GULF STATES UTILITIES COMPANY
POST OFFICE BOX 2951 • BEAUMONT, TEXAS 77704
AREA CODE 713 838-6631

July 19, 1984
RBG- 18,244
File No. G9.5,

Mr. H. R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

River Bend Station - Unit 1
Docket No. 50-458

Enclosed for your review is Gulf States Utilities Company (GSU) program plan for evaluating and testing the standby diesel generators manufactured by Transamerica Delaval Inc. (TDI).

In November, 1983, GSU initiated the Diesel Qualification Program at River Bend Station and has been involved in the TDI Owners Group (TDIOG) since December, 1983. The program presented herein includes all recommended actions of the TDIOG and the manufacture.

This program plan addresses the plans for testing scheduled to commence at the end of this month, the post-testing inspection, and long term surveillance and monitoring. In addition, GSU is requesting changes to the number of start tests and to the overload test being performed on these engines.

Sincerely,

William J. Booker Jr.

J. E. Booker
Manager-Engineering
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/JEP/kt

B001
1/1

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This topical report has three purposes:

(1) To present GSU's Program Plan to qualify the Transamerica Delaval, Inc. (TDI) manufactured standby diesel generators for River Bend Station.

(2) To provide the Staff an opportunity to review, in advance, the plans for testing, post test inspection, and long term surveillance and monitoring.

(3) To submit for NRC Staff review, the current results of design review and preservice inspection activities at River Bend Station.

GSU initiated the Diesel Qualification Program at River Bend Station in Novemb. r, 1983 in response to TDI diesel component failures elsewhere and identified potential deficiencies in TDI's quality assurance program.

The objectives of the River Bend Diesel Qualifications Program are:

(1) To evaluate the TDI diesels and;

(2) to determine what is necessary to assure reliable standby power at River Bend Station. The Diesel Qualification Program includes activities to solve the known problems of the TDI diesels and;

(3) to obtain NRC approval of the standby power supplies for River Bend Station.

The GSU approach to qualification of the TDI diesels is:

(1) To correct the known problems before the diesels are operated at River Bend Station. This involves preservice engine disassembly for inspection, upgrading, and rebuilding.

(2) To confirm engine reliability by testing and post test inspection, without engine disassembly.

(3) To assure continued diesel reliability by a program of inservice surveillance, inspection, monitoring, and preventative maintenance.

The feasibility of this approach has been established through the design reviews provided by the TDI Diesel Generator Owners Group, the testing and inspections performed by the TDI diesel owners, and the product improvement recommendations provided by TDI. GSU and its contractors have devoted an intensive effort to accumulate this experience and to implement corrective action to improve diesel generator reliability prior to operation of the engines at River Bend Station. After rebuilding, the engines will be tested to confirm operational reliability. After testing, the engines will be inspected to identify latent defects not disclosed during rebuilding or testing. This inspection will involve minor disassembly, sufficient to detect latent problems, but not so extensive as to require retesting.

Figure 1 shows the logical relationship of program tasks, and Figure 2 shows the program schedule. The initial phase involves evaluation of industry experience, design review recommendations, and preservice inspection results. The second phase involves engine rework, rebuilding, confirmatory testing and post test inspection. This phase is expected to result in successful qualification of the TDI diesels.

The last phase is a program of continuing surveillance, inspection, monitoring, and preventative maintenance. The continuing surveillance and monitoring program will be finalized after the post test inspection is completed.

This report describes the plans for design reviews, inspections, testing, and long term preventative maintenance, surveillance and monitoring. The format of the report permits the results of ongoing activities to be added by revisions or supplements as the work proceeds. When complete, the report will describe, or incorporate by reference, the results of the design reviews, preservice inspections, rework activities, testing, and post test inspections. Data presented is current as of July 5, 1984.

FIGURE 1
RIVER BEND DIESEL ACTIVITIES

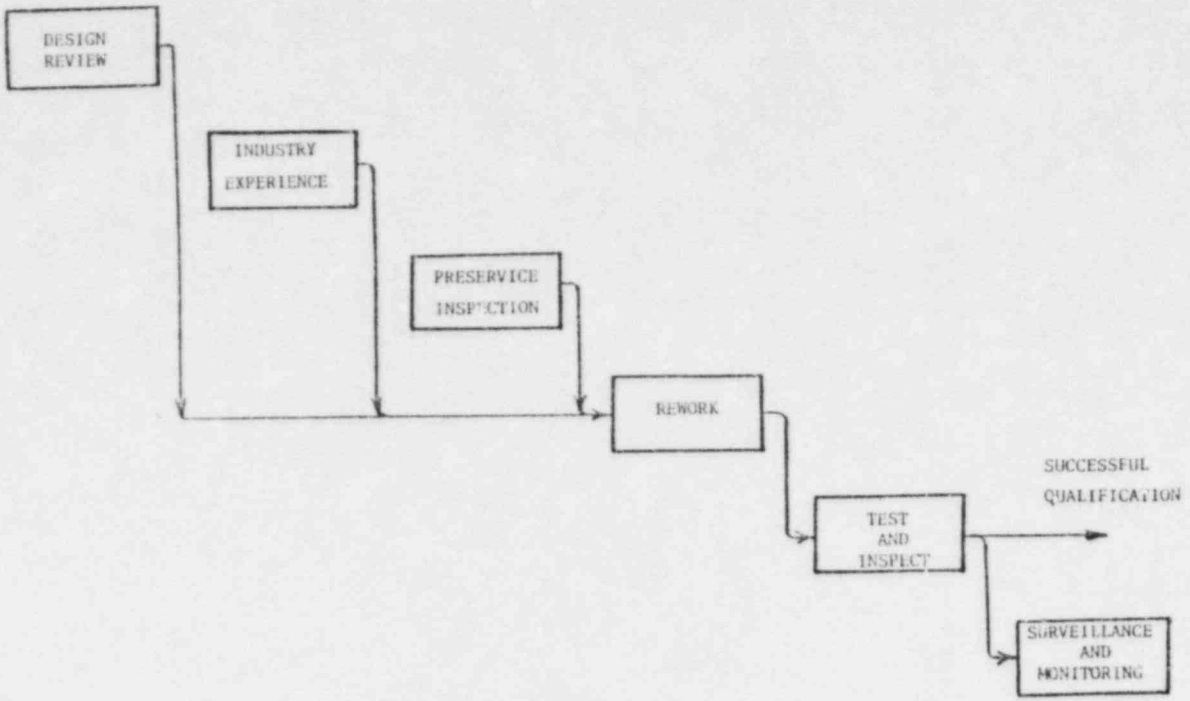
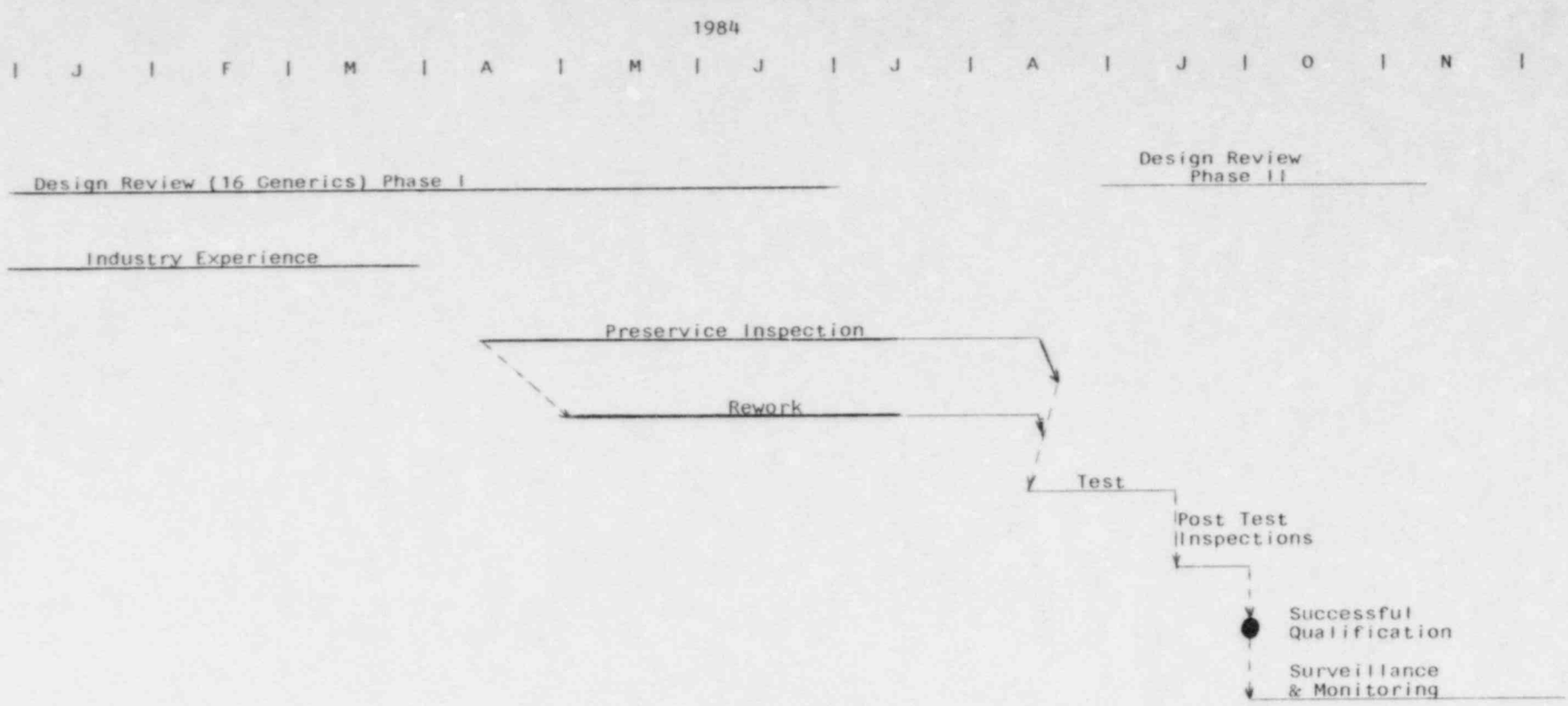


FIGURE 2
PROGRAM SCHEDULE



2.0 PROGRAM ACTIVITIES

The following subsections detail the work to be performed and current results.

2.1 Industry Experience Review

The purpose of this activity is to define the known problems of the TDI engines and to determine if these problems might be applicable to River Bend Station.

- Review of industry experience data accumulated by the TDI Diesel Generator Owners Group.

- Visits by River Bend Project Personnel to observe diesel inspections at other nuclear stations.

- Participation in TDI Diesel Owners Group meetings and activities.

- Informal exchange of information with other TDI diesel owners.

The accumulated experience is evaluated for applicability to the River Bend Station diesels. Those items considered applicable are further investigated. This either is done as part of the TDI Diesel Generator Owners Group Review Quality Revalidation effort, or they are added to the work list of inspections, tests, or investigations conducted by GSU and its contractors at River Bend Station. Results of industry experience reviews conducted to date are reflected in the plans for design review, preservice inspection, rework, testing, post test inspection, and surveillance and monitoring which are described in later sections of this report.

2.2 Design Review

The purpose of this activity is to verify the design adequacy of the diesel generator components and systems. The TDI Diesel Generator Owners Group will perform design reviews of TDI supplied components whose failure might affect the safety functions of the diesel generators.

Table 1 lists the TDI supplied components to the parts group level as listed in the TDI parts manual. For each component, the table lists the design review report reference, and summarizes the conclusions of the design review. Those reports listed are thereby incorporated by reference in this report. Product improvements or upgrades are also identified in the table.

TABLE 1
DESIGN REVIEWS

NOTE: DATA CURRENT TO 07/05/84

COMPONENT NUMBER	DESCRIPTION (IMPROVEMENTS)	DESIGN REVIEW REFERENCE	REPORT CONCLUSIONS
03-305	Base and Bearing Caps	Ref. 14	Adequate, subject to inspection
03-307	Lube Oil Fittings-Internal	Phase 2	
03-310	Crankshaft and Main Bearings	Ref. 15	Adequate for Shoreham. River Bend Report to be submitted 11/84
03-315	Cylinder Block Liners and Water Manifold (see Section 2.4)	Ref. 5,7,8	Adequate, subject to inspection.
03-317	Water Discharge Manifold	Phase 2	
03-330	Flywheel	Phase 2	
03-331	Flywheel Guard	Not Required	
03-335	Gear Case	Not Required	
03-340	Connecting Rods	Ref. 3,12	Adequate, subject to inspection.
03-341	Piston (AE Pistons installed, see Section 2.4)	Ref. 1, 2	Adequate
03-345	Tappets and Guides	Phase 2	
03-350	Camshaft-Cam Bearing and Cam Gear	Phase 2	
03-355	Idler and Miscellaneous Gears (see Section 2.4)		
03-359	Air Start Valve	Ref. 13	Adequate
03-360	Cylinder Head and Valves	Ref. 4	Adequate. Fire deck thickness and casting quality to be verified, and replaced where necessary. Group II heads require periodic leak testing
03-361	Cylinder Indicating Locks	Not Required	
03-362	Cylinder Head Covers	Phase 2	
03-365	Fuel Injection Equipment	Ref. 11	Adequate if inspection criteria are met
03-371	Fuel Pump Linkage	Phase 2	

TABLE 1
DESIGN REVIEWS
(Continued)

NOTE: DATA CURRENT TO 07/05/84

COMPONENT NUMBER	DESCRIPTION (IMPROVEMENTS)	DESIGN REVIEW REPORT REFERENCE	CONCLUSIONS
03-375	Intake Manifold	Phase 2	
03-380	Exhaust Manifold	Phase 2	
03-385	Covers-Cylinder Block	Phase 2	
03-387	Crankcase Ventilator	Phase 2	
03-390	Rocker Arms and Pushrods (friction welded pushrods, see section 2.4)	Ref. 10,16	Rocker arms adequate, subject to inspection Pushrods upgraded to friction welded design which is adequate
03-402	Governor Drive	Phase 2	
03-410	Overspeed Trip	Phase 2	
03-413	Governor Linkage	Phase 2	
03-415	Governor	Phase 2	
00-420	Pressure Regulating Valve-Lube Oil	Phase 2	
03-420	Lube Oil Pump-Engine Driven	Phase 2	
03-425	Water Pump Jacket Water	Ref. 6	Replace impeller change material and eliminate keyway.
03-435	Jacket Water Fittings	Phase 2	
03-437	Turbocharger-Water Fittings	Phase 2	
03-441	Starting Air Lines	Phase 2	
03-442	Starting Air Distributor	Phase 2	
03-445	Fuel Booster Pump	Phase 2	
03-460	Strainer, Duplex Lube Oil	Phase 2	
03-465	Lube Oil Fittings	Phase 2	
03-467	Turbocharger Lube Oil Fittings	Phase 2	
NB-002	Intercooler	Phase 2	

TABLE 1
DESIGN REVIEWS
(Continued)

NOTE: DATA CURRENT TO 07/05/84

COMPONENT NUMBER	DESCRIPTION (IMPROVEMENTS)	DESIGN REVIEW REFERENCE	REPORT CONCLUSIONS
03-475	Turbocharger and Intercooler Brackets	Phase 2	
MP-020	Turbocharger	Ref. 9	Modify prelube system. Preiodic inspection of bearings
00-491	Air Inlet Adapter	Not Required	
00-495	Exhaust Outlet Adapter	Not Required	
03-503	Thermometer	Not Required	
03-500	Control Panel	Phase 2	
03-515	Thermostatic Valve	Phase 2	
03-520	Instruction Plates	Not Required	
03-525	Barring Device-Pneumatic	Phase 2	
03-530	Engine Platform	Not Required	
03-531	Platform, Ladder	Not Required	
03-540	Lube Oil Sump Tank	Phase 2	
03-550	Foundation Bolts	Phase 2	
03-630	Pyrometer Conduit	Phase 2	
03-650	Electrical Equipment	Phase 2	
03-688	Electrical Wiring	Phase 1	
03-689	Off Engine Wiring	Phase 2	
03-690	Safety Alarm On Engine	Phase 2	
03-691	Off Engine Alarm Sensors	Phase 2	
03-695	Safety Shutdown	Phase 2	
03-700	Standpipe	Phase 2	

TABLE 1
DESIGN REVIEWS
(Continued)

NOTE: DATA CURRENT TO 07/05/84

COMPONENT NUMBER	DESCRIPTION (IMPROVEMENTS)	DESIGN REVIEW REPORT REFERENCE	CONCLUSIONS
03-715	Sub Base	Phase 2	
03-717	Auxiliary Skid	Phase 2	
03-800	Heater, Jacket, Water Heater, Lube Oil Sump Tank	Phase 2	
03-805	Intake and Exhaust Equipment	Phase 2	
03-810	Jacket Water Equipment	Phase 2	
03-820	Lube Oil Equipment	Phase 2	
03-825	Fuel Oil Equipment	Phase 2	

Design Review Report References:

1. Investigation of Type AF and AE Piston Skirts. TDI Owners Group letter OGTP-41; C.L. Ray Jr to H.R. Denton, 5/24/84

2. The Influence of Thermal Distortion on the Fatigue Performance of AF and AE Piston Skirts; TDI Owners Group letter OGTP-72; C.L. Ray Jr to H.R. Denton, 6/14/84.

3. Design Review of Connecting Rods TDI Inline DSR-48 Emergency Diesel Generators; TDI Owners Group letter OGTP-79; 6/18/84.

4. Evaluation of Cylinder Heads of TDI Series R-4 Diesel Engines; TDI Owners Group letter OGTP-25; C.L. Ray Jr. to H.R. Denton, 5/14/84.

5. Design Review of TDI R-4 Series Emergency Diesel Generators Cylinder Blocks and Liners; TDI Owners Group letter OGTP-90; C.L. Ray Jr. to H.R. Denton, 6/25/84.

6. Emergency Diesel Generator Engine Driven Jacket Water Pump Design Review; TDI Owners Group letter TDI-15; W.J. Museler to H.R. Denton 4/16/84.

7. Emergency Diesel Generator Cylinder Head Stud Analysis; TDI Owners Group letter TDI-8; W.J. Museler to H.R. Denton, March 30, 1984.

8. Supplement to the Emergency Diesel Generator Cylinder Head Stud Stress Analysis; April 1984.

9. Design Review of Elliot Model 90G Turbocharger used on TDI DSR-48 and DSRV-16 Emergency Diesel Generator Sets; TDI Owners Group letter OGTP-26; C.L. Ray to H.R. Denton 5/14/84.

10. Design Review of Rocker Arm Capscrews; TDI Owners Group letter TDI-19; W.J. Museler to H.R. Denton, 4/25/84.

11. Design Review of Fuel Oil Injection Tubing; TDI Owners Group letter OGTP-8; C.L. Ray to H.R. Denton, 4/27/84.

12. Design Review of Connecting Rod Bearing Shells; W.J. Museler to H.R. Denton, 3/12/84.

13. Design Review of Air Start Valve Compressor Dimension and Stress Analysis; TDI Owners Group letter TDI0-5; W.J. Museler to H.R. Denton, 3/15/84.

14. Design Review of Engine Base & Bearing Caps; TDI Owners Group letter OGTP-10; C.L. Ray to H.R. Denton, 4/27/84.

15. Design Review of Crankshaft; TDI Owners Group letter TDI-17; W.J. Museler to H.R. Denton, 4/20/84.

16. Design Review of Pushrods; TDI Owners Group letter TDI-16; W.J. Museler to H.R. Denton, 4/19/84.

2.3 Preservice Inspection

The purpose of the preservice inspection effort is to verify that the installation is complete and correct and that the manufactured quality of the engines comply with the design requirements. This will be done in three steps:

(1) As built installation verification. This includes inspections by TDI and major subvendors to TDI, including Electric Products (electric generator), RTE Delta (switchgear), Elliot (turbocharger), and Woodward (governor). In addition, GSU inspects other components selected from industry experience information. The purpose of these inspections is to verify that the engine installation is complete and correct. A list of inspections performed and the results are listed in Table 3.

(2) Preliminary testing of auxiliary components and systems. The purpose of these tests is to verify that auxiliary systems, interlocks, controls, and alarms operate in accordance with specifications. This includes system flushing, hydrostatic testing, relief valve testing for setpoint and seal leakage, initial startup, operation, and performance testing and vibration testing of pumps and compressors, performance testing of air dryers, and individual checkout of all electrical components and instrument loops.

(3) Preservice disassembly inspection. The purpose of this inspection is to verify that the manufactured quality of the engines is in accordance with the requirements established by the TDI Diesel Generator Owners Group design reviews. This inspection involves removal of cylinder heads, pistons, connecting rods, and cylinder liners for detailed part-by-part inspection. In addition, the turbochargers will be disassembled for inspection. Inspection of the crankshaft, gear case, and camshaft will be performed in situ.

Table 3 lists the engine component groups, the inspection methods employed, and inspection results. Where parts are replaced, the replacements are subjected to the same inspections.

TABLE 3
PRESERVICE INSPECTIONS

DATA CURRENT TO: 07/05/84

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS DIESEL A	RESULTS DIESEL B
03-305	Base and Bearing Caps	LP of mating surfaces of base and bearing cap		
03-307	Lube Oil Fittings Internal	Visual, for proper connection and security		
03-310	Crankshaft and Main Bearings	Visual and LP of crank pin journal, and crank pin journal fillets. EC of crank pin journal fillets on cylinders 5, 7, and 8. LP of #5 main bearing shell on engine B.		
03-315	Cylinder Block Liners and Water Manifold	Dimensional inspection of liner, and liner landing. LP of block liner landing. MT of block top. Visual of liner. Visual of water manifold. Visual, material and hardness test of cylinder head studs. Visual of stud nuts.		
03-317	Water Discharge Manifold	Visual for leakage at couplings		
03-330	Flywheel	Bolt torque verification		
03-331	Flywheel Guard	Visual for security		
03-335	Gear Case	Bolt torque verification		
03-340	Connecting Rods	EC & visual of connecting rod oil passage. Material hardness test of con rod. LP wrist pin bushing. Visual, LP and RT of con rod bearing shells.		
03-341	Piston	LP and visual of piston skirts Visual of crown Visual of piston rings LP of piston pins		
03-345	Tappets and Guides	Visual Valve lash and clearances		

TABLE 3
PRESERVICE INSPECTIONS
(Continued)

DATA CURRENT TO: 07/05/84

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS DIESEL A	RESULTS DIESEL B
03-350	Camshaft-Cam Bearing and Cam Gear	Visual and hardness test of cam lobes Verify proper assembly Valve timing		
03-355	Idler and Miscellaneous Gears	Visual of crank to pump gear, bolts and gaskets		
03-359	Air Start Valve	Visual of valve seating Bolt torque verification Verify proper gasket		
03-360	Cylinder Head and Valves	Cylinder head: LP of valve seats UT, MT of fire deck LP and visual of valves Bluing of valve seating Visual of valve springs Visual and PT of subcovers		
03-365	Fuel Injection Equipment	EC fuel injection tube ID Check spray tips for clogging Verify tubing support assembly		
03-371	Fuel Pump Linkage	Hardness test of shaft Verify assembly, free travel, proper lubrication		
03-375	Intake Manifold	Visual for cracks at flange facing		
03-380	Exhaust Manifold	Bolt torque verification		
03-385	Covers-Cylinder Block	Bolt torque verification		
03-387	Crankcase Ventilator	Visual for leaktightness and security		
03-390	Rocker Arms and Push Rods	Visual Material test on one rocker arm Torque verification LP push rods one cylinder MT rocker arm capscrews Material, hardness of rocker arm capscrews Verify clearances		

TABLE 3
PRESERVICE INSPECTIONS
(Continued)

DATA CURRENT TO:

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS DIESEL A	RESULTS DIESEL B
03-402	Governor Drive	Verify coupling material, and proper assembly		
03-410	Overspeed Trip	Verify proper assembly (per 10CFR21 notice)		
03-413	Governor Linkage	Verify proper assembly, and free movement		
03-415	Governor	Startup checkout Verify assembly of heat exchanger. Clean and inspect		
00-420	Pressure Regulating Valve-Lube Oil	Verify cleanliness, and clearances. Visual of sleeve spring		
03-420	Lube Oil Pump-Engine Driven	Verify proper installation		
03-425	Water Pump-Jacket Water	Visual to verify impeller material. Disassembly scheduled for impeller replacement.		
03-435	Jacket Water Fittings	Visual for security and leaktightness		
03-437	Turbocharger-Water Fittings	Visual for security and leaktightness		
03-441	Starting Air Lines	Visual for security and leaktightness		
03-442	Starting Air Distributor	Visual for security and leaktightness		
03-445	Fuel Booster Pump	Visual for security and leaktightness		
03-455	Fuel Oil Filters	Torque verification		
03-460	Strainer, Duplex Lube Oil	Visual for cleanliness and leaktightness		

TABLE 3
PRESERVICE INSPECTIONS
(Continued)

DATA CURRENT TO: 07/05/84

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS DIESEL A	RESULTS DIESEL B
03-465	Lube Oil Fittings	Visual for leaktightness and security		
03-467	Turbocharger Lube Oil Fittings	Verify proper assembly		
NB-002	Intercooler	Visual for leaktightness and security Bolt torque verification		
03-475	Turbocharger and Intercooler Brackets	Visual of butterfly valve for wear Bolt torque verification		
MP-020	Turbocharger	LP stationary nozzle ring Visual of thrust bearing, thrust bearing clearance Bolt torque verification		
00-491	Air Inlet Adapter	Visual for security		
00-495	Exhaust Outlet Adapter	Visual for security		
03-503	Thermometer	None. Verified by test		
03-500	Control Panel	Verify cleanliness		
03-515	Thermostatic Valve	Rebuild per IE Notice 82-56		
03-520	Instruction Plates	None required		
03-525	Barring Device-Pneumatic	None required		
03-530	Engine	Visual for security		
03-531	Platform, Ladder	Visual for security		
03-540	Lube Oil Sump Tank	Visual for leakage		
03-550	Foundation Bolts	Bolt torque verification		
03-630	Pyrometer Conduit	Visual for security		

TABLE 3
PRESERVICE INSPECTIONS
(Continued)

DATA CURRENT TO: 07/05/84

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS DIESEL A	RESULTS DIESEL B
03-650	Electrical Equipment	Visual of brush assemblies Visual of slip rings for roundness and fit brushes to rings Visual for cleanliness Dimensional for alignment, mechanical center, air gap Visual for lubrication Bolt torque verification Megger test		
03-688	Electrical Wiring	Visual for security		
03-689	Off Engine Wiring	Construction QC		
03-690	Safety Alarm On Engine	None. Verified by test		
03-691	Off Engine Alarm Sensors	None. Verified by test		
03-695	Safety Shutdown	None. Verified by test		
00-700	Standpipe	Visual for security cleanliness		
03-715	Sub Base	Visual for integrity of grout		
03-717	Auxiliary Skid	Check strainers for cleanliness, calibrate relief valves	SAT	
03-800	Heater, Jacket Water Heater, Lube Oil Sump Tank	Visual for leakage and security of corrections		
03-805	Intake and Exhaust Equipment	Visual for leakage and security		
03-810	Jacket Water Equipment	Visual for leakage and security		
03-820	Lube Oil Equipment	Visual for leakage and security		
03-825	Fuel Oil Equipment	Visual for leakage and security		

2.4 Rework

A number of product improvements and upgrades are now available for TDI engines which improve reliability. GSU has elected to install a number of these improvements as detailed in Table 1. The following paragraphs describe the benefits of the significant upgrades.

- Cylinder block and liners. The cylinder liners, cylinder head, studs and block liner landing surfaces will be modified to comply with TDI's current manufacturing specification. The modification reduces cylinder block stress by reducing mechanical interference between the cylinder head, block and liner, and by increasing the vertical distance between the stud threads in the block and the liner landing surface. These measurements will increase the margin against cylinder block cracking.

- Pistons. The original pistons will be replaced by the improved model "AE" piston, the current TDI production standard, inspected to the criteria of the TDI Diesel Generator Owners Group. Available information indicates that the original heat treated and stress relieved AN pistons are acceptable for service. However, the AE pistons were considered desirable because of lower piston skirt stresses and favorable operating experience. As part of the AE piston installation, other TDI product improvements will be installed. These include improved piston rings to reduce the likelyhood of liner scuffing during break-in, rework of piston crowns to reduce liner wear and oil consumption, and an improved piston pin retaining ring to improve maintainability.

- Valve pushrods. The improved friction welded pushrods were installed as recommended by the TDI Owners Group Design Review.

- Jacket water pump. The jacket water pump will be reworked to include a modular iron impellar without a keyway as recommended by the TDI Diesel Generator Owners Group.

- Turbocharger. The turbocharger lubrication system will be modified to improve lubrication during starting and reduce thrust bearing wear. The turbocharger mounting bracket will be stiffened to reduce vibration and a turbocharger speed measuring device will be installed on one engine to obtain test data useful in verifying the adequacy of the prelubrication system.

- Fuel injection equipment. Fuel injection tubing, shown by inspection to have ID surface defects deeper than the 0.004 inch acceptance criteria will be shrouded on a temporary basis to permit engine testing. The shrouding will contain fuel spray in the event of tubing rupture. By the end of 1984 TDI will be able to supply fuel injection tubing which has been given an autofrettage treatment to improve its fatigue resistance. This tubing has been ordered.

  The original fuel injector tips with a 140 degree spray angle, will be replaced with an improved model with a 135 degree spray angle to eliminate fuel spray on cylinder walls and reduce liner wear. The 135 degree tips are the current TDI production standard.

  The fuel injection pump return line will be replaced with heavier wall tubing as recommended by TDI.

- Idler gear. An improved idler gear locknut will be installed as a TDI recommended product improvement.

2.5 Confirmatory Testing

The purpose of this activity is to verify engine reliability following engine inspection and rebuilding. Table 5 describes the tests to be performed. The preoperational tests described in Section 14.2.12.1.36 (Revised) will be performed in conjunction with the tests described in this section. The revised FSAR Section 14.2.12.1.36 is reproduced as Appendix 1 of this report.

The proposed testing program does not comply with the requirements of Pegulatory Guide 1.108. The number of start tests is less than specified in Regulatory Guide 1.108, Section C.2.a(9), and the overload test described in Regulator Guide 1.108, Section C.2.a(3), is not planned. With respect to the start tests, given the documented high starting reliability of the TDI engines, the proposed program of ten modified starts and two fast starts is considered an adequate demonstration of starting reliability. Additional fast starts would impose additional wear on the engines, thereby subjecting the engines to service for more severe than the expected plant service conditions.

The overload test is not considered necessary, because the River Bend Station diesels will not be operated above the continuous rating of 3,500KW. Therefore, testing at the overload rating is not considered necessary, and could reduce long term engine reliability by subjecting engine components to unnecessary stress cycles more severe than expected to occur in accident conditions.

In the event of component failures during testing, GSU will investigate the root cause, and take corrective action to remedy the problem and prevent reoccurrence. Retesting would be performed if the corrective action is considered to affect the test objectives i.e.: 1) the ability to deliver rated output, 2) the ability to start reliably, or 3) the torsional vibrator characteristic of the crankshaft.

TABLE 5
OPERATIONAL TESTING

NOTE: Testing not Complete
Data Current as of 07/05/84

TEST OBJECTIVE	ACCEPTANCE CRITERIA	RESULTS OR SCHEDULED COMPLETION
1) Manufacturer recommended test in accordance with TDI Service Information Memoranda #99		
a) Initial start, slow idle, No load, (15 minutes)	Operating parameters in the normal range Satisfactory crankcase inspection	
b) 450 rpm, no load, (30 minutes)	Adjust governor Overspeed trip satisfactory Verify generator differential shutdown Operating parameters in normal range Satisfactory crankcase inspection	
c) Generator phasing	Satisfactory Generator electrical checks Set electrical portion of governor	
d) 1 hour at 25% rated load	Operating parameters in normal range	
e) 1 hour at 50% rated load	Operating parameters in normal range	
f) 2 hours at 75% rated load	Operating parameters in normal range	
g) Return to 25% rated load	Operating parameters in normal range Verify parameters consistent with Step (d)	
h) 4 hours at 100% load (3500KW), followed by internal engine inpsection, turbocharger vibration, bearing cooling and lubrication test	Operating parameters in normal range Crankcase inspection Crankshaft web deflection Piston skirt wear Cylinder liner wear Gear set wear Valves and rocker arms wear and clearances Cold compression pressure Generator winding temperature	

TABLE 5
OPERATIONAL TESTING
(Continued)

NOTE: Testing not Complete
Data Current as of 07/05/84

TEST OBJECTIVE	ACCEPTANCE CRITERIA	RESULTS OR SCHEDULED COMPLETION
1) Engine timing and adjustments. 24 hours at 100% load. (power duration may vary)	Smooth operation Cylinder firing pressures in balance Operating parameters in normal range Crankcase web deflection	
2) Crankshaft torsional vibration test	Crankshaft stresses with allowable values	
3) Engine performance test. Demonstrate that each diesel operates within design parameters at 100% rated load, and demonstrate starting reliability.	Operating parameters in normal range. All start attempts successful.	
a) 24 hours at 100% rated load		
b) Ten modified starts (Note 1) to the load required by a loss of offsite power (approximately 75% of rated load) and run for a minimum of one hour.		
c) Two fast starts (Note 2) to 100% of rated load, and run for a minimum of four hours.		

NOTES

1. A modified start is defined as a start including a prelube period as recommended by the manufacturer and a 3 to 5 minute loading to the specified load level. Modified starts may be conducted with the engine at operating temperature.

2. Fast starts are simulated "black starts" on simulation of an ESF signal with the engine on ready standby status.

2.6 Post Test Inspection

Following the tests described in Section 2.5, GSU will perform an engine inspection consisting of the items in Table 6. The purpose of this inspection is to look for potential latent problems not discovered in earlier inspections and tests and verify readiness for further operation. The preoperational test phase, consisting of the tests defined in FSAR Section 14.2.12.1.36, (see Appendix 1), will begin upon satisfactory completion of the inspection and any required rework or retesting.

The post test inspection program is designed to provide a thorough engine inspection without major engine disassembly. Major disassambly is not considered necessary because of the thoroughness of the preservice inspection and design review program. Critical components can be adequately inspected by removing access covers and by oil analysis. The oil analysis will indicate abnormal wear of bushings and bearings and the elemental analysis will identify the component in distress. The oil analysis will also serve as a baseline for continued surveillance in the operating phase. Visual inspections to verify nominal wear, absence of discoloration, from overheating, water leakage, and absence of wear products (metal particles) will identify distress conditions in combustion with oil analysis.

TABLE 6
POST TEST INSPECTIONS

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS
03-305	Base and Bearing Caps	Visual for normal wear and absence of discoloration Oil analysis Torque verification	
03-307	Lube Oil Fittings-Internal	Visual, for security	
03-310	Crankshaft and Main Bearings	Hot web deflection Thrust bearing clearance	
03-315	Cylinder Block Liners and Water Manifold	Visual for normal wear of liners Visual for cleanliness, water leakage	
03-317	Water Discharge Manifold	Visual for security and leaktightness	
03-330	Flywheel	Bolt torque	
03-331	Flywheel Guard	Visual, for security	
03-335	Gear Case	Visual, for normal wear pattern, security	
03-340	Connecting Rods	Visual, for normal wear and absence of discoloration Oil analysis	
03-341	Piston	Visual for normal wear from crankcase Borescope inspection of piston crown and combustion chamber Oil analysis	
03-345	Tappets and Guides	Visual for normal wear Valve leak and clearances	
03-350	Cam Shaft-Cam Bearing and Cam Gear	Visual of cam lobes for normal wear Valve timing	

TABLE 6
POST TEST INSPECTIONS
(Continued)

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS
03-355	Idler and Miscellaneous Gears	Visual for normal wear and security	
03-359	Air Start Valve	Capscrew torque Borescope inspection from combustion chamber Leak tightness (air start supply filter)	
03-360	Cylinder Head and Valves	Borescope inspection of combustion chamber and valves Leaktightness of gaskets Bar engine with cylinder cocks open for leakage	
03-365	Fuel Injection Equipment	Visual on tips for normal firing, roundness	
03-371	Fuel Pump Linkage	Visual for security and free movement	
03-375	Intake Manifold	Retorque bolts Visual for leak tightness, and security	
03-380	Exhaust Manifold	Retorque bolts Visual for leak tightness and security	
03-385	Covers-Cylinder Block	Retorque bolts	
03-387	Crankcase Ventilator	Visual for leak tightness and security	
03-390	Rocker Arms and Push Rods	Visual for normal wear and lubrication Valve lash and clearances	
03-402	Governor Drive	Visual for security	
03-410	Overspeed Trip	Visual for security	
03-413	Governor Linkage	Visual for security, free movement	

TABLE 6
POST TEST INSPECTIONS
(Continued)

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS
03-415	Governor	None. Verified during operation	
00-420	Pressure Regulating Valve-Lube Oil	None. Verified during operation	
03-420	Lube Oil Pump-Engine Driven	Visual for wear and clearances	
03-425	Water Pump-Jacket Water	Scheduled disassembly for replacement of impeller	
03-435	Jacket Water Fittings	Visual for security and leaktightness	
03-437	Turbocharger-Water Fittings	Visual for security and leaktightness	
03-441	Starting Air Lines	Visual for security and leaktightness. Visual of air supply filter for free flow, cleanliness on engine side.	
03-442	Starting Air Distributor	Visual for security and leaktightness	
03-445	Fuel Booster Pump	Visual for security and leaktightness	
03-460	Strainer, Duplex Lube Oil	Visual for cleanliness Evaluate particles if found	
03-465	Lube Oil Fittings	Visual for leaktightness and security	
03-467	Turbocharger Lube Oil Fittings	Visual for leaktightness and security	
NB-002	Intercooler	Visual for leakage and security Retorque bolts	
03-475	Turbocharger and Intercooler Brackets	Retorque bolts Visual for integrity of welds, and security	

TABLE 6
POST TEST INSPECTIONS
(Continued)

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS
MP-020	Turbocharger	LD stationary nozzle ring Visual of thrust bearing Bolt torque verification	
00-491	Air Inlet Adapter	Visual for security	
00-495	Exhaust Outlet Adapter	Visual for security	
03-503	Thermometer	None. Verified during operation	
03-500	Control Panel	None. Verified during operation	
03-515	Thermostatic Valve	None. Verified during operation	
03-520	Instruction Plates	None	
03-525	Barring Device-Pneumatic	None required	
03-530	Engine	Visual for security	
03-531	Platform, Ladder	Visual for security	
03-540	Lube Oil Sump Tank	Oil analysis Visual for leakage	
03-550	Foundation Bolts	Retorque	
03-630	Pyrometer Conduit	Visual for security	
03-650	Electrical Equipment	Visual of slip rings and brushes for wear and adjustment Visual for security Pedestal bearing oil analysis	
03-688	Electrical Wiring	Visual for security	
03-689	Off Engine Wiring	Visual for security	
03-690	Safety Alarm On Engine	None. Verified during operation	

TABLE 6
POST TEST INSPECTIONS
(Continued)

COMPONENT NUMBER	DESCRIPTION	INSPECTION METHOD	RESULTS
03-691	Off Engine Alarm Sensors	None. Verified during operation	
03-695	Safety Shutdown	None. Verified during operation	
00-700	Standpipe	Visual for leakage, security	
03-715	Sub Base	Visual for integrity of grout	
03-717	Auxiliary Skid	Retorque bolting	
03-800	Heater, Jacket, Water Heater, Lube Oil Sump Tank	Visual for leakage and security of corrections	
03-805	Intake and Exhaust Equipment	Visual for leakage and security	
03-810	Jacket Water Equipment	Visual for leakage and security	
03-820	Lube Oil Equipment	Visual for leakage and security	
03-825	Fuel Oil Equipment	Visual for leakage and security	

2.7 Surveillance and Monitoring

GSU will implement a program of preventative maintenance, surveillance and monitoring to ensure long term engine reliability. This program will be added to the report in a revision following the completion of engine testing and post test inspection.

3.0 CONCLUSIONS

GSU believes that the problems of the TDI diesel generators are now understood as a result of the work of the TDI Diesel Generator Owners Group and the TDI Diesel Owners. Solutions to those problems are provided for River Bend Station through the measures described in this report. This program includes all the recommended action of the TDI Diesel Generator Owners Group and Transamerica Delevalve Inc. GSU believes these measures will provide reliable standby power for River Bend Station.

4.0 NRC QUESTIONS AND RESPONSES

(LATER)

APPENDIX 1

d. Demonstrate in conjunction with the RHR preoperational test that the RHR system can be operated in the suppression pool cooling mode and the shutdown cooling mode from the remote shutdown panel. 5

e. Demonstrate in conjunction with the nuclear boiler preoperational test that the three designated safety relief valves can be operated from the remote shutdown panel.

4. Acceptance Criteria

a. Remote shutdown system valves, controls, instruments, and pumps operate in all required modes as specified by the GE Preoperational Test Specification.

5 b. Operation of the RHR, RCIC, standby service water, and safety relief valve systems functions as specified by the GE Preoperational Test Specification.

14.2.12.1.36 Standby Diesel Generator Preoperational Test

1. Test Objectives

a. To demonstrate the reliability of the standby diesel generator power sources

b. To provide assurance that the system is capable of providing standby electrical power during normal and simulated accident conditions

c. To demonstrate the system's ability to pick up standby loads during simulated accident conditions

d. To demonstrate the operability of the diesel generator auxiliary systems, i.e., diesel fuel oil transfer and diesel generator starting air supply system

2. Prerequisites

13 a. Required preliminary tests completed

b. All instrument calibration and loop checks completed

c. The following system and/or components available:

(1) Fire protection system in diesel generator room

(2) SWP

(3) Pneumatic sources

(4) Electrical power to motors, fans, etc

(5) Diesel generator building ventilation system as required to support testing | 13

d. Sufficient diesel fuel on site to perform tests

3. Test Procedure

a. Test all diesel starting and trip sequences to assure proper operation.

b. Test all auxiliary systems to demonstrate that they operate in accordance with test specifications.

c. Verify that all interlocks, controls, and alarms operate in accordance with test specifications.

d. Demonstrate proper manual and automatic operation of the diesel generators and that they can start automatically upon simulated loss of ac voltage and attain the required frequency and voltage within the specified limits.

e. Demonstrate proper response and operation for test basis accident (DBA) loading sequence to test basis load requirements, and verify that voltage and frequency are maintained within specified limits.

f. Demonstrate proper operation of the diesel generator during load shedding, load sequencing, and load rejection. Include a test of loss of the largest single load while maintaining voltage and frequency within test limits, and a test of the complete loss of

load in which overspeed limits are not exceeded.

g. Demonstrate full-load carrying capability of the diesel generators for a period of not less than 24 hr, ~~of which 22 hr are not less than the equivalent DBA full load value for the respective standby bus, and 2 hr are at the DEMA standard 2-hr load rating (110 percent of nameplate rating)~~. at 3500 kw. Verify that voltage and frequency are maintained within test limits and that the diesel cooling systems function within test limits.

h. Demonstrate functional capability at operating temperature conditions by reperforming tests d and e above immediately (within 5 min), after completion of the 24-hr load test g above.

i. Demonstrate the ability to:

(1) Synchronize the diesel generators with offsite power while connected to the standby load

(2) Transfer the load from the diesel generators to the offsite power

(3) Isolate the diesel generators and restore them to standby status.

j. Demonstrate that the rate of fuel consumption while operating at the DBA load is such that the requirements for 7-day storage inventory are met for each diesel generator.

k. The reliability of each diesel generator unit is demonstrated as per Regulatory Guide 1.108, paragraph C.2.a(9), ← INSERT

l. Demonstrate that the capability of the diesel generators to supply standby power within the required time is not impaired during periodic surveillance testing.

m. Demonstration of reliability and independence of the redundant diesel generator units is provided through their simultaneous starting during the testing discussed in Section 14.2.12.1.44.

Insert for FSAR Section 14.2.12.1.36(k)

except that the number of start tests is less than specified in Section C.2.a(9) and the overload test described in Section C.2.a(3) of Regulatory Guide 1.108 will not be performed. The overload test is not considered necessary because the diesels will not be operated above the continuous rating of 3500kw.

n. Demonstrate that the standby diesel generator can be started from minimum design starting air pressure and that the starting air system provides the number of starts by design with the recharging compressors isolated. 5

4. Acceptance Criteria

a. System configuration and operation are comparable to that shown in the manufacturer's technical instruction manual.

b. Automatic sequencing of generator-driven equipment occurs as specified by FSAR Chapter 8, Table 8.3-2.

c. All auxiliary systems function as specified by FSAR Chapter 9, Sections 9.5.4, 9.5.5, 9.5.6, 9.5.7, and 9.5.8, and the manufacturer's technical instruction manual. 5

d. Rated load and frequency can be attained.

e. Load rejection does not result in exceeding speeds or voltages which cause diesel generator tripping or mechanical damage.

f. The standby diesels start with minimum air pressure and start with the recharging air compressors isolated, as specified by FSAR Chapter 9, Sections 9.5.6.1 and 9.5.6.2.1.

14.2.12.1.37 Vessel Internals Vibration Preoperational Test

1. Test Objective

Vibration tests are conducted to verify the structural integrity of core support structure and reactor internals in accordance with Regulatory Guide 1.20. The jet pumps are part of this program.

2. Prerequisites

a. Reactor recirculation system operational

b. Capability to maintain reactor pressure and temperature requirements has been established.