CATAWBA NUCLEAR STATION
DIESEL ENGINE 1B COMPONENT REVALIDATION INSPECTION

FINAL REPORT

PREPARED BY
DUKE POWER COMPANY

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1.0 Introduction

This report describes the results of the extended operation test and subsequent inspections and evaluations performed on the Catawba 1B diesel engine. These tests and 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 extended operation test was performed May 30, 1984 to July 9, 1984 and resulted in accumulating a total of about 755 hours of operation on the 1B diesel. The inspections of the 1B diesel engine discussed herein were performed in July through August, 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 and 2 with the exception that link rods and bushings, and related parts, were inspected on a 100% basis rather than on a sample basis. Also, the main bearing journals at three crankshaft locations were added to the inspection plan.

The diesel disassembly, reassembly, and inspections were 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 6.0, Appendix A and are discussed in Section 4.0. 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 was performed and is documented in Appendix B of Section 6.0.

This report on the Catawba 1B diesel inspections covers over all of the inspection plan which includes over 2700 separate inspections. Supplemental inspections of large and small piping, as well as conduit have been performed on behalf of the TDI Owners Group for the Phase II of the Owners Group inspection program and the results of these inspections will be released in their final form early November, 1984.

2.0 Summary and Conclusions

2.1 Overview of Extended Operations Test Results

The extended operation test purpose was to subject diesel 1B to loads equal to or greater than required for emergency power to demonstrate its ability to operate in a reliable fashion. The test was structured so that the diesel has experienced over 10^7 stress cycles (about 740 hours of operation) at its completion. This stress cycle magnitude empirically demonstrates the fatigue adequacy of iron and steel parts.

As noted in Section 3 of this report, the 1B diesel extended operation was initiated on May 30, 1984 and completed on July 9, 1984. During the test about 504 hours of documented run time were put on the engine with approximately 97% of this above that required for ESF or blackout load conditions. With the time accumulated prior to the extended operation test, diesel 1B has about 755 hours of total operation at Catawba.

The extended operation test of diesel 1B successfully demonstrated that the engine will meet the emergency and blackout load and duration requirements at Catawba. The several minor problems experienced during the test did not prevent the engine from deliverying the maximum emergency/blackout load of 5600 kw. The minor problems associated with the engine were:

- Fuel pump delivery valve block cracks that reduced the power on a cylinder. During an emergency, the other cylinders would pickup the load.

- Low pressure lube oil trips due to switching a filter. This low pressure trip is not operational during emergency run conditions and hence would not impair diesel operability.

- Turbochargers were replaced due to worn thrust bearings, even though the worn bearings had not caused any operation problems. The bearing wear is gradual and due to lack of lubrication during startup. A prelube modification has been added to the engine which will reduce this wear.

- Cylinder head jacket water leaks were experienced. These leaks do not effect engine operability since they leak out of the engine to the ambient. The engine was run with these leaks for days prior to replacement.

- An intercooler jacket water pipe weld broke causing seepage of jacket water to the ambient. This condition was in evidence for several days prior to shutdown for other reasons when it was repaired.

- A turbocharger adapter flange weld cracked allowing a minor amount of intake air to escape to ambient. The engine was run for days with this condition with no measureable affect on diesel performance.

- Two fuel line fittings leaked during the extended operation test. During an actual emergency condition, the operator would take necessary steps either to retorque the fitting or temporarily seal it so as to allow continued operation.

The above minor problem areas are further discussed in Section 4.0.

2.2 Overview of Inspection Results

As discussed above, the Catawba 1B diesel engine successfully completed its extended operation test which resulted in about 755 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 completed. The results of the inspections are summarized in Table 2-1. Engineering and quality assurance evaluations of the inspection results have been performed. This work is considered to have identified all significant conditions. These conditions are discussed below.

The most significant results of the Catawba 1B 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 1B 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 1B diesel. This problem was expected since it was experienced on the 1A engine. Two of the type AN piston skirts used in the 1B diesel were found to have cracks in an internal circumferential reinforcing rib. This problem is discussed further in Section 2.3.

- 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 earlier at Catawba and at other stations. As a result of this history, a redesigned lube oil system has been installed which is expected to prevent recurrence of the problem.

- Two subcover castings were found to have cracks in an intake rocker arm pedestal. These cracks are discussed in Section 2.4. Similar cracks were noted in the diesel 1A inspection as discussed in reference 3.

- A total of four Catawba cylinder heads (one on diesel 1A and three on 1B) experienced small jacket water leaks into the fuel injector cavity. Metallographic examinations of the head removed from the 1A diesel indicates that the leak was due to a fatigue crack. In addition, one cylinder head on diesel 1B had a crack in a stellite valve seat. This problem is discussed in Section 2.5.

- Three fuel injection pump delivery valve blocks cracked during the extended operation test. This problem is discussed in Section 2.6.

- A variety of routine minor conditions were noted, and are discussed in Section 4.0 and 6.0. None of these conditions impact the operability or structural integrity of the diesel. Typical conditions of this type include:

  - Flaked off exhaust valve stem chrome plate (Section 3.3.2)

  - Heads of small external bolts broken off, due to under or over torquing (Section 3.3.5)

2.3 Piston Skirt Cracking

Two type AN skirts were found to have cracks in the circumferential rib on the ID of the skirt. The cracks are similar to those found on four type AN piston skirts in diesel 1A as reported in reference 3.

An extensive failure analysis of the cracked Catawba type AN piston skirts has been nearly completed 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. Preliminary results indicate that tensile residual stresses on the order of 20 ksi were found to exist in the area where the type AN piston had cracked.

The cracked AN type pistons skirt in the Catawba 1B diesel did not cause any operational problems, and 14 of the 16 skirts were free of these 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. This problem is further discussed in Section 4.1.3.

2.4 Subcovers

Two cast iron subcovers were found to have cracks in a pedestal where the intake rocker arm shaft is bolted to the subcover, similar to those shown in Figure 2-2B of reference 3. These cracks have not affected diesel operability. FaAA has largely completed a failure analysis of a Catawba subcover as part of the Owners Group program. This analysis indicates that the cracks are due to installation tolerances between bushings and the pedestal leading to excessive interference and not to service. This problem is further discussed in Section 4.2.7.

2.5 Cylinder Head Leaks

Four cylinder heads at Catawba, one on engine 1A and three on engine 1B, developed small jacket water leaks into the fuel injection cavity. The 1A cylinder head has been examined by FaAA. This investigation (reference 4) 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 as shown in Figure 2-3 of reference 3. This welded-in plug is reported by TDI to have been used to repair the casting around the fuel injector hole. Evaluation of all heads now installed on engine 1B indicates that none of them have been repair welded with a plug. One other head on diesel 1B had a crack in a exhaust valve stellite seat. These problems are further discussed in 4.1.16.

2.6 Fuel Injection Pump Delivery Valve Block

A total of three delivery valve blocks were found to be cracked. Two were noted during the extended operation test. These were detected by a gradually falling cylinder temperature. One delivery valve block was found partially cracked during inspection after the extended operation test. The cracks are axial in nature and are produced by fuel pressure induced hoop stresses. Operationally a valve block crack results in less fuel being injected into the cylinder, i.e. it bypasses more fuel back to the fuel oil tank. Metallurgical examination results show that the cracks were fatigue induced, initiating from the valve seat. Based on discussions with the vendor, the cracks originated from heat check cracks in the valve seat caused by excessive grinding temperatures during manufacture. Other valve blocks on 1B have been magnetic particle inspected with no sign of the heat checking. The failure is shown in Figure 2-1 and further discussed in Section 4.2.2.

2.7 Conclusions

The extended operation test and the post test inspections have demonstrated that the Catawba 1B diesel will reliably provide standby electric generation. The extended operation test was for the most part accomplished at loads significantly greater than required for standby electric generation. As such, parts inspected have been subjected to considerably higher fatigue loads and temperatures than will be actually seen in service. 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.

TABLE 2-1
SUMMARY OF CATAWBA DIESEL 1B POST EXTENDED OPERATION TEST RESULTS

Part Name	Part No.	Class	Sample Size Percent Dimen.	Visual	S. NDE	V. NDE	Eng Ev	Notes	Results (Ref. paragraph)
Lube Oil Pressure Regulating Valve	00-420	A	-	-	-	-	X	9	Satisfactory
Jacket Water Standpipe, Ftngs, Gasket	00-700A	B	-	100	-	-	-	8	Satisfactory
Jacket Water Standpipe Valves	00-700B	B	-	-	-	-	X	9	Satisfactory
Jacket Water Standpipe Supports	00-700C	B	-	100	-	-	-	8	Satisfactory
Jacket Water Standpipe Switches	00-700E	B	-	-	-	-	X	9	Satisfactory
Jacket Water Standpipe Bolting Materials	00-700F	B	-	100	-	-	-	8	Satisfactory
Lube Oil Internal Headers	02-307A	A	-	100	-	-	-	-	Satisfactory
Lube Oil Tubing and Fittings-Internal	02-307B	A	-	100	-	-	-	-	Satisfactory
Lube Oil Line Supports-Internal	02-307D	B	-	100	-	-	-	-	Satisfactory
Crankshaft	02-310A	A	-	100	38	-	-	3,4	Satisfactory, minor ECT indication polished out. (4.1.1)
Crankshaft Thrust Bearing Ring	02-310C	A	100	-	-	-	-	4	Satisfactory
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	25	-	25	-	-	-	Satisfactory (4.1.5)
Cylinder Liner	02-315C	A	100	100	-	-	-	-	Satisfactory (4.1.4)
Cylinder Block Jacket Water Manifold	02-315D	B	-	100	-	-	-	-	Satisfactory
Cylinder Head Studs	02-315E	B	-	25	-	-	-	-	Satisfactory (4.1.7)
Cyl. Block Jacket Wtr. Manifold Nuts	02-315F	B	-	100	-	-	-	-	Satisfactory
Jacket Water Inlet Manifold Assembly	02-316A	B	-	100	-	-	-	8	Satisfactory
Jacket Water Inlet Manifold Coupling	02-316B	B	-	100	-	-	-	8	Satisfactory
Jacket Water Discharge Manifold	02-317A	B	-	100	-	-	-	-	Satisfactory
Jacket Water Disch. Manifold Coupling	02-317B	B	-	100	-	-	-	8	Satisfactory
Jacket Water Disch. Manifold Supports	02-317C	B	-	100	-	-	-	8	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	-	-	-	Satisfactory (4.1.9)
Connecting Rod Bearing Shells	02-340B	A	100	100	100	100	-	-	Sat., except 3 halves did not meet acceptance stds.(4.1.2)
Piston	02-341A	A	-	100	100	-	-	-	AN skirts replaced with AE skirts (4.1.3)
Piston Pin Assembly	02-341C	A	-	100	-	-	-	-	Satisfactory
Intake Tappets	02-345A	A	-	25	-	-	-	-	Satisfactory
Fuel Tappets	02-345B	A	-	25	-	-	-	-	Satisfactory
Camshaft Assembly	02-350A	A	-	100	-	-	-	-	Satisfactory
Camshaft Bearing	02-350B	B	-	100	-	-	-	5	Satisfactory
Camshaft Supports, Bolting and Gear	02-350C	A	-	100	-	-	-	-	Satisfactory
Crankshaft Gear	02-355A	A	-	100	-	-	-	-	Satisfactory
Idler Gear Assembly	02-355B	A	-	100	-	-	-	-	Satisfactory
Air Start Valve	02-359	A	25	100	-	-	-	-	Satisfactory (4.1.13)
Cylinder Head	02-360A	B	100	100	100	100	-	2	Sat., except for 3 leaks and 1 cracked valve seat (4.1.16)
Intake and Exhaust Valves	02-360B	B	-	100	-	-	-	-	Satisfactory, some valves have chipped chrome plating(4.3.1)
Valve Springs	02-360D	B	-	100	-	-	-	1	Satisfactory, except for one cracked damper spring (4.3.5)
Subcover Assembly	02-362A	B	-	100	100	-	-	-	Satisfactory, except for two cracked pedestals (4.2.7)
Fuel Injection Pump	02-365A	B	-	100	-	-	-	-	Satisfactory, except for 3 cracked blocks (4.2.1) (4.2.2)
Fuel Injection Tubing	02-365C	B	-	100	100	-	-	6,8	Satisfactory (4.1.11)
Fuel Injection Tubing Supports	02-365D	B	-	100	-	-	-	8	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
Exhaust Manifold Bolting	02-380B	B	9	9	-	-	-	-	Satisfactory (4.2.6
Crankcase Cover Gaskets and Bolting	02-386B	C	-	100	-	-	-	-	Satisfactory
Intake & Intermediate Rocker Arm Asmbly.	02-390A	B	-	100	-	-	-	-	Satisfactory
Exhaust Rocker Arm Assembly	02-390B	B	-	100	-	-	-	-	Satisfactory (4.2.10)
Intake and Exhaust Pushrods	02-390C	B	-	100	100	-	-	-	Satisfactory (4.1.14)

TABLE 2-1
SUMMARY OF CATAWBA DIESEL 1B POST EXTENDED OPERATION TEST RESULTS

Part Name	Part No.	Class	Dimen.	Sample Size Percent Visual	S. NDE	V. NDE	Eng Ev	Notes	Results (Ref. paragraph)
Connector Pushrod	02-390D	B	-	100	100	-	-	-	Satisfactory
Rocker Arm Bushings	02-390E	B	-	100	-	-	-	-	Satisfactory
Rocker Arm Bolting	02-390G	B	-	100	100	-	-	-	Satisfactory (4.1.8)
Overspeed Trip & Accessory Drive	02-410B	A	-	100	-	-	-	-	Satisfactory
Overspeed Trip Couplings	02-410C	A	-	100	-	-	-	-	Satisfactory
Speed Regulating Governor Drive	02-411A	A	-	100	-	-	-	-	Satisfactory
Governor Drive Couplings	02-411B	A	-	100	-	-	-	-	Satisfactory
Governor Linkage	02-413	A	-	100	-	-	-	-	Satisfactory
Fuel Pump Linkage-Auto Shutdown Cylinder	02-413B	B	-	100	-	-	-	-	Satisfactory
Governor Booster Servomotor	02-415B	B	-	-	-	-	X	9	Satisfactory
Intercooler Piping-Coupling, Bolt, Gskt.	02-436B	A	-	100	-	-	-	-	Satisfactory
Turbo Cooling Water Pipe and Fittings	02-437A	B	-	100	-	-	-	8	Satisfactory
Turbo Cooling Water Pipe Supports	02-437B	A	-	100	-	-	-	8	Satisfactory
Start Air Manifold Pipe, Tubing & Fttng.	02-441A	A	-	100	-	-	-	8	Satisfactory
Start Air Manifold Pipe Supports	02-441C	A	-	100	-	-	-	8	Satisfactory
Start Air Distributor Tbg., Ftg., Gskts.	02-442B	A	-	100	-	-	-	8	Satisfactory
Fuel Oil Piping and Tubing	02-450B	A	-	100	-	-	-	8	Satisfactory (4.2.11)
Fuel Oil Piping Supports	02-450D	A	-	100	-	-	-	8	Satisfactory
Fuel Oil Filter Mounting Hardware	02-455C	A	-	100	-	-	-	-	Satisfactory
External Lube Oil Lines	02-465A	A	-	100	-	-	-	8	Satisfactory
External Lube Oil Line Supports	02-465B	A	-	100	-	-	-	-	Satisfactory
External Lube Oil Valves	02-465C	A	-	-	-	-	X	9	Satisfactory
Turbocharger Lube Oil Piping	02-467A	B	-	100	-	-	-	-	Satisfactory (4.2.3) (4.2.8)
Turbocharger Lube Oil Piping Supports	02-467B	B	-	100	-	-	-	-	Satisfactory
Turbocharger Bracket	02-475A	B	-	100	-	-	-	-	Satisfactory
Turbocharger Bracket Bolting	02-475D	B	-	8	-	-	-	7	Sat., except 1 bolt failed during test (4.2.3)
Control Panel Cabinet	02-500A	A	-	-	-	-	X	9	Satisfactory
Control Air Accumulator	02-500F	A	-	-	-	-	X	9	Satisfactory
Control Air System Valves	02-500G	A	-	-	-	-	X	9	Satisfactory
Control Air System Pressure Switches	02-500H	B	-	-	-	-	X	9	Satisfactory
Control System Relays	02-500J	A	-	-	-	-	X	9	Satisfactory
Control System Solenoid Valves	02-500K	A	-	-	-	-	X	9	Satisfactory
Control Air System Piping, Tubing, Ftngs	02-500M	B	-	100	-	-	-	8	Satisfactory
Control Panel Wiring	02-500N	A	-	-	-	-	X	9	Satisfactory
Lube Oil Sump Tank	02-540A	B	-	100	-	-	-	-	Satisfactory
Lube Oil Sump Tank Bolting	02-540B	B	-	100	-	-	-	-	Satisfactory
Lube Oil Sump Tank Mounting Hardware	02-540C	B	-	100	-	-	-	-	Satisfactory
Instrumentation Thermocouples	02-630D	B	-	-	-	-	X	9	Satisfactory
Engine & Auxiliary Module Wiring Conduit	02-688A	A	-	100	-	-	-	-	Satisfactory
Engine and Auxiliary Module Wiring	02-688B	A	-	-	-	-	X	9	Satisfactory (4.1.10)
Engine and Auxiliary Module Wiring Boxes	02-688C	A	-	-	-	-	X	9	Satisfactory
Engine Alarm Sensors	02-690	A	-	-	-	-	X	9	Satisfactory
Off Engine Safety Alarm Sensors-Switches	02-691A	B	-	-	-	-	X	9	Satisfactory
Engine Shutdown Tubing and Fittings	02-695A	B	-	100	-	-	-	8	Satisfactory
Engine Shutdown Valves, Regs. & Orifice	02-695B	A	-	-	-	-	X	9	Satisfactory
Engine Shutdown Trip Switches	02-695C	A	-	-	-	-	X	9	Satisfactory
Fuel Oil Duplex Strainer	02-825D	A	-	-	-	-	X	9	Satisfactory
Turbocharger Thrust Bearing Lube System	02-CFR	C	-	100	-	-	-	-	Satisfactory (4.1.15)
Thermostatic Valve	C 136-40	B	-	-	-	-	X	9	Satisfactory
Intake Air Filter	CN-106	B	-	-	-	-	X	9	Satisfactory
Intake Air Silencer	CN-107	B	-	-	-	-	X	9	Satisfactory
Before and After Lube Oil Pump	CN-109	A	-	-	-	-	X	9	Satisfactory
Full Flow Lube Oil Filter	CN-110	A	-	-	-	-	X	9	Satisfactory

TABLE 2-1
SUMMARY OF CATAWBA DIESEL 1B POST EXTENDED OPERATION TEST RESULTS

Part Name	Part No.	Class	Sample Size Percent Dimen.	Visual	S. NDE	V. NDE	Eng Ev	Notes	Results (Ref. paragraph)
Lube Oil Heat Exchanger	CN-111	B	-	-	-	-	X	9	Satisfactory
Generator Shaft and Bearings	CN-119A	A	-	-	-	-	X	9	Satisfactory
Jacket Water Heat Exchanger	CN-120	B	-	-	-	-	X	9	Satisfactory
Oil Prelube Filter	CN-122	A	-	-	-	-	X	9	Satisfactory
Lube Oil Keepwarm Strainer	CN-131	A	-	-	-	-	X	9	Satisfactory
Intercooler	P-086	A	-	100	100	-	-	-	Satisfactory crack in flange repaired (4.2.5)
Turbocharger	MP-022/3	A	100	100	-	-	-	-	Turbochargers & exh. man. bolts were replaced (4.2.4)(4.2.5)
Lube Oil Full Pressure Strainer	SE-025	A	-	-	-	-	X	9	Satisfactory

Notes To Table

1. Intake and exaust valve springs have proper color code.
2. Ultrasonic wall thickness measurement of fire deck area and fuel nozzle area. Inspection to determine if head has been repaired.
3. A torsiograph was developed of the crankshaft.
4. Crankshaft web deflections and thrust clearance was measured with the diesel hot as well as cold.
5. Inspections of the camshaft bearings was not performed since an inspection of the camshaft lobes showed no abnormal wear.
6. BCT inspections were limited to both ends of all high pressure injection lines.
7. Turbocharger bracket bolting was replaced.
8. Walkdown inspections conducted as part of procedures 53-57 are complete and the results are contained in Appendix A. Walkdown inspections performed as part of the Owners Group Phase II Evaluation have been completed and the results will be published by the Owners Group at a later time.
9. Engineering validation of part is to determine if there are any significant unresolved maintenance or operational problems associated with the part.

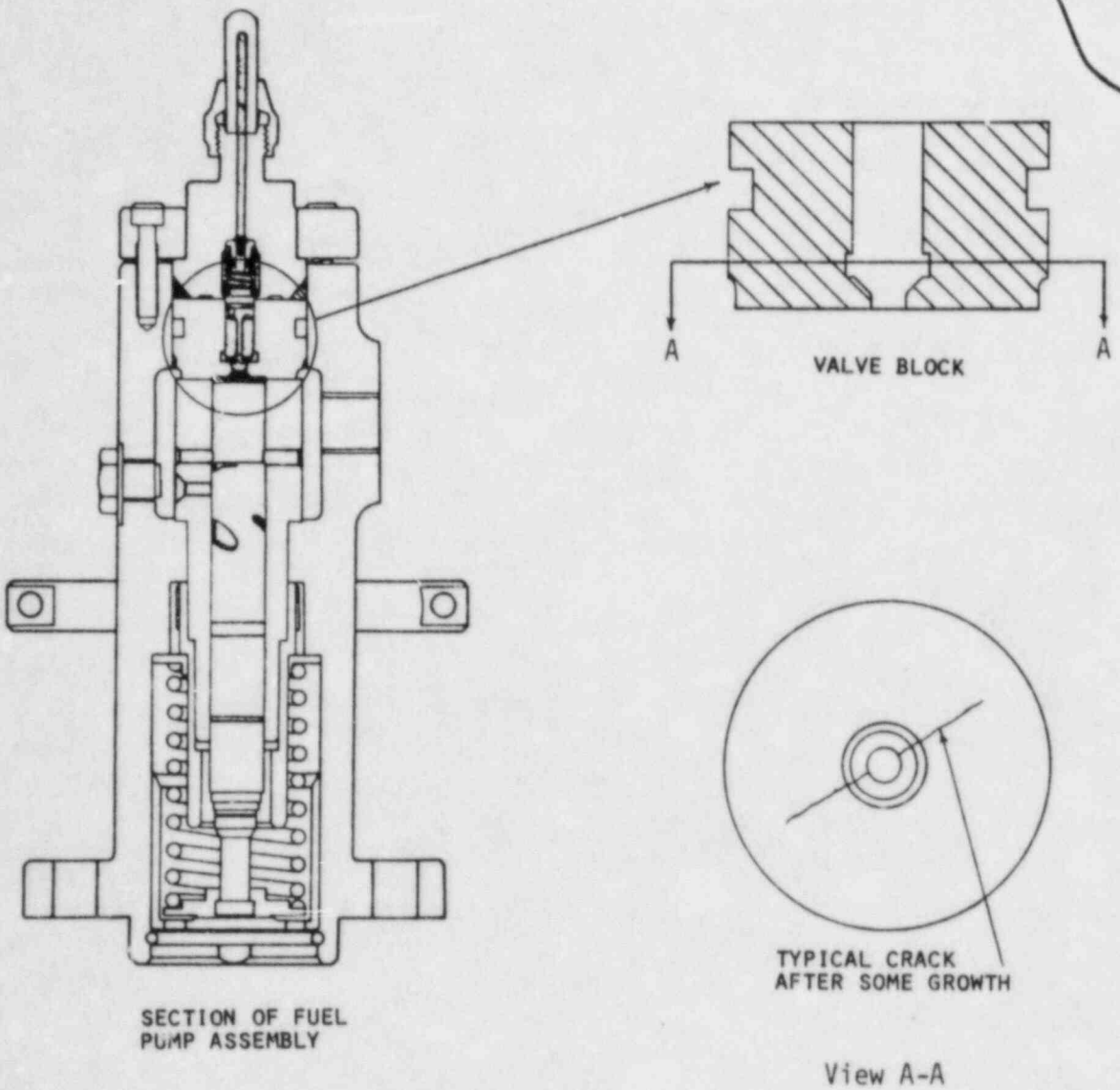

Figure 2-1. Cracked Fuel Pump Delivery Valve Block

3.0 Discussion of Extended Operation Test

The purpose of the extended operation test and the parameters sampled or measured are outlined in reference 1. This section will discuss the results of the test.

The 1B diesel extended operation was initiated on May 30, 1984, and was successfully completed on July 9, 1984. During that time period the engine operated about 504 hours of documented run time. That time added to about the 252 hours of run time accumulated prior to the extended run test and resulted in a total documented run time of about 755 hours for the 1B diesel. The following information summarizes the test run results.

3.1 Operating Profile

The Catawba TDI DSRV-16-4 diesels have a rated load of 7000kw. The maximum calculated emergency diesel generator load under black out conditions is 5600kw. During the extended operation test, the engine was operated at loads in excess of the required 5600kw approximately 97% of the test period. Specifically, during the extended operation test the generator load was as follows:

Generator Load (MW)	Time (hours)
7.6	1
7.2	1
7.1	11
7.0	432.5
6.9	11
6.8	17
6.7	2
6.6	7
4	4
2	1
1.5	2
1	2
.6	1
0	6
Varying load (governor test)	5

3.2 Vibration Analysis

Daily vibration plots were compared to a baseline plot to identify any abnormal or significant changes in vibration levels, any longer term trends in vibration levels, or any other anomalies. During the extended operation test period no abnormal or significant changes in vibration levels or trends were identified.

3.3 Lube Oil Analyses

Daily samples of lube oil were tested for viscosity and water content. All analyses showed acceptable values for lube oil viscosity and water content.

3.4 Fuel Oil Analyses

Samples of fuel oil from the delivery tankers were tested for specific gravity and percent of water and sediment. All analyses showed acceptable values for fuel oil specific gravity and percent of water and sediment.

Hourly samples during the test of the fuel oil day tank typically showed no water was present. Any small amount of water present was drained by the operator.

3.5 Operating Parameters

The diesel operating parameters, both on the strip charts and log sheet, were reviewed each day to ascertain significant or abnormal changes and to look for trends in the data indiating gradual degradation of the engine. With the exception of four cases, no significant or abnormal changes or data trends were detected in the operating parameters.

The four cases of significant trends in data or where a trip occurred were:

- The 7R fuel pump was replaced due to low pyrometer readings on the cylinder during the shutdown that commenced on June 3, 1984. Similarly, the 5L fuel pump was replaced due to low pyrometer reading during the shutdown commencing on June 15, 1984. For further details see Section 4.2.2.

- The engine tripped on low lube oil pressure due to changing the lube oil strainers while the diesel was operating on June 12, 1984. This type of trip is blocked during emergency operation, so it has no implication in regard to diesel operability under design condition.

- Repair and adjustment of the voltage regulator was required during the period June 16 through 19, 1984 due to load swings.

- The engine tripped on low turbo oil pressure due to a dirty lube oil strainer on July 3, 1984. This type of trip is blocked during emergency operation, so it has no implication in regard to diesel operability under design conditions.

3.6 Problem Reports

Several problem reports were generated during the course of the extended run test. These reports covered the following engine parts:

- Fuel line fitting

- Turbocharger thrust bearings

- Cylinder head jacket water leakage
- Fuel injection pump delivery valve block
- Intercooler jacket water pipe weldment
- Turbocharger adaptor
- Air distributor capscrew

Further discussion of these problems is given in Section 4.

4.0 Discussion of Inspection Results

This discussion of inspection results is contained in four parts. The first part (Section 4.1) covers inspections related to the generic problems being addressed by the TDI Owners Group. The second part (Section 4.2) covers inspections performed to address concerns raised by specific problems which have been experienced with Catawba diesels. The third part (Section 4.3) covers significant inspection results not covered by the first two parts. The fourth part (Section 4.4) covers results of the engineering validation review. All of these inspections are documented in the Appendices, Section 6.0.

4.1 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.

4.1.1 Crankshaft (Part No. 02-310A)

PROBLEM:

A crankshaft failure occurred at Shoreham. The cause of the failure was high cycle fatigue cracks initiating from fillets in the crankshaft at the junction of a crankpin and web (reference 5). 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 6 and 7). Due to satisfactory inspection of the Catawba Diesel 1A (reference 3), only visual inspections of crankpin web fillets on Catawba Diesel 1B were performed.

At San Onofre, a TDI diesel engine experienced cracks in main bearing journal oil holes. The V-16 Catawba diesel crankshafts are also different than the San Onofre V-20 crankshafts. However, as this failure was nuclear service related, inspections of the highest load main bearing journal oil holes on 1B were performed.

SCOPE OF INSPECTIONS:

The crankshaft inspections consisted of:

- Web deflection measurements.
- Visual inspections of the crankpin journals on all eight crankpins.
- Fluorescent dye penetrant and ECT inspection of oil holes in main bearing journals #4, #6, and #8.

No significant conditions were noted. Two small indications were detected on #6 main bearing journal oil hole by ECT. The first indication was approximately 1/16 inch in a radial direction about 2.5 inches into the hole. The second indication was approximately 1/8 inch in an axial direction on the journal .100 inches from the oil hole. These indications were polished out at a depth of less than .001 inches.

SUMMARY:

In summary, the inspections of the crankshaft indicate that it is free of significant defects and is not experiencing the type of problem experienced with the San Onofre crankshaft. The small indications detected by ECT in the #6 main journal oil hole are believed to be machining marks. It was concluded that these indications were non service induced.

4.1.2 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 7) 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.
- PT examination of the bearing shells.
- X-ray examination of all bearing shells.

RESULTS OF INSPECTIONS:

No cracks were detected by visual or liquid penetrant inspection. Visual and liquid penetrant inspections indicated babbit 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 does not affect bearing operation (reference 8). X-ray inspections indicate that three of the sixteen bearing halves inspected do not meet acceptance standards due to indications related to as manufactured material condition.

SUMMARY:

Surface inspection results indicate that connecting rod bearing shells are acceptable for continued operation. X-ray inspections results indicate that three bearing halves do not meet acceptance standards due to as manufactured material conditions. Spare bearing halves which meet all inspection standards have been installed in place of the three.

4.1.3 Pistons (Part No. 02-341A)

PROBLEM:

Inspection of the Catawba 1A diesel type AN skirts indicated that 4 out of 16 skirts had cracks at the circumferential rib to piston pin boss fillet. As a result, all Catawba 1A and 1B piston skirts were replaced with type AE skirts. The removed 1B type AN skirts were inspected for information purposes.

SCOPE OF INSPECTIONS

The inspection performed of the the removed type AN pistons skirts are listed below:

- Visual inspection of 100% of the piston skirts.
- PT examination of stud bosses of 100% of the piston skirts.
- PT examination of piston pin bosses and belleville seat surface of 100% of the piston skirts.
- MT examination of areas adjacent to piston pin bosses (these are the areas where several cracks were noted).

RESULTS OF INSPECTIONS:

The most significant condition noted was the presence of cracks in two piston skirts similar to those noted in the 1A piston skirts (reference 3). The cause of the cracking is believed to be cyclic fatigue. FaAA is performing a detailed failure analysis of type AN skirts. A number of other minor reportable indications were noted, but none of these appeared to be related to service; rather, they appeared to be due to minor casting imperfections.

SUMMARY:

Cracks were found to be present in two piston skirts. All of the piston skirts will be replaced with type AE pistons. In addition, a detailed failure analysis is being performed as part of the TDI Owners Group program.

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

PROBLEM:

Severe grooving has been noted in at least one TDI nuclear diesel engine (reference 11). 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 scratching was observed which is normal for a diesel which has seen substantial service. These scratches are considered to have no effect on diesel operability.

SUMMARY:

The inspections indicate that the cylinder liners are in satisfactory condition. Honing to break up the glaze in order to allow new piston rings to seat has eliminated the scratches observed in the liners.

4.1.5 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 11).

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 four cylinders (4 and 5 right; 4 and 5 left) and the cylinder liner landing area within the block was PT examined.

RESULTS OF INSPECTIONS:

No significant indications were noted.

SUMMARY:

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

4.1.6 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 11 and 12).

SCOPE OF INSPECTIONS:

The main bearing saddle area around and between the stud holes was PT examined for bearings 4, 5, 6, and 8 on diesel 1A. In addition, the stud tension required to permit removal of the nuts was measured on diesel 1A. Owing to the fact that all inspection results on diesel 1A (reference 3) were satisfactory, these inspections were not carried out on diesel 1B.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Not applicable.

4.1.7 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 13). Hence, visual inspections on a sampling basis were performed of the Catawba diesels.

SCOPE OF INSPECTIONS:

- Studs from the four cylinders (3,4,5, and 6L) were visually inspected.

RESULTS OF INSPECTIONS:

All cylinder head studs inspected satisfactorily passed the visual examinations.

SUMMARY:

A sampling inspection of cylinder head studs indicates that they are acceptable.

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

PROBLEM:

A fatigue failure is reported to have occurred with a rocker arm capscrew at Shoreham (reference 11). This failure was attributed to undertorquing. Reference 22 indicates that properly torqued capscrews have satisfactory fatigue resistance.

SCOPE OF INSPECTIONS:

The rocker arm capscrews were visually and MT examined.

RESULTS OF INSPECTIONS:

No indications were noted in the visual or MT examination.

SUMMARY:

The diesel engine 1B capscrews were found to be satisfactory.

4.1.9 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 11).

SCOPE OF INSPECTIONS:

The inspections of the connecting rods included the following:

- Visual inspection was performed of all connecting rods.
- Magnetic particle inspection of all connecting rod link rod and rod-to-box bolts was accomplished.
- The areas of the rod box which have been reported as being subject to cracking were LP examined.
- 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.
- Connecting rod rack-teeth (serrations) degree of contact with mating part was measured by bluing the part on all connecting rods.

RESULTS OF INSPECTION

All connecting rods passed the above inspections. Degree of contact along the rack-teeth (serrations) varied between 80 and 95 %.

SUMMARY:

The diesel 1B connecting rods were found to be acceptable. After reassembly in the engine, connecting rod capscrews were ultrasonically examined to assure that preloads were adequate.

4.1.10 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 11 and 19).

SCOPE OF INSPECTION:

Stone and Webster, as part of TDI Owners Group activities, reviewed the Catawba electrical cable installation (reference 19).

RESULTS OF INSPECTION:

The Stone & Webster inspections (reference 14) have been completed with the following results:

- TDI SIM 361 had not been implemented on the Catawba diesels. This involves replacement of: shielded cable from a terminal block to the tachometer relay in the engine control panel; shielded cable from Airpax magnetic pickup to the junction box on the side of the engine; and multiconductor cable from an engine mounted junction box to the Woodward governor actuator.

- Certification that States type NT sliding link terminal blocks used in the starting air solenoid controls were not manufactured between 1974 and 1976.

SUMMARY:

Following the Stone & Webster inspection TDI SIM 361 has been accomplished by Duke Power Co. With this replacement, all wiring is of acceptable temperature rating and adequately sized for circuit ampacities. Duke Power Co. (reference 14) has a program for inspecting States sliding link terminal blocks during installation and each time the link is operated. Performance problems and defective links are reported to Design Engineering. Hence, Duke Power Co. already has a program for uncovering defective terminal blocks and therefore find it unnecessary to verify the manufacturing date of the TDI terminal blocks.

4.1.11 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 a pre-existing .006" draw seam at the tubing ID. (reference 16).

SCOPE OF INSPECTIONS:

All of the high pressure fuel injection lines have been inspected in an area six inches from each end or from the end to the first turn using ECT methods.

RESULTS OF INSPECTIONS:

The results were satisfactory.

SUMMARY:

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

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

PROBLEM:

Several jacket water pump shaft failures occurred at Shoreham (reference 17). 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 diesel 1A jacket water pump (reference 3). Because inspections were accomplished on the 1B jacket water pumps after its extended operational test. The NRC staff SER (reference 18) has informed Duke Power Co. that during the first refueling outage that the torque of the nut holding the external spine to the shaft taper on the jacket water pump must be checked.

SCOPE OF INSPECTIONS:

Not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Duke Power Co. considers the jacket water pumps to be acceptable. Torque measurements on the external spline nut, however, will be measured at the first refueling outage.

4.1.13 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 21). 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 length of capscrews for 4 valves.
- Visual inspection of the valve seat areas on the heads for all valves.

RESULTS OF INSPECTIONS:

Capscrew lengths were acceptable, and the valves showed no signs of insufficient clamping force.

SUMMARY:

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

4.1.14 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 on the 1A diesel. The push rods were then installed in the 1B diesel and accumulated over 500 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 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 since the friction welded design has operated over 900 hours with no sign of cracking.

4.1.15 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 11). An improved lube oil supply system was incorporated on Catawba diesels in September 1984.

SCOPE OF INSPECTION:

o The bearings were visually and dimensionally inspected.

RESULTS OF INSPECTIONS:

The turbocharger bearings were found to be severely worn. This wear was due to inadequate lubrication during startup. It should be noted that this wear had not affected turbocharger operation during the extended operation test.

SUMMARY:

The turbocharger bearings have been replaced with new parts. These are expected to operate as well as the original bearings, which caused no operational problems for several hundred hours. The new lube oil system which was incorporated will assure that the bearings get adequate lubrication during normal startups which will significantly reduce wear.

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

PROBLEM:

Three small jacket water leaks have been experienced on Catawba diesel 1B resulting in water leaking into the fuel injector nozzle cavity. One leak of similar origin was seen on diesel 1A. Failure analysis of one of the leaking heads has been completed (reference 4). 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, reference 3).

SCOPE OF INSPECTION

The inspections performed of the cylinder head included:

- Visual examination of valve seats.
- PT examination of valve seats in cylinder heads and the area between valve seats on the head.
- UT examination of fire deck thickness at selected locations.
- Visual inspection of heads to determine if they have a welded in plug.

RESULTS OF INSPECTIONS:

One head had a crack in a valve seat. No heads had welded plugs other than the three that leaked.

SUMMARY:

The head with the cracked valve seat is being replaced. The heads with the repaired plug weld are also being replaced. It should be noted that neither the cracked valve seat nor the leaking heads would have affected diesel engine operability in an emergency.

4.2 Catawba Specific Problems

4.2.1 Fuel Injection Pump Nozzle Valve Holder (Part No. 02-365A)

PROBLEM:

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

SCOPE OF INSPECTIONS:

Visual inspection of the 1B valve holder bores using a boroscope was accomplished to determine if there were linear defects.

RESULTS OF INSPECTIONS:

Only one of the 1B valve holders had linear indications. The bore of this valve holder was polished to remove the indications.

ENGINEERING EVALUATION:

A failure analysis was performed on the 1A fuel injection pump nozzle valve holder (reference 20). The results of this analysis indicate that an axially oriented linear indication in the high pressure fuel oil passage of the failed part led to

the reported failure. Further analysis indicates that axial linear indications that would lead to cracking of the valve holder would cause cracking to occur within 10 million cycles of fuel pump operation. As the Catawba valve holders have withstood 10 million cycles of operation, the valve holder failure experience is considered an isolated material defect.

SUMMARY:

It is concluded that the valve holder failure is due to a material defect. Failure analysis indicates that due to extended operation of the diesel, no defects that would cause cracking are present in the remaining valve holders. In addition valve holders that had indications based on boroscope inspections were removed from the engine, cleaned and/or reamed, reinspected, and found to be free of defects.

4.2.2 Fuel Injection Pump Delivery Valve Block (Part No. F-099-170)

PROBLEM:

During the 1B extended operational test two fuel injection pump delivery valve blocks leaked because of axial cracks. This type of failure does not exhaust fuel to the ambient but allows fuel to bypass the injectors and be returned to the fuel oil tank.

SCOPE OF INSPECTIONS:

The following inspections were accomplished:

- Visual examination for signs of cracks.
- MT examination in valve seat area.

RESULTS OF INSPECTIONS:

One other delivery valve block was found partially cracked after disassembly of diesel 1B. A metallurgical evaluation indicated that the cracks were fatigue induced, and initiated at the valve seat area. Duke Power Company contacted the vendor of the delivery valve blocks, and the vendor indicated that the probable cause of the failures was heat check cracking in the valve seats due to excessive grinding temperatures during manufacturing. Results of MT inspection of delivery valve blocks which were not cracked indicated no evidence of heat check cracking.

SUMMARY:

The fact that all of the installed delivery valve blocks that were not cracked as well as the blocks which replaced the cracked ones showed no evidence of heat check cracking assures

that this will not be a problem on the return to service of diesel 1B. In addition, such failures would not affect diesel operability in an emergency situation. The failure results in gradually declining cylinder temperatures in the effected cylinder and the remaining cylinders will assume the load. No inspections of the fuel injection pump delivery valve blocks are planned for diesel 1A since it is felt that with over 10^7 fatigue cycles on the blocks that any heat check cracks would have propagated to the point of failure and been detected based on reduced cylinder temperature.

4.2.3 Turbocharger Prelube Oil Lines (Part No. 02-467A)

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 and using additional clamps, vibration dampening devices, improved compression fittings and heavier wall stainless steel tubing. The same modifications to the turbocharger prelube oil lines on diesel 1B were made prior to the extended operation test. No leakage was noted from the 1B lines during its extended operation test giving assurance that the design modifications have adequately addressed the problem. Hence, no inspections of these lines were specified on diesel 1B.

SCOPE OF INSPECTIONS:

Not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

Not applicable.

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

PROBLEM:

A turbocharger to air inlet adaptor cracked at a flange weld. A similar problem occurred on diesel 1A. In addition, the internal air flow divider (flow distributor) had a small crack at the junction to the case of the adaptor. This problem was not seen on diesel 1A. An engineering evaluation indicates that the cracks are caused by excessive displacements of the case.

SCOPE OF INSPECTIONS:

The adaptor welds were visually and MT examined after repair.

RESULTS OF INSPECTIONS:

No defects were noted.

SUMMARY:

A redesign has been implemented on both Unit 1 diesels consisting of a flexible connection between the adapter and turbocharger to absorb displacements. In addition, on both Unit 1 diesels, strongbacks have been welded to the case to eliminate the flexing which caused the air flow divider weld failure. This redesign will assure that in the future the adapter will not crack.

4.2.5 Intercooler Jacket Water Flange (Part No. 136F-068)

PROBLEM:

A jacket water penetration into the water box on the intercooler seeped water during the extended operation test on diesel 1B. Jacket water piping to this penetration was vibrating at the diesel fundamental frequency. The penetration was weld repaired. A rigid hanger was added to the external piping to change its characteristic frequency.

SCOPE OF INSPECTION:

Not applicable.

RESULTS OF INSPECTION:

Not applicable.

SUMMARY:

A rigid pipe hanger has been installed on both Unit 1 diesels to change the natural frequency and limit displacements. This modification will eliminate pipe weld cracking at the penetration in to the water box of the intercooler.

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

PROBLEM:

Occasional failures of these capscrews has occurred due to fatigue (reference 20) because of over or under torque.

SCOPE OF INSPECTIONS:

All of these capscrews are being replaced with capscrews with improved fatigue strength and 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.

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

PROBLEM:

A 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. A similar problem was detected on diesel 1A (see Figure 2-2B, reference 3). The cause of the problem is believed due to installation tolerances between bushings and the pedestal leading to excessive interference fits.

SCOPE OF INSPECTION:

- 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 has been performed by FaAA under TDI Owners Group direction. This indicates that the cracks were due to installation or manufacturing errors and not due to service. Thus, replacement of the defective subcover castings resolves the problem.

4.2.8 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 was replaced with an improved design as part of the diesel reassembly. The 1B turbocharger lube oil drain line was replaced prior to its extended operational test.

SCOPE OF INSPECTION:

Not applicable.

SUMMARY:

This problem has been resolved by installation of a permanent drain line. The fact that this permanent drain line design did not leak during the 1B extended operation test provides assurance that the problem has been eliminated.

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

PROBLEM:

One 1/2 inch stainless manifold to turbocharger adaptor bolt was found broken during disassembly of diesel 1B. This is similar to diesel 1A (reference 3) where four were found broken. The investigation shows that the bolts failed from creep rupture (reference 20).

SCOPE OF INSPECTION:

Not applicable.

RESULTS OF INSPECTION:

Not applicable.

SUMMARY:

These bolts have been replaced with creep resistant SA 453, Grade 660, Condition A material. In addition, bolt installation procedures have been revised to insure that proper preloads are applied during this installation. Also, improved thread lubricant will be used on reassembly to ease removal in the future.

4.2.10 Rocker Arm Adjusting Screw Swivel Pad (Part No. 02-390B)

PROBLEM:

One of the swivel pads was found cracked during operation on diesel 1B. This occurrence was reported in reference 3. Failure analysis (reference 20) 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. Another swivel pad was found cracked during reassembly following the inspections. This pad is believed to have been cracked when the rocker arm was knocked over in storage.

SCOPE OF INSPECTIONS:

All swivel pads were visually inspected.

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.

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

PROBLEM:

Failures have been reported as occurring on fittings, apparently as a result of vibration induced fatigue due to the absence of the supports required by the TDI drawing (reference 11). During the extended operation test one high pressure and one low pressure fuel line fitting leaked The high pressure fitting was retorqued eliminating the leak. The low pressure fitting had teflon tape added to eliminate the leakage.

SCOPE OF INSPECTIONS:

The inspections of the fuel lines include a walk down inspection to verify that the piping is installed per the applicable design drawing and properly supported to suppress vibration.

RESULTS OF INSPECTIONS:

The inspection of the fuel lines was satisfactory.

SUMMARY:

During reassembly of the engine fuel lines, fittings were installed to Duke Power Company procedures to prevent improper torque values from being applied. In addition, walkdown inspections of the fuel lines have insured that the lines are properly attached, such that vibration problems are not expected.

4.3 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 1B diesel engine. The results of these inspections showed that the 1B diesel engine was in excellent condition, with a few relatively minor problems in addition to the problems discussed in sections 4.1 and 4.2 above. The only additional problems noted were as follows:

- Valve stems had chipped chrome plate and areas where the chrome thickness had been reduced.

- One main bearing was found to have a circumferential score in it.
- Several bolts and capscrews were found to have missing heads or cracks.
- A valve damper spring was found to be cracked.

These problems are discussed below.

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

PROBLEM:

Eight valve stems had areas with chipped or reduced thickness 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. Twenty valves had non-relevant scratching of the chromium plating.

SCOPE OF INSPECTIONS:

All 64 valve stems were visually inspected.

RESULTS OF INSPECTIONS:

As discussed above, 8 exhaust valve stems had chipped or removed chrome plating in areas about 6 to 8 inches above the valve seat and 20 had non-relevant scratching of the chrome plate. No structural damage was observed.

SUMMARY:

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

4.3.2 Main Bearing (Part No. 02-305A)

PROBLEM:

One main bearing (#6) was found to have a circumferential score. This was detected in pulling bearings 4,6,and 8 for ECT and PT of the journal oil holes.

SCOPE OF INSPECTIONS:

Since the bearing was acceptable for continued use no other bearings other than 4 and 8 were removed.

RESULTS OF INSPECTIONS:

The only problem noted was the scoring of this bearing.

SUMMARY:

Lower main bearing 6 is being replaced, even though the score did not affect operability. This problem is considered to have been an isolated case of damage by a piece of debris at initial assembly.

4.3.3 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. Engineering evaluation of the capscrew indicated fatigue failure.

SCOPE OF INSPECTIONS:

These bolts were replaced on diesel 1A and 1B. Inspections were therefore, not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

The capscrew apparently failed due to fatigue. All capscrews have been replaced with new material of increased fatigue resistance. Reassembly procedures have been revised to assure that proper preloads are applied.

4.3.4 Starting Air Distributor Cover Capscrew (Item 12-TDI dwg. 00-442-08)

PROBLEM:

The head on one of six 1/2 inch capscrews on the right bank starting air distributor cover fell off. This problem was noted during a routine visual inspection of the engine during shutdown. It is believed that the likely cause of the problem is fatigue due to under or over-torquing of the capscrew.

SCOPE OF INSPECTION:

These bolts have been replaced and inspections are therefore not applicable.

RESULTS OF INSPECTIONS:

Not applicable.

SUMMARY:

All capscrews are being replaced with a new material of increased fatigue resistance. During reassembly, proper preloads are applied to the capscrews.

4.3.5 Intake Valve Damper Spring (Part No. 03-360-04AF)

PROBLEM:

One damper spring (Cylinder 7L) was found broken in two on disassembly of the heads. The damper spring was designed and installed on TDI engines about 15 years ago when intake valve springs were cracking. Subsequently, TDI learned that the problem with cracked valve springs was in the shot peening processes. Today with proper shot peened valve springs, the damper spring is superfluous and new TDI heads are supplied without the damper springs.

SCOPE OF INSPECTIONS

All intake damper springs were visually inspected.

RESULTS OF INSPECTIONS

All intake damper springs other than the one that was cracked appeared satisfactory.

SUMMARY

The damper spring is a superfluous component that is completely captured by the valve spring. Hence, if the damper spring failed it would not effect diesel engine operability, as was the case with engine 1B with over 750 hours of operation. Because of this, no additional failure analysis was done on the cracked damper spring. Duke Power Co. is in the process of preparing instructions to Catawba to remove these damper springs whenever work involves disassembly of the valve springs.

4.4 Result of Engineering Validation

In section 6.0, Appendix B, an engineering validation of parts not inspected by traditional non-destructive techniques was performed. The engineering validation included thoroughly reviewing operational and maintenance records to assure that no problems have been experienced.

The only problem found that is not mentioned elsewhere in this report was two intermittent shorts in thermocouples found during engine heatup. The effected thermocouples were replaced. This problem was also in evidence on diesel 1A (reference 3). As thermocouples do not effect engine operability in a emergency run situation, these failures are not considered significant.

5.0 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. Duke Power Co. letter dated July 6, 1984 to H.R. Denton, NRC, containing detailed 1B diesel inspection plans.

3. Duke Power Co. letter dated June 29, 1984 to H.R. Denton, NRC, enclosing "Catawba Nuclear Station, Diesel Engine 1A Component Revalidation Inspection".

4. Failure Analysis Associates, "Metallurgical Analysis of Catawba Injection Port Leak", June 1984.

5. IE Information Notice No. 83-58, "Transamerica Delaval Diesel Generator Crankshaft Failure", NRC, August 30, 1983.

6. Bechtel Power Corporation, "Evaluation of Crankshaft Stresses for Duke Power Corporation, Catawba Nuclear Station", March 19, 1984.

7. Failure Analysis Associates, "Design Review of Connecting Rod Bearing Shells for Transamerica Delaval Enterprise Engines", March 12, 1984.

8. Duke Power Co. Meeting Minutes, Diesel Generator Owners Group. Shoreham Nuclear Power Station, S. R. Ward author, May 24, 1984

9. Delaval minutes of November 30, 1983 meeting with TDI Owners Group.

10. Failure Analysis Associates, "Investigation of Types AF and AE Piston Skirts", May 27, 1984.

11. 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.

12. Failure Analysis Associates, "Design Review of Engine Base and Bearing Caps for Transamerica Delaval Diesel Engine", April 1984.

13. Stone and Webster Engineering Corporation, "Emergency Diesel Generator Cylinder Head Stud Stress Analysis", March 1984.

14 Stone and Webster Engineering Corporation, "Supplement to Emergency Diesel Generator Auxiliary Module Control Wiring and Termination Qualification Review". June 1984

15. Duke Power Co. letter from G.T. Lamb to K.S. Canady, "Catawba Nuclear Station 1E Information Notice 80-08 States Sliding Link Terminal Block", File CN1412.11-1; EGS N-14.01, May 7, 1980.

16. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Fuel Oil Injection Tubing, Qualification Analysis", April 1984.

17. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Engine Driven Jacket Water Pump, Design Review", April 1984.

18. NRC letter of August 14, 1984 to H. B. Tucker of Duke Power Co. forward Staff Safety Evaluation Report pertaining to Catawba diesel generators.

19. Stone and Webster Engineering Corporation, "Emergency Diesel Generator, Auxiliary Module Control Wiring and Termination, Qualification Review", April 1984.

20. Duke Power Co., "Failure Analysis Report Catawba Nuclear Diesels 1A and 1B", June 26, 1984.

21. Stone and Webster Engineering Corporation, "Emergency Diesel Generator Air Start Valve Capscrew ,Dimension and Stress Analysis", March 1984 and Supplement, April 1984.

22. Stone and Webster Engineering Corporation, "Emergency Diesel Generator Rocker Arm Capscrew Stress Analysis", dated March 1984, and Supplement dated April 1984.

6.0 Appendices

A. Inspection Reports

B. Engineering Validation Report

APPENDIX A

INSPECTION REPORTS

Table of Contents

Table of Contents

Catawba Diesel 1B Inspection Report

Part Name: Air Start Valve Class: A

Part Number: 02-359 Work Request No. 1002 MNT

No. of Separate Inspections: 40

Attributes Verified and Sample Size

1. Measure length air start valve cap screws per 11.3.2, ref. 1, 8 insp.
2. Visual inspect valve seat area each valve per 11.3.3, ref. 1, 16 insp.
3. Visual inspect valve internal surfaces per 11.3.4, ref. 1, 16 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. The lengths of the air start valve capscrews were found to be satisfactory.
2. Visual inspections of the valve seating surfaces were satisfactory.
3. Visual inspections of the valve internal surfaces were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Intake and Exhaust Valves Class: B

Part Number: 02-360B Work Request No. 1002 MNT

No. of Separate Inspections: 264

Attributes Verified and Sample Size

1. Visual inspections on seat area, valve guides, valve stem surface and top per 11.4.2,3,4,5 ref.1, 256 insp.
2. Visual exam of valve head weld per 11.4.6 ref. 1, 8 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Visual inspections of the valve surfaces showed numerous area of pits and scratches. Eight valves had chipped or peeling chrome plating.

2. Visual inspections of the friction welds were satisfactory.

Disposition of Inspection Findings

1. The majority of the reported pits and scratches were evaluated as being the result of normal wear and valves with these indications have been determined to be acceptable for reuse. The valves with peeling and flaking chrome plating as well as valves with indications of the onset of chrome plating peeling are to be replaced with new valves.

Catawba Diesel 1B Inspection Report

Part Name: Valve Springs Class: B

Part Number: 02-360D Work Request No. 1002 MNT

No. of Separate Inspections: 128

Attributes Verified and Sample Size

1. Check spring color code per 11.4.7, ref. 1, 64 insp.
2. Visual check intake and exhaust valve spring per 11.4.8, ref. 1, 64 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Several valve springs were found to have possibly incorrect color codes.
2. One valve (7L intake) was discovered to have a cracked damper spring. (part no. 03-360-04AF)

Disposition of Inspection Results

1. The acceptance standards for the valve spring color codes was a white stripe down the side of the spring. In some instances the white stripe has been discolored by heat or oil staining. The valve springs were evaluated as being acceptable for re-use

2. The cracked damper spring was replaced.

Catawba Diesel 1B Inspection Report

Part Name: Cylinder Head Class: B

Part Number: 02-360A Work Request No. 1002 MNT

No. of Separate Inspections: 320

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 11.5.3, ref. 1,80 insp.
3. Perform ultrasonic thickness measurement of fire deck per 11.5.4, ref. 1, 96 insp.
4. Visual inspect fire deck area for evidence of weld repairs per 11.5.5, ref. 1, 16 insp.
5. Visual inspect fuel injection nozzle studs per 11.13, ref.1, 32 insp.
6. MT inspect fuel injection nozzle studs per 11.13.2, ref 1, 32 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Visual inspections of the valve seat contact areas showed four seats with scratches and pits.
2. One linear indication was noted on the #4 seat of cylinder head 2R.
3. Thickness of the fire deck ranged from .486 to .952 inches.
4. At the time of inspection, no cylinder heads showed signs of having been weld repaired. Three cylinder heads that were removed due to leaks showed evidence of weld repair.
5. Visual inspections of the fuel injector studs were satisfactory.
6. MT inspection demonstrated no rejectable indications.

Disposition of Inspection Findings

1. The valve seats with the defects noted above were resurfaced, lapped and valves were reinstalled.
2. Cylinder head 2R is to be replaced.
3. No unusually thin wall thickness were observed and all of the wall thicknesses are considered to be acceptable.
4. All cylinder heads replaced on the B engine were free from welded plugs.

Catawba Diesel 1B Inspection Report

Part Name: Subcover Assembly Class: B

Part Number: 02-362A Work Request No. 1002 MNT

No. of Separate Inspections: 80

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.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Visual inspections of the subcovers revealed minor chips and scratches.
2. Subcovers 1R and 7R showed 1 inch long indications in the pedestal sections by PT examination

Disposition of Inspection Findings

1. The small chips and scratches were evaluated as being of no significance.
2. The subcovers with PT indications have been replaced.

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Catawba Diesel 1B Inspection Report

Part Name: Intake and Intermediate Rocker Arm Assembly Class: B

Part No.: 02-390A Work Request No.: 1002 MNT

No. of Separate Inspections: 192

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. Visual inspect adjusting screw swivel pads per 11.7.6, ref. 1, 32 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Visual inspections of the rocker shaft assemblies were satisfactory.
2. Visual inspections of the rocker arm lips were satisfactory.
3. No lips were ground, so this procedure was not applicable.
4. Visual inspections of the sockets were satisfactory.
5. Visual inspections of the adjusting screw feet were satisfactory, however one swivel pad was found to be cracked during operation.

Disposition of Inspection Findings

5. The cracked swivel pad was determined to be the result of a manufactoring error. This part was replaced. One other swivel pad cracked when the rocker arm was knocked over in storage. This part was also replaced.

Catawba Diesel 1B Inspection Report

Part Name: Rocker Arm Bushings Class: B

Part No.: 02-390E Work Request No.: 1002 MNT

No. of Separate Inspections: 48

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/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Several of the rocker arm bushings inspected showed minor defects consistant with wear.

Disposition of Inspection Findings

1. The defects in these parts have been determined to be resultant of normal wear and the parts are considered acceptable for continued use.

Catawba Diesel 1B Inspection Report

Part Name: Exhaust Rocker Arm Assembly Class: B

Part No.: 02-390B Work Request No.: 1002 MNT

No. of Separate Inspections: 96

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. Visual inspect adjusting screw swivel pads per 11.8.6, ref. 1, 32 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. Visual inspection of the exhaust rocker arm shafts was satisfactory.
2. Visual inspections of the rocker arm lips were satisfactory.
3. No rocker arm lips were measured as none were ground.
4. Visual inspections of the rocker arm sockets were satisfactory.
5. Visual inspections of the adjusting screw pads were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Intake and Exhaust Pushrods Class: B

Part No.: 02-390C Work Request No.: 1002 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 spherical surfaces per 11.9.4, ref.1, 64 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. All pushrods were found to be friction welded on visual inspections.
2. PT exam of intake and exhaust pushrods showed no rejectable indications.
3. Visual inspections of pushrod spherical surfaces, showed one pushrod with minor defects.

Disposition of Inspection Findings

3. The minor defects shown on visual examination were evaluated to be the result of normal wear and the part will be re-used.

Catawba Diesel 1B Inspection Report

Part Name: Connector Pushrod Class: B

Part No.: 02-390D Work Request No.: 1002 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 spherical surfaces per 11.10.4, ref.1, 32 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts Special Inspection

Inspection Results

1. All pushrods were found to be friction welded.
2. PT exam of connector pushrods showed no rejectable indications.
3. Visual inspections of the pushrods were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Rocker Arm Bolting Class: B

Part No.: 02-390G Work Request No.: 1002 MNT

No. of Separate Inspections: 128

Attributes Verified and Sample Size

1. Magnetic particle test per 11.11.2, ref.1, 64 insp.
2. Visual inspect capscrews per 11.11.3 ref.1, 64 insp.

References

1. MP/0/A/1000/37 Diesel Engine Cylinder Head and Associated Parts

Inspection Results

1. MT examinations of the rocker arm capscrews showed no rejectable indications.
2. Visual inspection of the rocker arm capscrew showed a nick in the threads on cylinder 1R, otherwise the inspections were satisfactory.

Disposition of Inspection Findings

1. The minor defect noted above was considered to be the result of normal wear and the part was evaluated as acceptable for re-use.

Catawba Diesel 1B Inspection Report

Part Name: Connecting Rods and Bushings Class: A

Part Number: 02-340A Work Request No. 1003 MNT

No. of Separate Inspections: 264

Attributes Verified and Sample Size

1. Visual inspect connecting rods per 11.3.2, ref.1, 24 insp.
2. Perform PT test per 11.3.4 and 11.5.3, ref. 1, 8 insp.
3. Inspect connecting rod bolt contact surfaces per 11.4.1, ref. 1, 40 insp.
4. MT inspect connecting rod bolts per 11.4.2, ref. 1, 40 insp.
5. Visual inspect master rod and link rod piston pin bushings per 11.5.2, 16 insp.
6. Measure surface contact on each connecting rod serration by blueing per 11.11, ref.1 8 insp.
7. Measure connecting rod bushing demensions per 11.13, ref. 1, 120 insp.
8. Visual inspect link rod dowel per 11.14, ref. 1, 8 insp.

References

1. MP/0/A/1000/38 Diesel Engine Piston, Rod, Bushing and Shells Special Inspection

Inspection Results

1. Visual inspection of connecting rods showed several instances of minor scratches.
2. PT examinations showed areas of pitting on piston pin bushing 8L, otherwise there were no rejectible indications.
3. Connecting rod bolt contact surfaces were satisfactory.
4. MT examinations of the connecting rod bolts showed no rejectable indications. Five connecting rod bolt washer had linear indications.
5. Visual inspection of connecting rod bushings showed several instances of minor pits, scoring and scratches.
6. Surface contact of the connecting rod serrations was measured to be 80-95%.
7. All connecting rod bushing dimensions were satisfactory.
8. Visual inspections of the link rod dowels were satisfactory.

Disposition of Inspection Findings

1. The minor scratches on the connecting rods were considered acceptable.
2. The pitting shown on the PT examination was determine to be resultant of normal wear and is considered acceptable.

4. The linear indications on one washer polished out in aprox. .010 inches, i.e., were insignificant. Metallurgical exam showed no indication in the other four washers.
5. The indications noted were evaluated to be the result of normal wear and the bushings are acceptable for re-use.
6. Surface contact is within the TDI recommended clearances.

Catawba Diesel 1B Inspection Report

Part Name: Connecting Rod Bearing Shells Class: A

Part Number: 02-340B Work Request No. 1003 MNT

No. of Separate Inspections: 212

Attributes Verified and Sample Size

1. Visual inspect crankpin shells per 11.5.2, ref. 1, 20 insp.
2. Liquid penetrant inspect per 11.5.3, ref. 1, 16 insp.
3. X-ray inspection per 11.5.4, ref. 1, 8 insp.

References

1. MP/0/A/1000/38 Diesel Engine Piston, Rod, Bushing and Shell Special Inspection

Inspection Results

1. Visual inspection of the crankpin bearing shells showed multiple instances of minor scratching, pitting, and galling.
2. PT exams showed no rejectable indications.
3. RT examination showed one bearing shell half to be rejectable and two others which are limited to use as upper shells.

Disposition of Inspection Findings

1. The minor defects listed above were not considered to be excessive wear and not detrimental to engine performance.
3. The shell with a rejectable RT indication was will be replaced.

Catawba Diesel 1B Inspection Report

Part Name: Piston Class: A

Part Number: 02-341A Work Request No. 1003 MNT

No. of Separate Inspections: 96

Attributes Verified and Sample Size

1. Visual inspect fitup of crown to skirt per 11.6.1, ref. 1, 16 insp.
2. Liquid penetrant inspect stud bosses in crown and skirt area per 11.6.5, ref. 1, 160 insp.
3. Measure surface hardness of piston skirt per 11.8.4, ref. 1, 16 insp.

References

1. MP/0/A/1000/38 Diesel Engine Piston, Rod, Bushing and Shells Special Inspection

Inspection Results

1. Visual inspections of crown to skirt fitup were satisfactory.
2. PT exams of the piston stud bosses showed no rejectable indications.
3. The surface hardness of the piston skirt ranged from BHN 199-289.
4. PT inspections showed two areas of small rejectable indications in the piston pin race areas of pistons 3R and 6R. These appear to be areas of porosity and/or casting defects.
5. MT inspections showed two skirts with indications in the pad areas of belleville spring contact (1L,3L), two skirts with indications on the exterior surface (2L,2R), one skirt with a small circumferential indication in an interior rib (1L) and two skirts with axial indications in the interior ribs (1R,6L). All indications except the last two appear to be porosity and/or minor casting defects.

Disposition of Inspection Findings

3. The hardness of the piston skirts were on the average 12% less than those measured at the TDI factory. This discrepancy is thought to be the result of such effects as surface roughness and probe positioning and is considered acceptable.

4&5 These inspections were performed on the AN skirst removed from the engine. As the AN skirts were replaced with AE skirts, these inspections are provided for information only.

Catawba Diesel 1B Inspection Report

Part Name: Piston Pin Assembly Class: A

Part Number: 02-341C Work Request No. 1003 MNT

No. of Separate Inspections: 16

Attributes Verified and Sample Size

1. Visual inspect per 11.7.2, ref. 1, 16 insp.

References

1. MP/0/A/1000/38 Diesel Engine Piston, Rod, Bushings and Shells Special Inspection

Inspection Results

1. Visual inspection of the piston pins demonstrated one pin with a small chip and another with a small scratch, all others were satisfactory.

Disposition of Inspection Findings

1. Defects noted on visual inspection were evaluated as being cosmetic and the parts are considered acceptable for re-use.

Catawba Diesel 1B Inspection Report

Part Name: Crankshaft Thrust Bearing Ring Class: A

Part Number: 02-310C Work Request No.: 1007 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Measure thrust clearance per 11.3.1, ref. 1, 2 insp.

References

1. MP/0/A/1000/39 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1. Hot and cold clearances were found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Crankshaft Class: A

Part Number: 02-310A Work Request No.1007 MNT

No. of Separate Inspections: 36

Attributes Verified and Sample Size

1. Visual inspect crankpins 1-8 per 11.4.1, ref. 1, 8 insp.
2. Measure web clearance per 11.3.1, ref. 1, 16 insp.
3. PT inspect oil holes of main bearing journals per 11.6.1, ref.1. 6 insp.
4. ECT inspect oil holes per 11.6.2, ref. 1. 6 insp.

References

1. MP/0/A/1000/39 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly, and Crankcase Covers Special Inspection

Inspection Results

1. Results of the visual inspections of the crankpins were satisfactory.
2. Hot and cold clearances were satisfactory.
3. The results of the PT inspection of the oil holes were satisfactory.
4. Two small indications were found in oil hole 6 by ECT.

Disposition of Inspection Findings

4. The ECT indications were found in an area of machining marks. These indications were removed after polishing less than .001 inches.

Catawba Diesel 1B Inspection Report

Part Name: Crankcase Assembly Class: A

Part Number: 02-311A Work Request No. 1007 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 11.5.1, ref. 1, 18 insp.

References

1. MP/0/A/1000/39 Diesel Engine Crankshaft and Turning Gear, Gear, Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1. Visual inspections of the bolt hole matched surfaces were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Crankcase Covers Gaskets and Bolting Class: C

Part No.: 02-386B Work Request No.: 1007 MNT

No. of Separate Inspections: 16

Attributes Verified and Sample Size

1. Visual inspect crankcase covers per 11.5.2, ref 1, 16 insp.

References

1. MP/0/A/1000/39 Diesel Engine Crankcase and Turning Gear, Gear Crankshaft Bearings, Crankcase Assembly and Crankcase Covers Special Inspection

Inspection Results

1. Visual inspections of the crankcase covers were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Crankshaft Pump Drive Gear Class: A

Part Number: 02-355A Work Request No. 1005 MNT

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/0/A/1000/40	Diesel Engine Idler Gears and Pump Drive Gears Inspections and Adjustments

Inspection Results

1 & 2. Visual inspections of the two crankshaft gears were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Idler Gear Assembly Class: A

Part Number: 02-355B Work Request No. 1005 MNT

No. of Separate Inspections: 8

Attributes Verified and Sample Size

1. Visual inspect idler gears per 11.2.3, ref. 1, 2 insp.
2. Measure backlash of assembly per 11.3, ref. 1, 6 insp.

References

1. MP/0/A/1000/40 Diesel Engine Idler Gears and Pump Drive Gears Inspections and Adjustments

Inspection Results

1. Visual inspections of the idler gears were satisfactory.

2. Gear backlash was measured and found to be satisfactory for an engine that has seen extended service.

Disposition of Inspection Results

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Front Gear Case Bolting Class: C

Part Number: 02-335B Work Request No.: 1005 MNT

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/0/A/1000/41 Diesel Engine Gear Case Gaskets and Bolting Special Inspection

Inspection Results

1. The left front cover showed a concentration of oil near the gaskets.

2. One capscrew was found with no markings.

Disposition of Inspection Findings

1. The concentration of oil was determined to be the result of previous maintenance work and was not considered to be indicative of gasket leaks.

2. Capscrews found without markings were replaced with screws of appropriate grade.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-395B Work Request No.:1005 MNT

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/0/A/1000/41 Diesel Engine Gear Case Gaskets and Bolting Special Inspection

Inspection Results

1. The left side cover was found with a concentration of oil near the gaskets.

2. Five capscrews were found to have no markings.

Disposition of Inspection Findings

1. The concentration of oil was determined to have been the result of previous maintenance work and is not considered indicative of leaks.

2. Capscrews found with no markings were replaced with screws of appropriate grade.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-371B Work Request No.:1019 MNT

No. of Separate Inspections: 3

Attributes Verified and Sample Size

1. Visual inspect fuel pump linkage per 11.1.2, ref. 1, 2 insp.
2. Check site documentation to ensure adequate lubrication per 11.1.3, ref 1, 1 insp.

References

1. MP/0/A/1000/42 Diesel Engine Fuel Pump and Linkage - Special Inspection

Inspection Results

1. Visual inspections of the fuel pump linkage were satisfactory.
2. Site documentation was checked and an adequate lubrication schedule is in place.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1B Inspection Report

Part Name: Fuel Injection Pump Class: B

Part No.: 02-365A Work Request No.: 1010 MNT

No. of Separate Inspections: 32

Attributes Verified and Sample Size

1. Visual inspect for pump valve holder per 11.2.2, ref. 1, 16 insp.
2. MT inspect delivery valve assembly per 11.4.3, ref. 1, 16 insp.

References

1. MP/0/A/1000/42 Diesel Engine Fuel Pump and Linkage Special Inspection

Inspection Results

1. Visual inspections of the fuel pump valve holders were satisfactory.

2. MT inspections of the delivery valve blocks showed no rejectable indications.

Disposition of Inspection Findings

2. Three delivery valve blocks were found cracked during or after the extended run test. All valve blocks replaced on the engine were MT inspected and no rejectable indications were found.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Oil Filter Mounting Hardware Class: A

Part No.: 02-455C Work Request No.:1010 MNT

No. of Separate Inspections: 2

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 11.3.1. ref. 2. 1 insp.

References

1.	MP/0/A/1000/55	Diesel Engine Fuel Piping System Special Inspection
2	MP/0/A/1000/42	Diesel Engine Fuel Pump and Linkage Special Inspection

Inspection Results

1. Visual inspections of the mounting hardware were satisfactory.
2. Torque of the fuel oil filter bolt was found to be correct.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Lube Oil Internal Headers Class: A

Part No.: 02-307A Work Request No.:1015 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/1000/43 Diesel Engine Lube Oil System Piping and Sump Special Inspection

Inspection Results

1. Visual inspections of the lube oil internal headers were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Lube Oil Tubing and Fittings Class: A

Part No.: 02-307B Work Request No.: 1015 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

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

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

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil System Piping and Supports Special Inspection

Inspection Results

1&2 Visual inspections of the internal and external lube oil tubing and fittings were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Lube Oil Line Supports Class: B

Part No.: 02-307D Work Request No.: 1015 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/1000/43 Diesel Engine Lube Oil System Piping and Sump Special Inspection

Inspection Results

1. Visual inspections of the lube oil line supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: External Lube Oil Lines Class: A

Part No.: 02-465A Work Request No.: 1015 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/0/A/1000/43 Diesel Engine Lube Oil System Piping and Sump Special Inspection

Inspection Results

1. Visual inspections of the external lube oil lines were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: External Lube Oil Supports Class: A

Part No.: 02-465B Work Request No.: 1015 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/1000/43 Diesel Engine Lube Oil System Piping and Sump Special Inspection

Inspection Results

1. Visual inspections of the external lube oil supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbocharger Lube Oil Piping Class: B

Part No.: 02-467A Work Request No.: 1015 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect piping, tubing and fittings per 11.5, ref. 1, 1 insp.

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil Piping and Sump - Special Inspection

Inspection Results

1. Visual inspections of the turbocharger lube oil piping were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbo Lube Oil Piping Supports Class: B

Part No.: 02-467B Work Request No.:1015 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect turbo lube oil piping supports per 11.5, ref. 1, 1 insp.

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil Piping and Sump - Special Inspection

Inspection Results

1. Visual inspections of the turbo lube oil piping supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Lube Oil Sump Tank Class: B

Part No.: 02-540A Work Request No.: 1015 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil System Piping and Sump - Special Inspection

Inspection Results

1. Visual inspections of the lube oil sump tank were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Lube Oil Sump Tank Bolting Class: B

Part No.: 02-540B Work Request No.:1015 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Verify mounting bolts are correctly installed per 11.4.2, ref.1, 1 insp.

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil System Piping and Sump - Special Inspection

Inspection Results

1. Visual inspections of the lube oil sump tank bolting were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-540C Work Request No.:1015 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/1000/43 Diesel Engine Lube Oil System Piping and Sump - Special Inspection

Inspection Results

1. Visual inspections of the lube oil sump tank mounting hardware were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbo. Thrust Bearing Lube Oil System Class:C

Part No.: 02-CFR Work Request No.:1015 MNT

No. of Separate Inspections:1

Attributes Verified and Sample Size

1. Visual inspect turbo. thrust bearing lube oil system per 11.5, ref.1, 1 insp.

References

1. MP/0/A/1000/43 Diesel Engine Lube Oil Piping and Sump Special Inspection

Inspection Results

1. Visual inspections of the turbo thrust bearing lube oil system were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Cylinder Block Class: A

Part Number: 02-315A Work Request No. 1003 MNT

No. of Separate Inspections: 68

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/44 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspections

Inspection Results

1. Liquid penetrant of the cylinder block tops showed no rejectable indications.
2. UT was not necessary as PT results were satisfactory.
3. Dimensions of the cylinder liner landing area were taken and will be forwarded to the Owners Group.
4. PT examinations of the cylinder liner landing areas showed no rejectable indication.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Cylinder Liner Class: A

Part Number: 02-315C Work Request No. 1003 MNT

No. of Separate Inspections: 184

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, 96 insp.
3. Measure dist. cylinders protrude above block per 11.3.3, ref. 1, 64 insp.
4. Supplement visual inspections of liner per 11.6.3, ref. 1, 4 insp.
5. Dimensional insp. cylinder liner per 11.6.4, ref. 1, 4 insp.

References

1. MP/0/A/1000/44 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. Visual inspections of the cylinder liners showed minor scratches and scoring.
2. Measurements of the cylinder liner bore were within specified tolerances.
3. 23 of 64 measurements of cylinder liner protrusion were lower than nominal tolerances of .005 to .007 inches.
4. Supplemental visual inspections of the cylinder liners showed scuff marks and discolorations.
5. The dimensional inspections yielded the following results: O.D Lip - 19.497" - 19.499", O.D. seat surface - 18.988" - 18.993", Height - 1.504" - 1.505".

Disposition of Inspection Findings

1. Minor scratches in the cylinder liners were polished out by honing. The liners are considered acceptable for re-use.

3. Measured protrusion of the 23 measurements which were lower than the nominal ranged from .002 to .0045. This is considered acceptable for continued operation.

4. The scuff marks and discolorations found on supplemental inspections of the cylinder liners are considered to be the result of normal wear and are acceptable.

Catawba Diesel 1B Inspection Report

Part Name: Cylinder Head Studs Class: B

Part Number: 02-315E Work Request No. 1003 MNT

No. of Separate Inspections: 64

Attributes Verified and Sample Size

1. Inspect head studs for ID marks per 11.4.1, ref. 1, 32 insp.
2. Visual inspect head studs per 11.4.2, ref. 1, 32 insp.

References

1. MP/0/A/1000/44 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. Inspections of head studs showed appropriate identification numbers.
2. Visual inspections of cylinder head studs were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

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

Part Number: 02-315F Work Request No.1003 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/0/A/1000/44 Diesel Engine Cylinder Block, Cylinder Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. No identification marks were found on visual inspection.
2. No evidence of cracks or forging laps were found on visual inspection.

Disposition of Inspection Findings

1. Nut identification markings were for information only. No marks on the nuts were found. The nuts have performed satisfactorily in service and are therefore considered acceptable. There were no significant finds.

Catawba Diesel 1B Inspection Report

Part Name: Cylinder Block Jacket Water Manifold Class: A

Part Number: 02-315D Work Request No. 1003 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/1000/44 Diesel Engine Cylinder Block, Cylinder Liner and Jacket Water Manifold and Piping Special Inspection

Inspection Results

1. Visual inspections of the jacket water manifold were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Discharge Manifold Class: B

Part Number: 02-317A Work Request No. 1003 MNT

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/1000/44 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 inspections of the jacket water discharge manifold were satisfactory.

2. Walkdown inspections of the jacket water discharge manifold were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Camshaft Assembly Class: A

Part Number: 02-350A Work Request No. 1011 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/0/A/1000/45 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the camshaft lobes was satisfactory.
2. The inspection of the locking clips was satisfactory.

Disposition of Inspection Findings

1. There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Camshaft Bearing Class: A

Part Number: 02-350B Work Request No. 1011 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/1000/45 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 1B Inspection Report

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

Part Number: 02-350C Work Request No. 1011 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect left and right camshaft gears per 11.5.4, ref. 1, 2 insp.

References

1. MP/0/A/1000/45 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the camshaft gears was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Intake Tappets Class: A

Part Number: 02-345A Work Request No. 1011 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/0/A/1000/45 Diesel Engine Camshaft, Camshaft gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspections of the intake and exhaust tappet rollers were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Tappets Class: A

Part Number: 02-345B Work Request No. 1011 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/0/A/1000/45 Diesel Engine Camshaft, Camshaft Gear and Tappet Assembly Special Inspection

Inspection Results

1. Visual inspection of the fuel tappet rollers was satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Intake Manifolds Class: B

Part No.: 02-375 Work Request No.: 1002 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/1000/46 Diesel Engine Intake and Exaust Manifolds Special Inspection

Inspection Results

1. Visual inspections of the intake manifolds showed several instances of nicks, scratches and burrs.

Disposition of Inspection Findings

1. The minor scratches and nicks found on visual inspection are the result of normal wear and are considered acceptable.

Catawba Diesel 1B Inspection Report

Part Name: Exhaust Manifold Bolting Class: B

Part No.: 02-380B Work Request No.:1002 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/1000/46 Diesel Engine Intake and Exaust Manifolds Special Inspection

Inspection Results

1. Lengths of the capscrews were within specified tolerances.
2. Depths of the capscrew holes were satisfactory.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1B Inspection Report

Part Name: Exhaust Manifold Class: B

Part No.: 02-380A Work Request No.: 1002 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, 16 insp.
2. Visual inspect exhaust manifold per 11.3, ref. 2, 1 insp.

References

1.	MP/0/A/1000/46	Diesel Engine Intake and Exhaust Manifolds - Special Inspection
2.	MP/0/A/1000/56	Diesel Engine Exhaust Manifold - Special Inspection

Inspection Results

1. Visual inspections of the exhaust manifold to flange weld were satisfactory.

2. Visual inspections of the exhaust manifold were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Overspeed Trip Drive Coupling Class: A

Part No.: 02-410C Work Request No.: 1008 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Note condition of elastomer piece per 11.3.1.1, ref. 1, 1 insp.

References

1. MP/0/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drives Disassembly Inspection and Reassembly

Inspection Results

1. The elastomer piece was found in satisfactory condition.

Disposition of Inspection Findings

There were no significant findings

Catawba Diesel 1B Inspection Report

Part Name: Overspeed Trip and Accessory Drive Class: A

Part No.: 02-410B Work Request No.: 1008 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect O.S. trip drive drive gear per 11.3.2.1, ref.1, 1 insp.
2. Visual inspect O.S.trip drive driven gear per 11.3.2.2, ref.1, 1 insp.

References

1. MP/0/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drive - Disassembly, Inspection, and Reassembly

Inspection Results

1&2 The visual inspections of the drive and driven gears were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-411A Work Request No.: 1008 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect larger horizontal shaft drive gear per 11.5.2.1, ref. 1, 1 insp.
2. Visual inspect small horizontal shaft drive gear per 11.5.2.2, ref. 1, 1 insp.

References

1. MP/O/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drive-Disassembly, Inspection, and Reassembly

Inspection Results

1&2 Visual inspections of the drive gears were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-411B Work Request No.: 1008 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect coupling halves, shaft ends and spacers per 11.5.2.3, ref. 1, 2 insp.

References

1. MP/0/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drives Disassembly Inspection and Reassembly.

Inspection Results

1. Visual inspections of the coupling components were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-413B Work Request No.:1008 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Check linkage action per 11.6.1, ref. 1, 1 insp.
2. Visual inspect cross shaft assembly per 11.6.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drives - Disassembly, Inspection, and Reassembly

Inspection Results

1. The extensible linkage action was found satisfactory.
2. Visual inspections of the cross shaft assembly were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Speed Regulating Gov. Linkage Class: A

Part No.: 02-413A Work Request No.: 1008 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Check linkage action per 11.6.1., ref. 1, 1 insp.
2. Visual inspect cross shaft per 11.6.2., ref. 1, 1 insp.

References

1. MP/0/A/1000/47 Diesel Engine Governor and Overspeed Trip Accessory Drives Disassembly Inspection and Reassembly

Inspection Results

1&2 Linkage and shaft visual inspections were found to be satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Flywheel Bolting Class: A

Part Number: 02-330B Work Request No. 1009 MNT

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/1000/48 Diesel Engine Flywheel Bolting Special Inspection

Inspection Results

1. Visual inspection for loose roll pins showed all roll pins to be satisfactory.
2. Correct torques for the flywheel bolting were established by documentation.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbocharger Class: A

Part No.: MP/022/3 Work Request No.:1002 MNT

No. of Separate Inspections: 30

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 11.6.1, ref.1, 16 insp.

References

1. MP/0/A/1000/49 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

The inspections of the turbochargers were not performed as the turbochargers were replaced due to severely worn thrust bearings. One turbo-exhaust manifold bolt was found cracked.

Disposition of Inspection Findings

The turbochargers were replaced with newly rebuilt units. The turbo-exhaust manifold bolts were replaced with improved bolts.

Part Name: Turbocharger Bracket Class: B

Part No.: 02-475A Work Request No.: 1004 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visually inspect support bracket per 11.3.2, ref.1, 1 insp.

References

1. MP/0/A/1000/49 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Visual inspections of the turbocharger bracket were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbocharger Bracket Bolting Class: B

Part No.: 02-475D Work Request No.: 1004 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect bolted joint per 11.4.3, ref. 1, 2 insp.

References

1. MP/0/A/1000/49 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. One turbocharger to bracket capscrew was found broken before the extended run test. All screws were replaced before the extended run and have performed well.

Disposition of Inspection Findings

There were no significant findings.

Part Name: Intercooler Class: B

Part No.: F-086 Work Request No.: 1004 MNT

No. of Separate Inspections: 8

Attributes Verified and Sample Size

1. Visual inspection of intercooler and inlet and outlet adaptors per 11.5.2, ref. 1, 6 insp.

2. Perform PT or MT exam of each intercooler inlet adaptor flange weld per 11.5.3, ref. 1, 2 insp.

References

1. MP/0/A/1000/49 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. Visual inspections of the intercoolers and inlet and outlet adaptors were satisfactory.

2. The right bank flange weld had a crack which was found visually. The left bank showed no rejectable indications. A small crack was also noted in the air flow divider to case junction.

Disposition of Inspection Findings

2. A flexible coupling and strongbacks were installed at this location to ensure that these problems will not reoccur.

Catawba Diesel 1B Inspection Report

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

Part No.: 02-436B Work Request No.: 1004 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Check dresser coupling on piping per 11.5.4, ref. 1, 1 insp.

References

1. MP/0/A/1000/49 Diesel Engine Turbocharger and Intercooler - Special Inspection

Inspection Results

1. The 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

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Standpipe Fittings & Gaskets Class: B

Part No.: 00-700A Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect system per 11.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the jacket water standpipe fittings were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Standpipe Supports Class: B

Part No.: 00-700C Work Request No.: 1088 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/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the jacket water standpipe supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Standpipe Bolting Materials Class: B

Part No.: 00-700F Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect bolting per 11.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the jacket water standpipe bolting were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Manifold Assembly Class: B

Part No.: 02-316A Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections ofthe jacket water manifold assembly were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Inlet Manifold Coupling Class: B

Part No.: 02-316B Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the jacket water inlet manifold coupling were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Discharge Manifold Coupling Class: B

Part No.: 02-317B Work Request No. 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect coupling per 11.5, ref. 1, 1 insp.

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections ofthe jacket water discharge manifold coupling were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Jacket Water Discharge Manifold Supports Class: B

Part No.: 02-317C Work Request No.: 1088 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/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the jacket water discharge manifold supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbo Cooling Water Pipe and Fittings Class: B

Part No.: 02-437A Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect system per 11.5, ref. 1, 1 insp.

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System, Piping, Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the turbo cooling water piping were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Turbo Cooling Water Pipe Supports Class: A

Part No.: 02-437B Work Request No.: 1088 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect supports per 11.5, ref. 1, 1 insp.

References

1. MP/0/A/1000/53 Diesel Engine Jacket Water System Piping Standpipe and Manifold - Special Inspection

Inspection Results

1. Visual inspections of the turbo cooling water pipe supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Start Air Manifold Pipe, Tubing & Fittings Class: A

Part No.: 02-441A Work Request No.:1087 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/54 Diesel Engine Air Start Piping System - Special Inspection

Inspection Results

1. Visual inspections of the start air manifold system showed the pipe to be in conformance with the drawings.

Disposition of Inspection Findings

1. No discrepancies were found.

Catawba Diesel 1B Inspection Report

Part Name: Start Air Manifold Pipe Supports Class: A

Part No.: 02-441C Work Request No.:1087 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/1000/54 Diesel Engine Air Start Piping System - Special Inspection

Inspection Results

1. Results of the visual inspections of the air start manifold pipe supports showed minor discrepancies with the drawings.

Disposition of Inspection Findings

1. The minor discrepancies revealed by the inspections have not affected the start air system and are not considered a problem.

Catawba Diesel 1B Inspection Report

Part Name: Start Air Distributor Tubing, Ftngs, & Gskts Class: A

Part No.: 02-442B Work Request No.: 1087 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect distributor tubing system per 11.4, ref.1, 1 insp.

References

1. MP/0/A/1000/54 Diesel Engine Air Start Piping System - Special Inspection

Inspection Results

1. Visual inspections of the start air distributor tubing, fittings and gaskets showed them to be in conformance with the drawings.

Disposition of Inspection Findings

1. No discrepancies were found.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Injection Tubing Class:B

Part No.: 02-365C Work Request No.:1090 MNT

No. of Separate Inspections: 17

Attributes Verified and Sample Size

1. Visual inspect tubing per 11.2 ref. 1, 1 insp.
2. Eddy current inspect tubing per 11.3 ref. 1, 16 insp.

References

1. MP/O/A/1000/55 Diesel Engine Fuel Oil Piping System-Special Inspection.

Inspection Results

1. Visual inspections of the fuel injection tubing was satisfactory.
2. Eddy current inspections demonstrated no rejectable indications.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Injection Tubing Supports Class:B

Part No.: 02-365D Work Request No.:1090 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect tubing supports per 11.2, ref. 1, 1 insp.

References

1. MP/O/A/1000/35 Diesel Engine Fuel Oil Piping System - Special Inspection.

Inspection Results

1. Visual inspections of the fuel injection tubing supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Oil Piping and Tubing Class: A

Part No.: 02-450B Work Request No.:1090 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect system per 11.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/55 Diesel Engine Fuel Oil Piping System - Special Inspection

Inspection Results

1. Visual inspections of the fuel oil piping and tubing were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Fuel Oil Piping Supports Class: A

Part No.: 02-450D Work Request No.: 1090 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect supports per 11.2, ref. 1, 1 insp.

References

1. MP/0/A/1000/55 Diesel Engine Fuel Oil Piping System - Special Inspection

Inspection Results

1. Visual inspections of the fuel oil piping supports were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Control Panel Piping, Tubing, and Fittings Class: B

Part No.: 02-500M Work Request No.: 1089 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

1. Visual inspect tubing and fittings per 11.4, ref. 1, 1 insp.

References

1. MP/O/A/1000/57 Diesel Engine Shutdown Tubing and Electrical Conduit - Special Inspection.

Inspection Results

1. Results of the visual inspections of the control panel tubing and fittings were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Engine and Auxiliary Module Wiring Conduit Class: A

Part No.: 02-688A Work Request No.:1089 MNT

No. of Separate Inspections: 1

Attributes Verified and Sample Size

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

References

1. MP/0/A/1000/57 Diesel Engine Shutdown Tubing and Electrical Conduit Special Inspection

Inspection Results

1. Visual inspections of the engine and auxiliary module wiring conduit were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

Catawba Diesel 1B Inspection Report

Part Name: Engine Shutdown Tubing and Fittings Class: B

Part No.: 02-695A Work Request No.:1089 MNT

No. of Separate Inspections: 2

Attributes Verified and Sample Size

1. Visual inspect engine mounted tubing per 11.2, ref.1, 1 insp.

2. Visual inspect panel mounted tubing per 11.3, ref. 1, 1 insp.

References

1. MP/0/A/1000/57 Diesel Engine Shutdown Tubing and Electrical Conduit Special Inspection

Inspection Results

1&2 Visual inspections of engine and panel mounted shutdown tubing and fittings were satisfactory.

Disposition of Inspection Findings

There were no significant findings.

APPENDIX B

ENGINEERING VALIDATION REPORT

SELECTED CATAWBA 1B DIESEL PARTS

TABLE OF CONTENTS

B1.0 Introduction

The purpose of this report is to document the results of the engineering validation performed for selected parts of the Catawba 1B 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 some 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 of of this information was then performed to assess the condition and quality of the parts. Items appearing in Table B2-1 are an abbreviated list of the engineering validation components checked on diesel 1A (See Table B2-1, reference 3). The maintenance and operating logs for diesel 1B were searched to ascertain whether any of the diesel 1A components not appearing herein had any problems. No problems were uncovered.

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

B2.0 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/1000/35 through 51); 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/1000/53 through 57).

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

Part No.	Part Name	Class
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
02-311B	CAM BEARING CAPS AND DOWELS	B
02-415B	GOVERNOR BOOSTER SERVOMOTOR	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
02-630D	INSTRUMENTATION THERMOCOUPLES	B
02-688B	ENGINE AND AUX MODULE WIRING	A
02-688C	ENGINE AND AUX MODULE WIRING BOXES	A
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
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	FULL 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
SE-025	LUBE OIL FULL PRESSURE STRAINER	A

B3.0 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: The valve leaked at one of the flanges during July 1983. The flange was retorqued which stopped the leak. No unscheduled maintenance was required during extended run.

Visual Observation: The valve was visually observed by T. R. Jennings on September 21, 1984,

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: No visual observations were conducted.

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 switch 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: The switches have operated satisfactorily with no reported problems.

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 not visually observed.

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

B3.5 Part No.: 02-311B

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 755 hours of operation. Camshafts showed no wear of cam lobes, hence cam bearings are fullfilling 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.: 02-415B

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 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.

B3.7 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 T. R. Jennings on September 19, 1984 and appeared normal.

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

B3.8 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 performed 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.

B3.9 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.

B3.10 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: The control air system valves have performed satisfactorily with no maintenance required.

Maintenance History: No corrective maintenance has been performed. on the 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 indended 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.

B3.11 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.

B3.12 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.

B3.13 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.

B3.14 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.

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. 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.

B3.15 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 (jacket water and lube oil). This situation was corrected by replacing the thermocouples on March 6, 1984. The replacement thermocouples have performed satisfactorily.

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

B3.16 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 indicates that three cables must be replaced (see section 4.1.10)

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. The three cables which did not meet class 1E cabling requirements have been replaced.

B3.17 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/1000/57.

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.

B3.18 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.

ATTACHMENT TO B3.18

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

B3.19 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 with only periodic recalibration required.

Maintenance History: The only maintenance performed on the off engine safety alarm sensors has been periodic recalibration.

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.

ATTACHMENT TO B3.19

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

B3.20 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: The valves, regulators and orifices have demonstrated satisfactory performance requiring no corrective maintenance.

Maintenance History: 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.

B3.21 Part No.: 02-695C

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.

B3.22 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-H, 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 the periodical cleaning of the strainer elements and repair two fuel oil leaks.

Visual Observation: The strainer was observed by T. R. Jennings on September 19, 1984 and appeared normal.

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

B3.23 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.

Maintenance History: No maintenance has been required.

Visual Observation: No visual observation was made.

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

B3.24 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.

B3.25 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 September 20, 1984 by T.R. Jennings and appeared normal.

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

B3.26 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: Only routine preventive maintenance was performed on this pump.

Visual Observation: The pump installation was observed and appeared normal.

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

B3.27 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: Filter elements and o-rings have been periodically replaced.

Visual Observation: The filters were observed on September 19, 1984 by T. R. Jennings 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.

B3.28 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: The head bolts had to be torqued to stop a cooling water leak.

Visual Observation: The heat exchanger installation was observed on September 19, 1984 by T. R. Jennings 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.

B3.29 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 and pedestal torque checks. 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 September 19, 1984 by T. R. Jennings 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.

B3.30 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 as evidenced by satisfactory jacket water temperatures during diesel operation.

Maintenance History: No corrective maintenance has been required.

Visual Observation: The jacket water heat exchanger installation was observed 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.

B3.31 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 not observed as part of the engineering validation.

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

B3.32 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 not observed as part of the engineering validation.

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

B3.33 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 by T. R. Jennings on September 20, 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.

B4.0 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".