory operation.

Attachment to B3.17

Manufacturer Part No.	Description	Qty.	Visual Observations
KE-800-000	Check Valve-3"	4	Valves were observed to be of the type shown on the reference Drawing. No abnormal conditions were noted other than the absence of factory "Blue" paint.
SE-007-001	Strainer	4	Strainers were observed to be of the type shown on the reference drawing. No abnormal conditions were noted.
KR-002-000	Valve, Air Start	4	Valves were observed to be of the type shown on the reference drawing. No abnormal conditions were noted.
SB-006-000	Filter (Air Supply Line to Distributor)	2	Filters were observed to be of the type shown on the reference drawing. No abnormal conditions were noted. It was noted that some pipe fittings had been replaced.
F-573-413	Valve, Shuttle	1	The shuttle valve to the governor oil boost was observed to be the type designated on parts list 02-441 for 75017. No abnormal conditions were noted.
F-573-348	Valve, Check	2	The check valve on the line to the starting air distributors were observed to be the type designated on Parts List 02-441 for 75017. No abnormal conditions were noted.

B3.18

Part No.: 02-445

Part Name: Fuel Oil Booster Pump

Function: The fuel oil booster pump transfers fuel oil from the day tank to the diesel.

Drawings: 02-445-06, Fuel Oil Booster Pump

Operating History: The fuel oil booster pump has performed satisfactorily as evidenced by the satisfactory diesel engine operation for extended periods.

Maintenance History: No major maintenance has been performed on this pump, other than tightening a fitting to correct a leakage problem. (Ref. W.R. No. 8058 OPS, 2-2-84).

Visual Observations: The fuel oil booster pump was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The fuel oil pump is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.19

Part No.: 02-455A

Part Name: Fuel Oil Filter

Function: This filter is a duplex cartridge filter which removes particles from the fuel oil prior to its introduction to the fuel oil headers.

Drawings: The Hilliard Corp. Drawing DD-297-46, and TDI drawing 09-825-75017-H, Fuel Oil Piping Schematic

Operating History: The fuel oil filter has performed satisfactorily as evidenced by the satisfactory performance of the fuel oil system and the diesel engine.

Maintenance History: No corrective maintenance has been required. Filters are periodically replaced as needed based on increasing pressure drop.

Visual Observations: The installation of the filter was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The fuel oil filter is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.20

Part No.: 02-455B

Part Name: Fuel Oil Strainers

Function: These strainers filter the fuel oil to the fuel oil booster pump.

Drawings: Air Maze Drawing R9W1752 and TDI drawing 09-825-75017-H, Fuel Oil Piping Schematic

Operating History: The fuel oil strainer has performed satisfactorily as evidenced by the satisfactory performance of the fuel oil system and the diesel engine.

Maintenance History: The only maintenance required has been to periodically clean the filter elements.

Visual Observation: The installation of the strainer was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The fuel oil strainer is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.21

Part No.: 02-465C

Part Name: External Lube Oil Valves

Function: These valves are used to direct lube oil flow, isolate components, etc.

Drawings: TDI drawing 09-820-75017-E, Lube Oil Piping Schematic

Operating History: These valves have operated satisfactorily with no problems.

Maintenance History: No maintenance has been required.

Visual Observation: These valves were observed by J. Gorman on May 10, 1984 and appeared normal.

Conclusions: These valves are considered to be satisfactory as demonstrated by satisfactory performance during extended operation.

B3.22

Part No.: 02-500A

Part Name: Control Panel Cabinet

Function: The control panel cabinet houses essential control components for both off-engine electrical and off-engine pneumatic systems and provides barriers between Class 1E circuits and components within the cabinet and non 1E circuits and components.

Drawings: TDI drawing 52213

Operating History: No problems have been encountered with the panel.

Maintenance History: No maintenance has been done on the panel.

Visual Observation: Since the panel has had no maintenance or operating problems, no visual observations were deemed necessary.

Conclusion: The control panel cabinet, Part No. 02-500A, is considered to be satisfactory for its intended service as demonstrated by satisfactory performance.

B3.23

Part No.: 02-500F

Part Name: Control Air Accumulator

Function: The Control Air Accumulator acts as a timing device for some engine pneumatic control functions. Control air is admitted to these devices allowing a time delay for pressure to build which will then actuate other pressure activated devices in the pneumatic control system.

Drawings: There are no drawings available describing the accumulators. The capacity and circuit locations are described on TDI Drawing 52216, Panel Pneumatic Schematic.

Operating History: The three control air accumulators have performed satisfactorily with no reported problems.

Maintenance History: No maintenance has been performed on the control air accumulators.

Visual Observations: No visual observations have been accomplished as a part of this engineering validation.

Conclusions: The control air accumulators, part no. 02-500F, are considered to be satisfactory for their intended service as demonstrated by their satisfactory performance for extended periods of operation.

Part No.: 02-500G

Part Name: Control Air System Valves

Function: The control air system valves open and close upon a signal (pneumatic) from the pneumatic shutdown logic board, either permitting the engine to start and run or trip the engine by actuating the auto shutdown cylinder.

Drawings: TDI Drawings 52216, Panel Pneumatic Schematic, and 52215, Engine Pneumatic Schematic.

Operating History: Most of the control air system valves have performed satisfactorily with no maintenance required. One shuttle valve in the low low lube oil pressure circuit periodically stuck, preventing the engine from starting. This was corrected by replacing the valve.

Maintenance History: Other than the valve replacement described above, no maintenance has been required on the control air system valves.

Visual Observation: Visual observations have not been conducted as a part of the engineering validation.

Conclusions: These valves are considered to be satisfactory for their intended service as demonstrated by satisfactory performance for extended periods of operation.

Note-This review and discussion applies only to control air valves essential for engine operation and engine trip.

B3.25

Part No.: 02-500H

Part Name: Control Air System Pressure Switches

Function: The control air system pressure switches open and close depending on control air pressure in the pneumatic control system. These devices are also actuated by control air and serve both control system functions and supervisory functions.

Drawings: TDI drawing 52216, Panel Pneumatic Schematic

Operating History: All pressure switches have demonstrated satisfactory performance with no problems.

Maintenance History: No maintenance has been performed on the control air system pressure switches.

Visual Observation: As the pressure switches have operated satisfactorily, no visual observation was deemed necessary for this engineering evaluation.

Conclusion: The control air system pressure switches are considered to be satisfactory for their intended service as demonstrated by their satisfactory performance during extended operation.

B3.26

Part No.: 02-500J

Part Name: Control System Relays

Function: The Control System Relays provide electrical signals to various elements of the engine control system.

Drawings: TDI Drawing 52218, Panel Electrical Schematic.

Operating History: The control system relays have demonstrated satisfactory performance with no problems since modifications were made to the control panel wiring. (See Part No. 02-500N)

Maintenance History: There has been no required maintenance on these relays since the wiring modification.

Visual Observation: No visual observations were conducted as part of this engineering validation.

Conclusion: The control system relays are considered to be satisfactory for their intended service as demonstrated by their satisfactory performance during extended operation since the wiring modification.

B3.27

Part No.: 02-500K

Part Name: Control System Solenoid Valves

Function: The control system solenoid valves open or close when energized by the pneumatic or electrical control system, permitting the flow of control air in the system.

Darwings: TDI Drawing 52216, Panel Pneumatic Schematic, and 52218, Panel Electrical Schematic.

Operating History: The control system solenoid valves have performed satisfactorily with no problems.

Maintenance History: No maintenance has been required or performed on the control system solenoid valves.

Visual Observation: No visual observations were conducted as part of this engineering validation.

Conclusion: The control system solenoid valves are considered to be satisfactory for their intended service as demonstrated by their satisfactory performance during extended operation.

B3.28

Part No.: 02-500N

Part Name: Control Panel Wiring

Function: The control panel wiring interconnects the electrical components in the control panel system.

Drawings: TDI Drawing 52218, Panel Electrical Schematic and the attached listing of Duke Power Co. drawings.

Operating History: The control panel wiring was extensively modified by Duke Power Company at installation, startup and check out. Panel wiring changes installed by Duke Power Co. under their quality assurance system are documented in Duke Power Co. drawings listed in the attachment. Since these modifications, the wiring has performed satisfactorily and required no maintenance.

Maintenance History: No maintenance has been required or been performed since the modifications to the control panel wiring.

Visual Observations: No visual observations of the control panel wiring were made during this engineering validation as Duke Power Co. Quality Assurance has inspected all wiring modifications.

Conclusion: The control panel wiring is considered to be satisfactory as demonstrated by the absence of problems for an extended period of operation.

ATTACHMENT TO B3.28

Duke Power Company Elementary Diagrams updated for Control Panel Wiring changes:

CNEE-0120-01.01-01
CNEE-0120-01.01-02
CNEE-0120-01.01-03
CNEE-0120-01.01-04
CNEE-0120-01.01-05
CNEE-0120-01.01-06
CNEE-0120-02.01
CNEE-0120-02.01-01
CNEE-0120-03.01
CNEE-0120-04.01
CNEE-0120-04.01-01
CNEE-0120-04.01-02
CNEE-0120-05.01
CNEE-0120-05.01-02
CNEE-0120-05.01-03
CNEE-0120-05.01-04
CNEE-0120-05.01-05
CNEE-0120-05.01-06
CNEE-0120-05.02-01
CNEE-0120-06.01
CNEE-0120-07.01
CNEE-0120-07.01-01
CNEE-0120-07.01-03

B3.29

Part No.: 02-550

Part Name: Foundation Bolts and Anchors

Function: The foundation bolt and anchor assemblies serve to fasten the diesel base to the diesel room floor structure.

Drawings: TDI drawings 02-550-03, Engine Mounting; and 00-550-6005, Anchor, Foundation Bolt, Front and Rear

Operating History: These bolts and anchors have performed satisfactorily with no problems.

Maintenance History: No maintenance has been required.

Visual Observations: All of the bolts were observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The foundation bolts and anchors are considered to be satisfactory as demonstrated by the absence of problems for an extended period of operation.

Part No.: 02-630D

Part Name: Instrumentation Thermocouples

Function: The instrumentation thermocouples sense the temperatures in the lube oil system, jacket water system and exhaust system and provide signals to the control panel, giving indications and activating annunciators where appropriate. The thermocouples cannot cause the engine to trip or to fail to start on an emergency signal.

Drawings: TDI Drawing 09-688-75017, Engine Electrical Diagram and Schematic, and 09-691-75017, Off-Engine Electrical.

Operating History: Instrumentation thermocouples have indicated erroneous readings when the engine heated up at full load (jacket water and lube oil), and read accurately at slightly below full load. This situation was corrected by replacing the thermocouples. The replacement thermocouples have performed satisfactorily.

Maintenance History: Other than the replacements described above, no other maintenance has been performed of the instrumentation thermocouples.

Visual Observation: No visual observations have been made.

Conclusion: The instrumentation thermocouples are considered satisfactory for their intended service as demonstrated by their satisfactory performance (since replacement) for extended periods of operation.

B3.31

Part No.: 02-688B

Part Name: Engine and Auxiliary Module Wiring

Function: The engine and auxiliary module wiring connects the engine electrical sensors to the termination boxes. Also, power is provided to the engine electrical controls (solenoids, etc.) via this wiring.

Drawings: TDI drawing 09-688-75017, Engine Electrical Diagram and Schematic

Operating History: The engine and auxiliary module wiring have performed satisfactorily and required no maintenance.

Maintenance History: No maintenance has been required or performed on the engine and auxiliary module wiring.

Visual Observation: The engine and auxiliary module wiring was inspected by representatives of the diesel generator Owners Group during the week of May 7, 1984. Their report is expected to be available on June 15, 1984.

Conclusion: Preliminary conclusions indicate that the engine and auxiliary wiring is satisfactory for its intended service as demonstrated by its satisfactory performance during extended periods of operation.

B3.32

Part No.: 02-688C

Part Name: Engine and Auxiliary Module Wiring Boxes

Function: These boxes serve as termination points for the engine and auxiliary module wiring, via the engine mounted conduit. These boxes are connected to the control panel via Duke Power supplied conduit.

Drawings: TDI Drawing 09-688-75017, Engine Electrical Diagram and Schematic

Operating History: The engine and auxiliary module wiring boxes have performed satisfactorily and required no maintenance.

Maintenance History: No maintenance has been required or performed on the engine and auxiliary module wiring boxes.

Visual Observations: The engine and auxiliary module wiring boxes are to be inspected as part of the walkdown of engine conduit, Special Inspection Procedure No. MP/O/A/1000/29.

Conclusions: Preliminary conclusions indicate that the engine and auxiliary module wiring boxes are satisfactory for their intended services as demonstrated by satisfactory performance for extended periods of operation.

B3.33

Part No.: 02-689

Part Name: Off Engine Safety Alarm Sensors-Wiring

Function: The off engine safety alarm sensor wiring connects the sensors which are located off the engine to the local engine control panel. This wiring was supplied by Duke Power Company and is not part of the engineering validation.

B3.34

Part No.: 02-690

Part Name: Engine Alarm Sensors

Function: The engine alarm sensors provide signals to the supervisory alarms on the engine control panel during an emergency startup and run. These alarms do not shut the engine down during an emergency run. The sensors for these alarms are mounted on the engine. These alarms are tabulated in the attachment to this section. Refer to Part No. 02-360D for thermocouples derived from this section.

Drawings: TDI drawings 52218, Panel Electrical Schematic, 52216, Panel Pneumatic Schematic, and 52215, Engine Pneumatic Schematic.

Operating History: The engine alarm sensors have performed satisfactorily and required no maintenance.

Maintenance History: No maintenance has been performed on the engine alarm sensors other than thermocouples. (See Part No. 02-360D)

Visual Observation: No visual observation has been made.

Conclusion: The engine alarm sensors are considered satisfactory for their intended service as demonstrated by their satisfactory performance for extended periods of operation.

ENGINE ALARMS

High Differential Pressure Lube Oil Filter
High Differential Pressure Lube Oil Strainer
Low Pressure Lube Oil
Low Temperature Oil Inlet
Low Temperature Oil Outlet
High Temperature Oil Inlet
High Temperature Oil Outlet
Low Pressure Turbo Oil RF
Low Pressure Turbo Oil LF
Fuel Pump Overspeed Drive Failure
High Differential Pressure Fuel Oil Filter
High Differential Pressure Fuel Oil Pump Strainer
Low Pressure Fuel Oil
Low Pressure Jacket Water
High Temperature After Cooler Water In
Low Temperature Jacket Water In
High Temperature Jacket Water In
Exhaust Temperature High/Low
Barring Device Engaged

B3.35

Part No.: 02-691A

Part Name: Off Engine Safety Alarm Sensors-Switches

Function: The off engine safety alarm sensors provide signals to the supervisory alarm annunciators on the engine control panel. These alarms do not trip the engine during an emergency run. The sensors are located off the engine and are tabulated in the attachment to this section. Thermocouple sensors in the attachment are under Part No. 02-630D.

Drawings: TDI drawings 52218, Panel Electrical Schematic, 52216, Panel Pneumatic Schematic, 52215, Engine Pneumatic Schematic, and 09-691-75017, Off Engine Electrical.

Operating History: The off engine safety alarm sensors have performed satisfactorily.

Maintenance History: No maintenance has been performed on the off engine safety alarm sensors.

Visual Observation: Because of their satisfactory past performance and the non-critical nature of these items, visual observation is not required.

Conclusion: The off engine safety alarm sensors and switches are considered to be satisfactory for their intended service, as demonstrated by their satisfactory performance for extended periods of operation.

OFF ENGINE SAFETY ALARM SENSORS

Low Level Lube Oil Tank
High Level Main Fuel Tank
Low Level Main Fuel Tank
Main Fuel Oil Tank Tech. Spec. WARN
High Level Day Tank
Low Level Day Tank
Low Level Jacket Water
Low Temperature Jacket Water Out
High Temperature Jacket Water Out
Panel Intrusion
Aux Equip Not In Auto
Refer To Operational Mode
Building Ventillation Malfunction
High Level Deisel Generator Sump
High High Level Diesel Generator Sump
Unit Failed To Start
Low Pressure Starting Air
Low Pressure Control Air

B3.36

Part No.: 02-695B

Part Name: Engine Shutdown Valves, Regulators, Orifices

Function: The engine shutdown valves, regulators and orifices control the flow of air in the pneumatic shutdown control system on the diesel engine.

Drawings: TDI drawing 52215, Engine Pneumatic Schematic, and 52216, Panel Pneumatic Schematic.

Operating History: During the extended run test, an orifice supplying air to the low low lube oil pressure sensor clogged, causing the pressure sensor to trip the engine. The orifices were cleaned and the engine performed satisfactorily. All other orifices, valves and regulators have demonstrated satisfactory performance requiring no maintenance.

Maintenance History: Other than cleaning the orifices described above, no maintenance has been performed or required on the engine shutdown valves, regulators and orifices.

Visual Observation: No visual observations were made.

Conclusions: The engine shutdown valves, regulators and orifices are considered satisfactory for their intended service as demonstrated by their satisfactory performance for extended periods of operation, with the one exception described above. Preventive maintenance schedules will be reviewed to assure that procedures are being followed to keep the air adequately filtered.

Part Name: Engine Shutdown Trip Switches

Function: The engine shutdown trip switches shut the engine down and annunciate the cause of the trip. During emergency run only three trips shut down the engine, low low lubricating oil pressure, overspeed, and generator to switchgear differential (fault). During manual or remote run, six other trips in addition to the three mentioned above shut the engine down, two low pressure lube oils, high temperature lube oil out, high pressure crankcase, high temperature bearings, high temperature jacket water out, low pressure turbo oil and high vibration. The six manual run trips cannot shut down the engine during an emergency run.

Drawings: TDI drawings 52218, Panel Electrical Schematic, 52216, Panel Pneumatic Schematic and 52215, Engine Pneumatic Schematic.

Operating History: The engine shutdown trip switches have performed satisfactorily requiring no maintenance.

Maintenance History: No maintenance has been performed on the engine shutdown trip switches.

Visual Observation: Because of their satisfactory performance of their function, visual observation of the engine shutdown trip switches is not required.

Conclusion: The engine shutdown trip switches are considered satisfactory for their intended service as demonstrated by their satisfactory performance for extended periods of operation.

B3.38

Part No.: 02-825D

Part Name: Fuel Oil Duplex Strainer

Function: This strainer filters fuel oil which is supplied to the auxiliary (engine mounted) fuel oil pump.

Drawings: TDI drawing 09-825-75017-R, Fuel Oil Piping

Operating History: The duplex strainer has performed satisfactorily as evidenced by the satisfactory performance of the fuel oil system.

Maintenance History: The only maintenance required has been to periodically clean the strainer elements.

Visual Observation: The installation of the strainer was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusion: The fuel oil duplex strainer is considered to be satisfactory as demonstrated by satisfactory performance.

B3.39

Part No.: C 136/40

Part Name: Thermostatic Valve

Function: This valve automatically controls the flow of jacket water through the jacket water heat exchanger in order to control jacket water temperature.

Drawings: TDI drawing 100546, Jacket Water Piping Schematic

Operating History: This valve has worked satisfactorily after an initially incorrect installation direction was corrected.

Maintenance History: No maintenance has been required other than to correct the valve's initially incorrect flow direction.

Visual Observation: The valve was observed by J. Gorman on May 10, 1984 and appeared normal.

Conclusion: The valve is considered to be satisfactory as demonstrated by its satisfactory performance for extended periods of operation.

B3.40

Part No.: CN-106 and CN-107

Part Name: Intake Air Filter

Function: This component serves to filter the intake air.

Drawings: American Air Filter Co. Drawing A-92553

Operating History: The intake air filter has performed satisfactorily as evidenced by the satisfactory operation of the diesel engine.

Maintenance History: Filters have been replaced periodically as required based on pressure drop increases.

Visual Observation: No visual observation was made.

Conclusions: The intake air filter is considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.41

Part No.: CN-107

Part Name: Intake Air Silencers

Function: The silencers minimize noise generated by intake air.

Drawings: None available.

Operating History: There have been no problems with these silencers.

Maintenance History: No maintenance has been required.

Visual Observation: The silencers were observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusion: The silencers are considered to be satisfactory as demonstrated by satisfactory performance for an extended period of operation.

Part No.: CN-109

Part Name: Before and After Lube Oil Pump

Function: This pump provides heated lube oil to the diesel engine parts prior to engine operation and after the engine has "shut" down. This lube oil pump is also known as the keep warm lube oil pump.

Drawings: TDI drawing 09-820-75017-E, Lube Oil Piping Schematic

Operating History: The before and after lube oil pump has performed satisfactorily as evidenced by the satisfactory condition of the diesel engine bearing surfaces. The diesel has experienced a large number of start/stop operations during startup testing.

Maintenance History: The pump motor was replaced due to suspected water damage (W.R. No. 60000PS, 9-6-83).

Visual Observation: The pump installation was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusion: The before and after (keepwarm) lube oil pump is considered to be satisfactory as demonstrated by satisfactory performance during the startup testing start/stop engine operations.

B3.43

Part No.: CN-110

Part Name: Full Flow Lube Oil Filters

Function: These components filter the lube oil at the discharge of the lube oil pump.

Drawings: TDI drawing 09-820-75017-E, Lube Oil Piping Schematic

Operating History: The full flow lube oil filters have performed satisfactorily as evidenced by the satisfactory operation of the lube oil system. No engine bearings showed degradation attesting to the lack of particulate matter in the lube oil.

Maintenance History: No corrective maintenance has been required. Filter elements have been periodically replaced.

Visual Observation: The filter installation was observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The full flow lube oil filters are considered to be satisfactory as demonstrated by satisfactory performance for extended periods of operation.

B3.44

Part No.: CN-111

Part Name: Lube Oil Heat Exchanger (Cooler)

Function: The lube oil heat exchanger serves to cool lube oil to keep it in the desired temperature range.

Drawings: TDI drawings 09-820-75017-E, Lube Oil Piping Schematic; and 100546, Jacket Water Piping Schematic

Operating History: This heat exchanger has performed satisfactorily as evidenced by the satisfactory condition of the diesel bearings, and satisfactory lube oil temperature.

Maintenance History: No maintenance has been required.

Visual Observation: The heat exchanger installation was observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusions: The lube oil heat exchanger is considered to be satisfactory as demonstrated by satisfactory operation for extended periods of operation.

B3.45

Part No.: CN-119 A

Part Name: Generator Shaft and Bearing

Function: The generator shaft and bearing serve to support the generator.

Drawings: None available.

Operating History: No problems have been experienced with the generator shaft and bearing.

Maintenance History: No maintenance has been required except for periodic oil changes. Alignment of the generator shaft is checked during routine web deflection measurements made on the diesel.

Visual Observation: The generator shaft and bearing were observed, to the extent accessible without disassembly, on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The generator shaft and bearings are considered to be satisfactory as demonstrated by satisfactory operation of the generator for an extended period of operation.

B3.46

Part No.: CN-120 (75017-120)

Part Name: Jacket Water Heat Exchanger (Jacket Water Cooler)

Function: This is a shell and tube heat exchanger which serves to cool jacket water during engine operation. Service water is supplied to the tube side to remove heat. A thermostatic 3-way valve directs as much of the jacket water flow as required through the cooler to keep the jacket water at the desired temperature.

Drawings: TDI drawing 100546-F, Jacket Water Piping Schematic (no part drawing is available)

Operating History: This heat exchanger has performed satisfactorily (except for one minor head to shell gasket leak - see below) as evidenced by satisfactory jacket water temperatures during diesel operation.

Maintenance History: The head to gasket bolts were retorqued to correct a minor head-shell gasket leak. (The bolts had initially not been torqued to specific values).

Visual Observation: The jacket water heat exchanger installation was observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusion: The jacket water heat exchanger is considered to be satisfactory as demonstrated by satisfactory operation for extended periods of operation.

B3.47

Part No.: CN-122 (75017-131)

Part Name: Oil Prelube Filter

Function: This filter is located downstream of the keepwarm pump and upstream of the keepwarm strainer (CN-131). It serves to filter the keepwarm lube oil (prelube system).

Drawings: TDI drawing 09-820-75017-E, Lube Oil Piping Schematic (no part drawing is available)

Operating History: This filter has performed satisfactorily with no problems.

Maintenance History: No corrective maintenance has been required. The filter element and O-ring seal have been replaced periodically.

Visual Observation: The filter installation was observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusions: The prelube oil filter is considered to be satisfactory as demonstrated by satisfactory operation for extended periods of operation.

B3.48

Part No.: CN-131 (75017-131)

Part Name: Lube Oil Keepwarm Strainer

Function: This strainer is located downstream of the filter on the keepwarm prelube lube oil line. It serves to filter the lube oil prior to its introduction to the main lube oil header.

Drawings: TDI drawing 09-820-75017, Lube Oil Piping Schematic; and Air Maze Drawing "Model 07W231735 Simplex Lube Oil Strainer"

Operating History: This strainer has performed satisfactorily with no problems.

Maintenance History: No corrective maintenance has been required. Periodic strainer cleaning and occasional filter element replacement have been performed.

Visual Observation: The keepwarm strainer installation was observed on May 10, 1984 by J. Gorman and appeared to be normal.

Conclusion: The keepwarm strainer is considered to be satisfactory as demonstrated by extended periods of satisfactory operation.

B3.49

Part No.: F-068

Part Name: Intercoolers

Function: These are air-water heat exchangers located between the turbochargers and the engine intake air manifolds which cool the turbocharged air to the desired temperature.

Drawings: Young Radiator Co. drawing D 264836, Intercooler Assembly

Operating History: The intercoolers have performed satisfactorily with no problems.

Maintenance History: No maintenance has been required.

Visual Observation: The intercoolers were observed on May 10, 1984 by J. Gorman and appeared normal.

Conclusions: The intercoolers are considered to be satisfactory as demonstrated by satisfactory performance for an extended period of operation.

B3.50

Part No.: SE-025

Part Name: Lube Oil Full Pressure Strainers

Function: These two strainers filter the lube oil downstream of the main lube oil filters prior to the lube oil being introduced into the main lube oil headers.

Drawings: TDI drawing 09-820-75017-E, Lube Oil Piping Schematic; and Air Maze drawing E-00736-R9W1752, Strainer, Lube Oil-Simplex

Operating History: These strainers have performed satisfactorily with no problems, as evidenced by the satisfactory condition of the diesel bearings.

Maintenance History: No corrective maintenance has been required. Periodic strainer cleaning and occasional filter element replacement have been performed.

Visual Observation: The lube oil full pressure strainers were observed on May 10, 1984 and appeared to be installed normally.

Conclusion: The lube oil full pressure strainers are considered to be satisfactory as demonstrated by satisfactory performance for an extended period of operation.

References

1. Duke Power Company letter to NRC dated April 5, 1984, Re: Catawba Nuclear Station, Docket Nos. 50-413 and 50-414, forwarding report entitled "Catawba Nuclear Station, Extended Operation Tests and Inspection of Diesel Generators".