

TDI DIESEL GENERATOR
DESIGN REVIEW
AND QUALITY REVALIDATION
REPORT

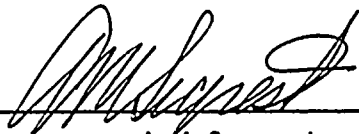
Prepared For

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT - UNIT 1

By

TDI DIESEL GENERATOR OWNERS GROUP

Revision 2
April 1986



A. M. Segrest
Program Manager
TDI Diesel Generator Owners Group

8606110622 860605
PDR ADOCK 05000400
S PDR

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

2.0 PROGRAM PLAN OVERVIEW

2.1 GENERIC PROBLEM RESOLUTION - PHASE I

2.2 COMPONENT SELECTION

2.3 TASK DESCRIPTION PREPARATION

2.4 DESIGN REVIEW

2.5 QUALITY REVALIDATION

2.6 FINAL DOCUMENTATION

3.0 RESULTS OF DESIGN REVIEW AND QUALITY REVALIDATION

3.1 SUMMARY RESOLUTION OF SIXTEEN GENERIC COMPONENTS (PHASE I)

3.2 SUMMARY RESOLUTION OF PHASE II COMPONENTS

4.0 SUMMARY/CONCLUSIONS

5.0 RECOMMENDATIONS

6.0 REFERENCES

APPENDICES

I. DR/QR SUMMARY REPORTS

II. MAINTENANCE & SURVEILLANCE RECOMMENDATIONS

III. INCLUDED REFERENCES



EXECUTIVE SUMMARY

Thirteen U.S. nuclear utilities have formed the Transamerica Delaval, Inc (TDI) Diesel Generator Owners Group in order to address operational and regulatory issues relative to Transamerica Delaval diesel generator sets used for backup power supplies in U.S. nuclear power plants. The TDI Diesel Generator Owners Group established a comprehensive program, through a combination of design reviews, quality revalidations, engine tests and component inspections, to provide an in-depth assessment of the adequacy of the respective utilities' TDI diesel generators to perform their intended safety related functions.

The first major program element was characterized as Phase I and involved the resolution of generic known problems. A review of the accumulated operational experience resulted in the conclusion by the Owners Group Technical Staff that a limited number of components warranted priority attention and consideration as significant known problems with potentially generic applicability. Final reports for each of these components were submitted by the Owners Group to the NRC for review. The purpose of this accelerated review was to establish a basis for licensing plants with TDI diesel generators prior to completion of the follow up effort described below. This review has shown that with implementation of the Phase I report recommendations, TDI diesel generators can reliably perform their intended function.

The second major program element involved design reviews and quality revalidations of selected engine components. The Owners Group Design Review and Quality Revalidation Program (DR/QR) was established to perform these examinations for each owner's engine in order to assess each engine's ability to reliably perform its intended design function. The effort was conducted by a centralized team of engineering personnel with specialized skills in appropriate fields including diesel generator design, operation, and manufacture.

The first portion of the DR/QR Program involved reviewing the Engine Parts List and selecting the components of each engine that warranted a detailed design review and/or quality revalidation. Following component selection these components were subjected to either a design review, a quality revalidation, or both. Upon completion of these reviews, the inspection results, document packages, design review findings and calculation results were reviewed and approved by the Owners Group Technical Staff.

The third major program element involved specific component tests and inspections. The Owners Group Technical Staff, in evaluating specific engine components, provided technical recommendations to each Owner regarding special component inspections, preventive maintenance, and surveillance recommendations which will give added assurance that the engines and components perform their intended operational functions over the life of the plant. The implementation of these recommendations is a plant-specific function.

This final report for Carolina Power & Light (CP&L) provides the results of this extensive investigation of 164 components of the TDI DSRV-16 diesel generators at Shearon Harris Nuclear Power Plant Unit 1. It forms the basis for the conclusion that the TDI diesel generators presently installed are fully capable of reliably performing their intended safety function.

1.0 INTRODUCTION

This report has been prepared for Carolina Power & Light by the TDI Diesel Generator Owners Group. The results of the Design Review and Quality Revalidation Program are specifically applicable to Shearon Harris and are based on the generic program methodology briefly discussed in Section 2.0.

The purpose of this report is to provide the results of an extensive investigation of the design and manufacture of 164 components of the TDI DSRV-16 diesel generators at Shearon Harris. This report forms the basis for the conclusion that the TDI diesel generators presently installed are fully capable of performing their safety function as described in the Shearon Harris Final Safety Analysis Report. |1



2.0 PROGRAM PLAN OVERVIEW

The TDI Owners Group Program Plan (the Plan) has been previously provided by reference (1). This overview of the Plan is provided to assist the reader in understanding the generic methodology by which the plant-specific results of Section 3.0 were obtained.

The Plan consists of two phases comprised of the following major elements:

Phase I
Generic Problem Resolution

Phase II
Component Selection
Task Description Preparation
Design Review
Quality Revalidation
Final Documentation

Each element is briefly discussed in the following sections.

11-1-1954



2.1 GENERIC PROBLEM RESOLUTION - PHASE I

Using input from various nuclear data sources (INPO, SOERs, LERs, 10CFR50.55e reports & 10CFR21 reports, etc) as well as non-nuclear sources (marine and stationary TDI engine applications), a substantial data base of TDI engine/component operational experience has been accumulated.

A review of this data by the TDI Diesel Generator Owners Group Technical Staff resulted in the conclusion that a limited number of TDI engine components had evidenced sufficient adverse operating experience in one or more applications, such that they warranted priority attention and consideration as significant known problems with potentially generic applicability. Therefore, the Owners Group technical resources were heavily applied to these problem areas in order to expedite the reviews, tests and/or analyses necessary to resolve them. The purpose of this accelerated review was to establish a basis for licensing those plants with near term licensing needs prior to the completion of the Phase II effort.

Resolution of these problems has been pursued on a priority basis and was termed the Phase I effort. The generic known problem listing is generic only to the extent that a body of experience exists to suggest that a design type (or several design types) of a particular component in service in one or more TDI engine applications has not performed acceptably or may not have been designed adequately.

A listing of the identified generic components is included as Table 2.1. Reports on these components have been previously submitted to the NRC for review. Summary Phase II reports for the generic problems (Phase I components) as they apply to Shearon Harris are included in Appendix I of this report.

The results of the reviews of these components are summarized in Section 3.0.

1 20 2 1 1 1



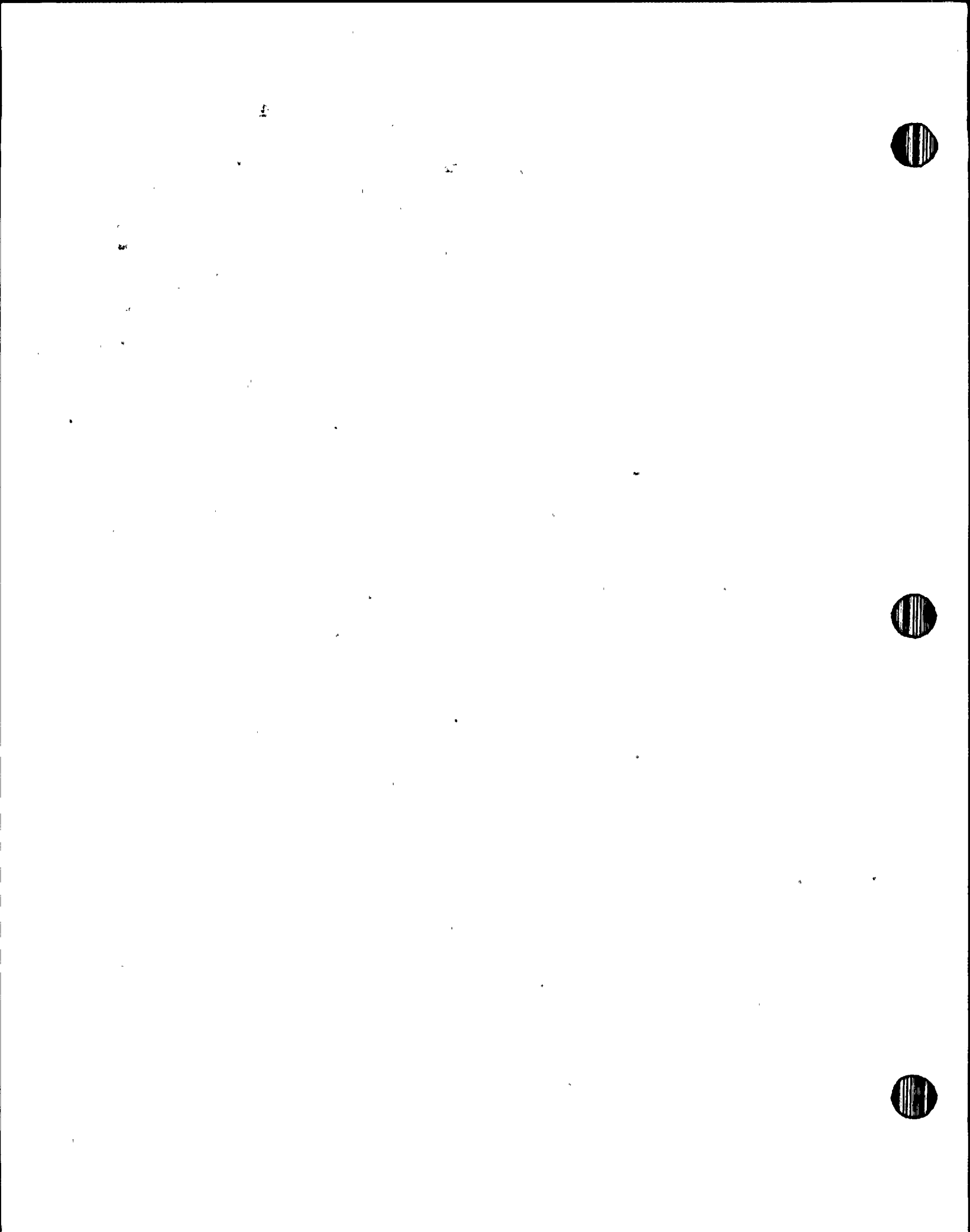
2.2 COMPONENT SELECTION

The diesel generator components to be subjected to the DR/QR Program were determined by a Component Selection Committee. Selection was based on the component's function and role in the overall operation of the engine, the component's nuclear and non-nuclear industry experience, and the Committee's engineering judgement. The selection process included a review of available operating information on TDI diesels and TDI recommended product improvements to ensure that relevant experience was considered.

As part of the component selection process, components were classified as either type A, B, or C. These classifications are based on the effect of the component's failure on the diesel generator performance. Type A components are those whose failure would result in diesel generator shutdown or failure to start in an accident mode. Type B components include those whose failure would result in reduced capacity of the diesel generator or the eventual failure of a Type A component if not detected. Components whose failure have little or no bearing on the effective use or operation of the diesel generator are classified as Type C.

Following classification, the Committee established appropriate design review and quality revalidation requirements. These requirements were then forwarded to the Design Review Group and Quality Revalidation Group for preparation of task descriptions.

Table 2.2 lists those components of the Shearon Harris diesel generators which were reviewed by the Component Selection Committee. The Table identifies the results of the Component Selection process by showing which components required a design review (DR) and/or a quality revalidation (QR), and those components requiring no review. The Category identified in Table 2.2 refers to the Appendix I heading under which that component's DR/QR Summary Report is found.



2.3 TASK DESCRIPTION PREPARATION

The Design Review Group and the Quality Revalidation Group prepared task descriptions to define the tasks (reviews, inspections, calculations, etc.) to be performed to determine the adequacy of each component. The task descriptions included recommendations identified in the selection process as well as Design Review Group and/or Quality Revalidation Group recommended component inspections. These task descriptions provide, as applicable:

- A. DR Task Descriptions
 1. Primary component function and required attributes,
 2. Applicable codes and standards,
 3. Alternative codes, standards, or analytical techniques,
 4. Analysis or evaluation to be performed to assure satisfactory design,
 5. Available verifications of TDI analysis (if any), and
 6. Final documentation requirements.

- B. QR Task Descriptions (Component Revalidation Checklist)
 1. Component to be validated
 2. Attributes to be verified
 3. Methodology to be used (documentation review, NDE techniques, etc.)
 4. Acceptance criteria
 5. Final documentation requirements

In some cases the Design Review Group and the Quality Revalidation Group prepared task descriptions which required no additional Design Review or Quality Revalidation for certain components. The individual task descriptions in Appendix I contain the justification for this reduction in scope. In general, the basis for not requiring a Design Review and/or Quality Revalidation Report is the following:

Lead Engine Component Reviews - This component was reviewed on a lead engine. Any recommendations which supported the conclusions in the lead engine report are evaluated for applicability to the follow on engine component and included in the task description.

Experience - Either no adverse site or industry experience exists or if it does exist, the task description addresses its resolution.

Task descriptions for all components are included with each component's DR/QR Summary Report in Appendix I. Figure 2.1 graphically depicts the process followed in the DR/QR Program.



2.4 DESIGN REVIEW

The Design Review Group completed the design review in accordance with the task descriptions. Due to the number and diversity of the components and standards involved, the design review was tailored to each component. The actual design review was accomplished by using any one or more of the following methods, including: a) an independent calculation performed by the Design Review Group; b) an independent review of the adequacy, appropriateness or correctness of existing vendor and/or subvendor calculations; c) testing specified by the Design Review Group; or, d) other methods specified and approved in the task descriptions.

During implementation of the task descriptions, the Design Review Group specified quality attributes (in addition to those identified during the component selection process) for incorporation into the quality revalidation process. The Design Review Group also identified any components which may require corrective action to improve reliability of the diesel generators. This included recommendations such as increased frequency of component replacement and/or maintenance, or additional in-service inspection.

2.5 QUALITY REVALIDATION

The Component Quality Revalidation Group was provided with the quality attributes required to be revalidated. QR Task Descriptions were developed to identify methodology for verification of attributes. These task descriptions include applicable component descriptions, attributes to be verified, methodology, acceptance criteria, and type of documentation to be provided.

Each component required to undergo Quality Revalidation was subjected to a documentation review. This process identified and catalogued all appropriate documentation (e.g. material test reports, NDE, vendor/subvendor records, site records, etc) associated with the component. With assistance from Quality Engineering, each document was reviewed for acceptability. These document packages were then made available to the Design Review Group to assist in the engineering review. Important attributes identified by the Design Review Group, for which acceptable documentation did not exist in the component file, were verified by tests and/or inspections performed by the Quality Group.

Tests or inspections required to be performed on components were then forwarded to Quality Engineering to develop detailed methodology and procedures to be followed. These instructions were issued to Quality Inspection via the task description. Field inspections and tests were performed by qualified personnel. Depending upon the specified test or inspection, spare parts or surplus parts in lieu of installed parts were used as the test/inspection article. Results of inspections and tests were summarized by the Quality Revalidation Group and reviewed by the Design Review Group as necessary.



2.6 FINAL DOCUMENTATION

The DR/QR program has been completed for Carolina Power & Light. A summary of the results of this effort are contained in Section 3.0.

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

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

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

1



TABLE 2-1

PHASE I COMPONENTS (GENERIC PHASE I)

<u>COMPONENT NUMBER</u>	<u>COMPONENT</u>
MP-017	Turbocharger
03-305A,C,D,E	Base & Bearing Caps
03-310A	Crankshaft
03-315A&C	Cylinder Block & Liners
03-315E	Cylinder Head Studs
03-340A	Connecting Rods
03-340B	Connecting Rod Bearing Shells
03-341A	Pistons
03-359	Airstart Valve Capscrews
03-360A	Cylinder Heads
03-365C	Fuel Oil Injection Tubing
03-390C&D	Main and Connecting Pushrods
03-390G	Rocker Arm Capscrews
03-425A	Jacket Water Pump
03-688B	Wiring & Termination

| 1

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
F-068	Intercooler	X	X		Turbo, Intake Intrclr. & Exhaust
F-139	Tools Turbo			X	
F-161	Pyrometer Wire			X	
MP022/23	Turbocharger	X	X		Turbo, Intake, Intrclr. & Exhaust
00-420	Lube Oil Pressure Regulating Valve	X	X		Lube Oil
00-491A	Turbocharger - Air Inlet Adapter: Adapter			X	
00-491B	Turbocharger - Air Inlet Adapter: Mounting Hardware W/Flexible Connector			X	
00-495A	Turbocharger - Air Outlet Adapter			X	
00-495B	Turbocharger Air Outlet Adapter: Mounting Hardware			X	
00-520	Instruction Plate - Warning Plate			X	
02-CFR	Turbocharger Thrust Bearing Lubricant System	X	X		Turbo, Intake, Intrclr. & Ex- haust
02-305A	Base and Bearing Caps: Base Assembly	X	X		Engine Base & Bearing Caps
02-305B	Base and Bearing Caps: Dowels			X	
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	X	X		Engine Base & Bearing Caps
02-305D	Base and Bearing Caps: Main Bearing Caps	X	X		Engine Base & Bearing Caps
02-305F	Base and Bearing Caps: Seals, Gaskets & Covers			X	

1

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-307A	Lube Oil Fittings: Internal - Headers	X	X		Lube Oil
02-307B	Lube Oil Fittings: Internal - Tube & Fittings	X	X		Lube Oil
02-307C	Lube Oil Fittings Internal: Seals			X	
02-307D	Lube Oil Fittings Internal: Supports	X	X		Lube Oil
02-310A	Crankshaft	X	X		Crankshaft & Bearings
02-310B	Main Bearings	X	X		Crankshaft & Bearing
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	X	X		Crankshaft & Bearing
02-311A	Crankcase: Crankcase Assy	X	X		Crankshaft & Bearing
02-311B	Cylinder Block Liners & Water Manifold: Cam Bearing Caps & Dowels			X	
02-311C	Crankcase: Crankcase Seal			X	
02-311D	Crankcase: Crankcase Mounting Hardware	X	X		Crankshaft & Bearings
02-315A	Cylinder Block	X	X		Cyl. Block & Liners & Water Manifold
02-315B	Cylinder Block: Block To Crankcase Dowel			X	
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	X	X		Cyl. Block & Liners & Water Manifold
02-315D	Cylinder Block Liners & Jacket Water Manifold & Piping	X	X		Cyl. Block & Liners & Water Manifold



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-315E	Cylinder Block Liners & Water Manifold: Studs	X	X		Cyl. Block & Liners & Water Manifold
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	X	X		Cyl. Block & Liner & Water Manifold
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	X	X		Cyl. Block & Liners & Water Manifold
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	X	X		Jacket Water
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	X	X		Jacket Water
02-316C	Jacket Water Inlet Manifold: Vent line to Discharge Manifold	X	X		Jacket Water
02-317A	Water Discharge Manifold: Jacket Water Discharge Manifold, Coupling and Seals	X	X		Jacket Water
02-317B	Water Discharge Manifold: Coupling & Seals	X	X		Jacket Water
02-317C	Water Discharge Manifold: Supports	X	X		Jacket Water
02-330A	Flywheel	X			Flywheel
02-330B	Flywheel - Bolting	X	X		Flywheel
02-331A	Guards: Flywheel Guard Assembly			X	
02-335A	Front Gear Case: Gear Case			X	
02-335B	Front Gearcase Bolting	X	X		Idler Gear Assembly & Front Gear Case
02-340A	Connecting Rods: Connecting Rods & Bushings	X	X		Connecting Rods



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-340B	Connecting Rod Bearing Shells	X	X		Connecting Rods
02-341A	Pistons	X	X		Pistons
02-341B	Pistons: Rings	X	X		Pistons
02-341C	Piston Pin Assembly	X	X		Pistons
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	X	X		Camshaft & Valve Train
02-345B	Tappets and Guides: Fuel Tappet Assembly	X	X		Camshaft & Valve Train
02-345C	Tappets and Guides: Fuel Pump Base Assembly	X	X		Camshaft & Valve Train
02-350A	Camshaft: Camshaft Assembly	X	X		Camshaft & Valve Train
02-350B	Camshaft: Camshaft Bearing	X			Camshaft & Valve Train
02-350C	Camshaft: Supports, Bolting and Gear	X	X		Camshaft & Valve Train
02-355A	Idler Gear Assemble: Crank To Pump Gear	X	X		Idler Gear Assembly & Front Gear Case
02-355B	Idler Gear Assembly: Idler Gear Assembly	X	X		Idler Gear Assembly & Front Gear Case
02-355C	Idler Gear Assembly: Gaskets & Bolting			X	
02-359	Air Start Valve	X	X		Air Start & Barring Device
02-360A	Cylinder Heads	X	X		Cylinder Heads & Valves
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	X	X		Cylinder Heads & Valves

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-360C	Cylinder Head and Valves: Bolting and Gaskets	X	X		Cylinder Heads & Valves
02-360D	Cylinder Head & Valves: Springs	X	X		Cylinder Heads & Valves
02-361	Indicating Cocks			X	
02-362A	Subcover	X	X		Camshaft & Valve Train
02-362B	Cylinder Head Covers: Gaskets and Bolting			X	
02-365A	Fuel Injection Pump	X			Fuel Oil Injection
02-365B	Fuel Injection Equipment - Fuel Injection Tips	X			Fuel Oil Injection
02-365C	Fuel Injection Equipment - Tube Assembly	X	X		Fuel Oil Injection
02-365D	Fuel Injection Equipment: Supports	X	X		Fuel Oil Injection
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	X	X		Fuel Oil Injection
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	X	X		Fuel Oil Injection
02-373A	Gear Case Opening - Cover			X	
02-373B	Gear Case Opening Cover - Gaskets & Bolting			X	
02-375	Intake Manifold and Piping	X	X		Turbo, Intake, Intrclr. & Ex- haust
02-380A	Exhaust Manifold	X	X		Turbo, Intake, Intrclr. & Ex- haust

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-380B	Exhaust Manifold: Gasket and Bolting	X	X		Turbo, Intake, Intrclr. & Exhaust
02-385A	Cylinder Block Covers: Covers			X	
02-385B	Cylinder Block Covers: Gaskets and Bolting	X	X		Cyl. Block & Liners & Water Manifold
02-386A	Crankcase Covers: Crankcase Cover Assy and Relief Valves			X	
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	X	X		Crankshaft & Bearings
02-387A	Crankcase Ventilator: Crankcase Vacuum Fan			X	
02-387B	Crankcase Ventilator - Oil Separator			X	
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	X	X		Camshaft & Valve Train
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	X	X		Camshaft & Valve Train
02-390C	Main and Connector Pushrods	X	X		Camshaft & Valve Train
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	X	X		Camshaft & Valve Train
02-390E	Rocker Arms and Pushrods: Bushings	X			Camshaft & Valve Train
02-390F	Rocker Arms and Pushrods: Misc. Bolts & Drive Studs	X	X		Camshaft & Valve Train
02-395A	Gear Case Covers: Cover			X	
02-395B	Gear Case Covers: Gaskets and Bolting			X	

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-410A	Overspeed Trip Governor	X	X		Overspeed Trip & Governor
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	X	X		Overspeed Trip & Governor
02-410C	Overspeed Trip: Coupling	X	X		Overspeed Trip & Governor
02-410D	Overspeed Trip Vent Valve	X	X		Overspeed Trip & Governor
02-411A	Governor Drive: Governor & Tachometer Drive Gear and Shaft	X	X		Overspeed Trip & Governor
02-411B	Governor Drive: Couplings, Pins & Keys	X	X		Overspeed Trip & Governor
02-413A	Governor Linkage	X	X		Overspeed Trip & Governor
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	X	X		Fuel Oil Injection
02-415A	Governor Assembly: Woodward Governor	X	X		Overspeed Trip & Governor
02-415B	Governor Assembly - Booster Servomotor	X			Overspeed Trip & Governor
02-415C	Governor Assembly - Heat Exchangers	X	X		Overspeed Trip & Governor
02-420	Engine Driven Lube Oil Pump	X	X		Lube Oil
02-425A	Engine Driven Jacket Water Pump	X	X		Jacket Water
02-435A	Jacket Water Fittings: Pipe & Fittings	X	X		Jacket Water
02-435B	Jacket Water Fittings - Supports	X	X		Jacket Water



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-435C	Jacket Water Inlet Fittings - Valves	X	X		Jacket Water
02-436A	Intercooler Piping	X	X		Turbo, Intake Intercooler & Exhaust
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	X	X		Turbo, Intake Intercooler & Exhaust
02-437	Turbo Water Piping: Pipe & Fittings	X	X		Jacket Water
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	X	X		Air Start & Barring Device
02-441B	Starting Air Manifold Valves, Filters & Strainer	X	X		Air Start & Barring Device
02-441C	Starting Air Manifold: Supports	X	X		Air Start & Barring Device
02-442A	Starting Air Distributor: Distributor Assembly	X	X		Air Start & Barring Device
02-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	X	X		Air Start & Barring Device
02-445	Fuel Oil Booster Pump	X	X		Fuel Oil Injection
02-450A	Fuel Oil Header: Piping/Tubing	X	X		Fuel Oil Injection
02-450B	Fuel Oil Header: Fuel Oil Supports	X	X		Fuel Oil Injection
02-455A	Fuel Oil Filters & Strainers: Filters	X	X		Fuel Oil Injection
02-455B	Fuel Oil Filters & Strainers: Strainers	X			Fuel Oil Injection
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	X	X		Fuel Oil Injection



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	X	X		Lube Oil
02-465B	Lube Oil Lines - External Supports	X	X		Lube Oil
02-465C	Lube Oil Lines External-Valves	X	X		Lube Oil
02-465D	Lube Oil Keepwarm Strainer	X	X		Lube Oil
02-467A	Turbocharger: Lube Oil Fitting - Pipe, Tubing, Fittings & Flexible Coupling	X	X		Lube Oil
02-467B	Turbocharger: Lube Oil Fittings - Supports	X	X		Lube Oil
02-475A	Turbocharge: Bracket	X	X		Turbo, Intake, Intrclr. & Ex- haust
02-475B	Air Butterfly Valve Assembly	X	X		Turbo, Intake, Intrclr. & Ex- haust
02-475C	Turbocharger: Bracket - Bolting & Gaskets	X	X		Turbo, Intake, Intrclr. & Ex- haust
02-500A	Control Panel Assembly Cabinet/System	X	X		Control Panel Assembly
02-500B	Control Panel Assembly: Annunciators			X	
02-500C	Control Panel Assembly: Circuit Breaker/Contact Blocks			X	
02-500D	Control Panel Assembly: Pressure Gauges			X	
02-500E	Control Panel Assembly: Hourmeter			X	



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-500F	Control Panel Assembly Accumulator	X	X		Control Panel Assembly
02-500G	Control Panel Valves	X	X		Control Panel Assembly
02-500H	Control Panel Assembly Pressure Switch	X	X		Control Panel Assembly
02-500I	Control Panel Assembly: Pyrometers			X	
02-500J	Control Panel Assembly: Control Relays	X	X		Control Panel Assembly
02-500K	Control Panel Assembly: Solenoid Valves	X	X		Control Panel Assembly
02-500L	Control Panel Assembly: Tachometer			X	
02-500M	Control Panel Assembly - Piping, Tubing, Fittings		X		Control Panel Assembly
02-500N	Control Panel Assembly: Terminal Boards/Switches/Wiring		X		Control Panel Assembly
02-503	Thermometer			X	
02-520	Instruction Plate: Nameplate			X	
02-525A	Barring Device - Pneumatic: Barring Device Assembly			X	
02-525C	Barring Device - Pneumatic: Misc. Fitting, Hose, Filters Tubing			X	
02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports			X	Air Start & Barring Device

1

1



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-530A	Platform - Front & Side: Side Platform Assembly			X	
02-530B	Platform - Front & Side: Front Platform Assembly			X	
02-531A	Platform, Ladders, Stairs - Stair Assembly			X	
02-531B	Platform, Ladders, Stairs - Supports			X	
02-540A	Lube Oil Sump with Strainer Assembly and Mounting Hardware		X		Lube Oil
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	X	X		Lube Oil
02-540C	Lube Oil Sump Tank: Mounting Hardware	X	X		Lube Oil
02-550	Foundation Bolts: Anchors, Bolts, Misc. Hardware	X	X		Engine & Aux. Sub Base & Foundation Bolts
02-590	Special Tools: Asst. Engine Assembly Tools			X	
02-630A	Pyrometer Conduit Assembly: Conduit	X	X		Engine Instru- mentation & Wiring
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	X	X		Engine Instru- mentation & Wiring
02-630C	Pyrometer Conduit Assembly: Support	X	X		Engine Instru- mentation & Wiring
02-630D	Pyrometer Conduit Assembly Thermocouple	X			Engine Instru- mentation & Wiring



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-630E	Pyrometer Conduit Assembly: Gaskets			X	
02-650A	Emergency Diesel Generator	X	X		Generator
02-650B	Generator Control	X	X		Generator
02-650C	Generator-Shaft & Bearing	X	X		Generator
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	X	X		Engine Instru- mentation & Wiring
02-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	X	X		Engine Instru- mentation & Wiring
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals		X		Engine Instu- mentation & Wiring
02-688D	On-Engine Alarm Sensors	X	X		Engine Instru- mentation & Wiring
02-689	Off-Engine Alarm Sensors	X	X		Engine Instru- mentation & Wiring
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	X	X		Engine Shut- down & Equip- ment
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	X	X		Engine Shut- down & Equip- ment
02-695C	Engine Shutdown Trip Switches	X	X		Engine Shut- down & Equip- ment
02-700A	Jacket Water Standpipe: Pipe, Fittings, Gaskets	X	X		Jacket Water



TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-700B	Jacket Water Standpipe: Valves	X	X		Jacket Water
02-700C	Jacket Water Standpipe: Pipe Supports	X	X		Jacket Water
02-700D	Jacket Water Standpipe: Gauges			X	
02-700E	Jacket Water Standpipe: Switches	X	X		Jacket Water
02-700F	Jacket Water Standpipe & Misc. Bolting	X	X		Jacket Water
02-717A	Auxiliary Skid	X	X		Jacket Water
02-717B	Aux Sub Base & Oil & Water Piping - Jacket Water: Valves	X	X		Jacket Water
02-717D	Aux Sub Base & Oil & Water Piping - Jacket Water: Pipe Couplings, Fittings, Orifices, Y-Strainers		X		Jacket Water
02-717E	Aux Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting		X		Jacket Water
02-717F	Aux. Sub Base & Oil & Water Piping - Jacket Water: Supports	X	X		Jacket Water
02-717H	Aux. Sub-Base & Oil & Water Piping - Lube Oil: Piping and Fittings	X	X		Lube Oil
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Valves	X	X		Lube Oil
02-717J	Aux Sub Base & Oil & Water Piping - Lube Oil: Gaskets & Bolting	X	X		Lube Oil

1

TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-717K	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	X	X		Lube Oil
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	X	X		Fuel Oil
02-717P	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	X	X		Fuel Oil
02-805A	Exhaust Silencer			X	
02-805B	Intake Air Filter	X	X		Turbo, Intake, Intercooler & Exhaust
02-805C	Intake Air Silencer		X		Turbo, Intake, Intercooler & Exhaust
02-805D	Flex Connections	X	X		Turbo, Intake, Intercooler & Exhaust
02-810A	Misc. Equipment - Heater, Jacket Water		X		Jacket Water
02-810C	Jacket Water Heat Exchanger	X	X		Jacket Water
02-810D	Jacket Water Standby Heater Pump		X		Jacket Water
02-810E	Thermostatic Valve	X	X		Jacket Water
02-820A	Lube Oil Full Pressure Strainer	X	X		Lube Oil
02-820B	Lube Oil Heat Exchanger	X	X		Lube Oil
02-820C	Misc. Equipment - Heater, Lube Oil Sump Tank		X		Lube Oil
02-820D	Lube Oil System - Aux Lube Oil Pump		X		Lube Oil

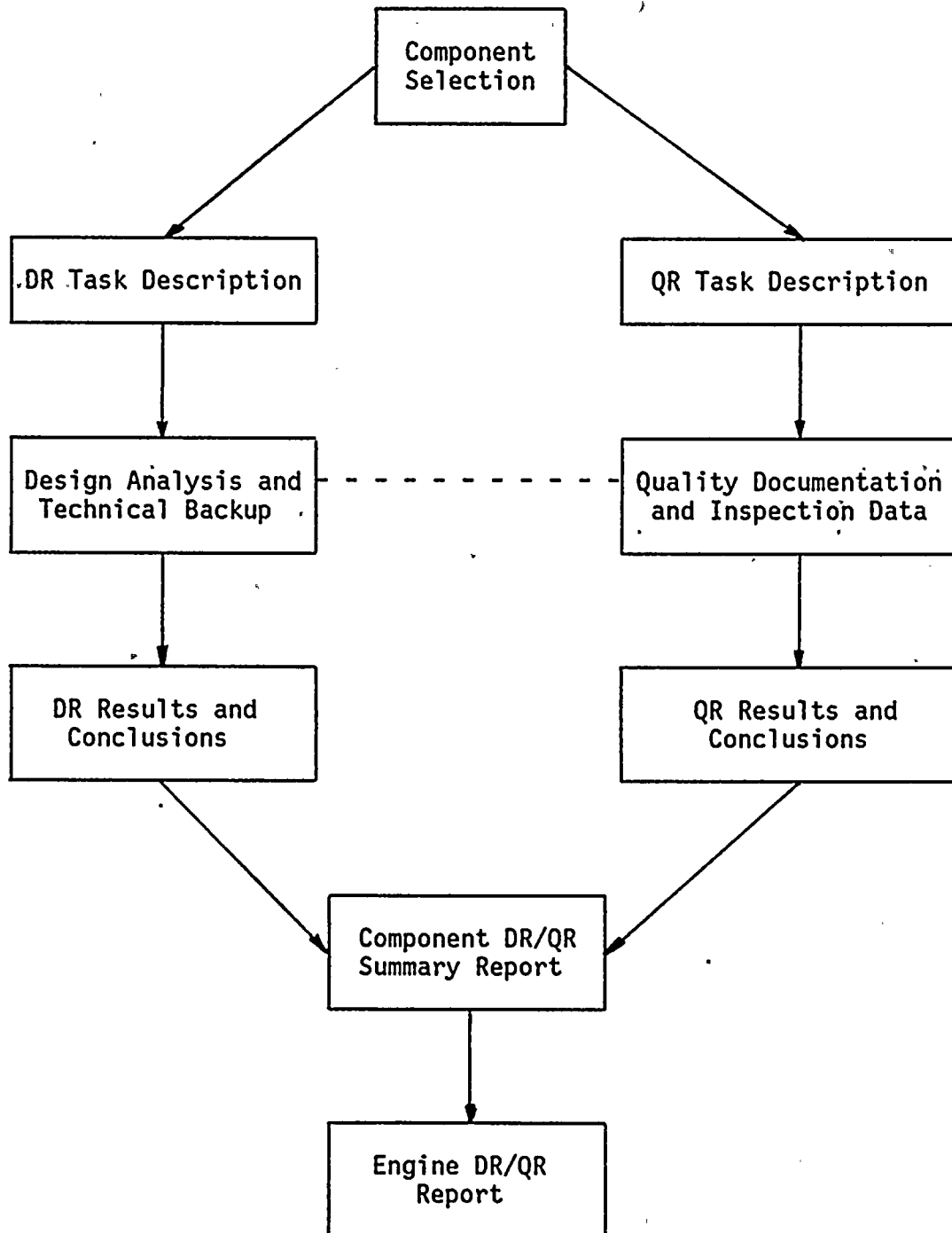
TABLE 2-2
SHEARON HARRIS COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-820E	Full Flow Lube Oil Filter	X	X		Lube Oil
02-820F	Lube Oil Keep Warm Pump	X	X		Lube Oil
02-820G	Lube Oil Keep Warm Filter	X	X		Lube Oil
02-825A	Fuel Oil Day Tank	X	X		Fuel Oil
02-835A	Starting Air Compressor			X	
02-835B	Misc Equipment: After Cooler			X	
02-835C	Air Dryer			X	
02-835D	Starting Air Tank	X	X		Air Start & Barring Device

| 1
| 1



FIGURE 2.1



3.0 Results of Design Review and Quality Revalidation

The DR/QR Program implemented for the Shearon Harris Nuclear Power Plant - Unit 1 TDI diesels was consistently performed with the generic methodology described in Section 2.0. The results of these reviews are summarized in this section. More detailed component summary reports are contained in Appendix I of this report.

Sections 3.1 and 3.2 list the components of the Shearon Harris diesel generators, which have been reviewed under Phase I and Phase II, respectively. The majority of these components are assessed to be acceptable for their intended service with unlimited life provided that the recommendations identified are followed. These recommendations deal mainly with additional inspection requirements, and installation, operating and maintenance procedure improvements. In some cases, procurement specification recommendations are identified to aid the utility in its spare parts program.

Some of the components modifications as identified in the recommended actions. The implementation of these recommended actions by the utility will result in a component which is acceptable for its intended service with unlimited life.

|1

3.1 Summary Resolution of Sixteen Generic Components (Phase I)

The results of the Phase I program have been submitted to the NRC in a series of reports and supplements (Refs. 2 through 34) which covered the 16 generic components. The results of these reviews are summarized below.

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

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Main and Connector Pushrods (03-390C, 03-390D)	Unlimited Life	Additional procurement requirement. Additional inspections recommended. Random destructive testing recommended.
Rocker Arm Capscrews (03-390F)	Unlimited Life	Additional maintenance Requirements.
Jacket Water Pump (03-425A)	Unlimited Life	Additional maintenance and inspection requirements.
Wiring and Terminations (03-688B)	Unlimited Life	None

1

3.2 Summary Resolution of Phase II Components

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>	
<u>TURBO, INTAKE, INTERCOOLER & EXHAUST</u>			
Intercooler (F-068)	Modification	Addition of a low point drain in the intake air downstream of the intercooler. Additional maintenance recommendations.	1
Turbocharger (MP-022/023)	Modifications	Additional Quality inspections recommended. Additional maintenance and modification recommendations.	1-
Turbocharger Thrust Bearing Lubricant System (02-CFR)	Modifications	Addition of supports in order to reduce the unsupported span lengths and to minimize vibration.	
Intake Manifold & Piping (Large Bore Scope Only) (02-375)	Modifications	Check installation of U-bolts on the crossover piping. Additional maintenance requirements. Additional quality inspections recommended.	
Exhaust Manifold (02-380A)	Modifications	Modifications concerning slip joints. Refer to Component Design Review Checklist for details. Additional maintenance requirement.	
Exhaust Manifold: Gasket & Bolting (02-380B)	Unlimited Life	Additional quality inspections recommended.	
Intercooler Piping: Pipe (Large Bore Scope Only) (02-436A&B)	Unlimited Life	None	
Turbocharger Bracket: Bolting and Gaskets (02-475A&C)	Unlimited Life	Implementation of proper torque on bracket bolting. Additional Quality Revalidation inspections recommended. Additional inspections recommended.	1
Air Butterfly Valve Assembly (02-475B)	Modifications	Addition of grease fittings as per TDI SIM 322. Additional maintenance recommendations. Additional quality inspections recommended.	

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Intake Air Filters (02-805B)	Unlimited Life	Additional maintenance requirements.
Intake Air Silencer (02-805C)	Unlimited Life	None
Flex Connections (02-805D)	Unlimited Life	None
<u>LUBE OIL</u>		
Lube Oil Pressure Regulating Valve (00-420)	Unlimited Life	Additional maintenance requirements.
Lube Oil Fittings: Internal Headers (Large Bore Scope Only) (02-307A-LB)	Unlimited Life	None
Lube Oil Fittings: Internal - Headers (Small Bore Scope Only) (02-307A-SB)	Unlimited Life	None
Lube Oil Fittings: Internal - Tubing and Fittings (Small Bore Scope Only) (02-307B)	Unlimited Life	None
Lube Oil Fittings: Internal - Supports (Small Bore Scope Only) (02-307D)	Unlimited Life	None
Engine Driven Lube Oil Pump (02-420)	Unlimited Life	None
Lube Oil Liner - External Tubings, Fittings, Couplings (Large Bore Scope Only) (02-465A-LB)	Unlimited Life	Additional maintenance require- ments.

1



<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Lube Oil Lines - External - Tubing, Fittings, Coupling (Small Bore Scope Only) (02-465A-SB)	Modifications	Addition and/or modification of supports. Refer to DR/QR Report 02-465B for details.
Lube Oil Lines - External Supports (Large Bore Scope Only) (02-465B-LB)	There are no supports for this component.	
Lube Oil Lines External: Supports (Small Bore Scope Only) (02-465B-SB)	Modifications	Replace two-direction lateral restraint located on the lube oil supply line between the front crossover header and strainers for Engine 1B with three-direction restraints. Addition of a two-direction lateral restraint to the riser of the 1½-inch diameter gear case lube oil line of Engine 1B.
Lube Oil Lines - External - Valves (02-465C)	Unlimited Life	None
Lube Oil Keepwarm Strainer (02-465D)	Unlimited Life	Additional maintenance recommendations.
Turbocharger - Lube Oil Fittings and Piping (Large Bore Scope Only) (02-467A-LB)	Modifications	Replace 2½-inch Dresser couplings with 2½-inch 150 lb. S.O. flanges with A307 bolts.
Turbocharger - Lube Oil Fittings and Piping (Small Bore Scope Only) (02-467A-SB)	Modifications	Modify supports. Refer to DR/QR Report 02-467B for details.
Turbocharger - Lube Oil Fittings: Piping (Large Bore Scope Only) (02-467B-LB)	Modifications	The multiple support located between the lube oil sump tank and Dresser coupling requires reinforcement of its support members and increases in their welds.

1

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Turbocharger - Lube Oil Fittings: Supports (Small Bore Scope Only) (02-467B-SB)	Modifications	Addition of a three-directional restraint to each turbocharger lube oil line to reduce the unsupported span length.
Lube Oil Sump Tank, with Strainer Assembly and Mounting Hardware (02-540A&C)	Unlimited Life	Additional Quality Revalidation requirements.
Lube Oil Sump Tank-Misc. Fittings, Gaskets, Pipe & Bolting (02-540B)	There is no small bore piping associated with this component.	
Auxiliary Sub Base & Oil & Water Piping-Lube Oil: Pipe and Fittings (Large Bore Scope Only) (02-717H-LB)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping - Lube Oil: Piping and Fittings (Small Bore Scope Only) (02-717H-SB)	Modifications	Addition of supports in order to reduce the unsupported tubing span lengths of the lube oil system.
Auxiliary Sub Base & Oil & Water Piping - Lube Oil: Valves (02-717I)	Unlimited Life	Additional maintenance recommendations.
Auxiliary Sub Base & Oil & Water Piping - Lube Oil - Gaskets and Bolting (02-717J)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping-Lube Oil: Supports and Mounting Hardware (Large Bore Scope Only) (02-717K)	Unlimited Life	None

1



<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Auxiliary Sub Base & Oil & Water Piping - Lube Oil: Supports and Mounting Hardware (Small Bore Scope Only) (02-717K)	Modifications	Modification of tubing supports to provide two-direction lateral restraints.
Lube Oil Full Pressure Strainer (02-820A)	Unlimited Life	Additional maintenance requirements.
Lube Oil Heat Exchanger (02-820A)	Unlimited Life	Additional maintenance requirements.
Misc. Equipment - Heater, Lube Oil Sump Tank (02-820C)	Unlimited Life	Additional maintenance requirements.
Lube Oil System - Aux. Lube Oil Pump (02-820D)	Unlimited Life	None
Full Flow Lube Oil Filter (02-820E)	Unlimited Life	Additional maintenance
Lube Oil Keep Warm Pump (02-820F)	Unlimited Life	None
Lube Oil Keep Warm Filter (02-820G)	Unlimited Life	None
Lube Oil Keep Warm Filter (02-820G)	Unlimited Life	Additional maintenance requirements.

ENGINE BASE & BEARING CAPS

Base and Bearing Caps - Base Assembly, Main Bearing Studs, and Main Bearing Caps (02-305A,C,D)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspection recommendation.
--	----------------	---

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
<u>CRANKSHAFT & BEARINGS</u>		
Crankshaft (02-310A)	Unlimited Life	Perform torsionograph test and compare results with TDI Holzer calculations and vibrational analysis. Polish and inspect oil holes to verify a satisfactory condition.
Main Bearings (02-310B)	Unlimited Life	Inspection for evidence of misalignment. Additional Quality inspections recommended.
Camshaft & Bearing: Thrust Bearing Ring (02-310C)	Unlimited Life	Additional maintenance recommendations.
Crankcase: Crankcase Assembly (02-311A)	Unlimited Life	Additional maintenance recommendations.
Crankcase: Crankcase Mounting Hardware (02-311D)	Unlimited Life	None
Crankcase: Crankcase Gaskets and Mounting Hardware (02-386B)	Unlimited Life	Additional Quality inspections recommended.

CYLINDER BLOCK, LINERS & WATER MANIFOLD

Cylinder Block (02-315A)	Unlimited Life	Implementation of routine inspection procedures. Verify liner bore and mating block dimensions.	1
Cylinder Block Liners & Water Manifold-Cylinder Liner (02-315C)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.	1

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Cylinder Block Liners and Jacket Water Manifold and Piping (Large Bore Scope Only) (02-315D)	Unlimited Life	None
Cylinder Block Liners and Water Manifold: Studs (02-315E)	Unlimited Life	Change in installation torque recommended. Additional Quality Revalidation inspections recommended.
Cylinder Block Liners and Water Manifold: Cylinder Head Nuts (02-315F)	Unlimited Life	Additional Quality inspections recommended.
Cylinder Block Liners and Water Manifold: Seals and Gaskets (02-315G)	Unlimited Life	Verify that the proper cylinder liner seals have been installed.
Cylinder Block Covers: Gaskets & Bolts (02-385B)	Unlimited Life	Additional Quality inspections recommended.
<u>AIRSTART & BARRING DEVICE</u>		
Air Start Valves (02-359)	Unlimited Life	Additional maintenance recommend- ations. Implementation of TDI SIMs 329 and 360. Additional Quality inspections recommended.
Starting Air Manifold: Piping, Tubing, & Fittings (Large Bore Scope Only) (02-441A-LB)	Unlimited Life	None
Starting Air Manifold: Piping, Tubing, and Fittings (Small Bore Scope Only) (02-441A-SB)	Modifications	Modify supports as indicated in DR/QR report 02-441C.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Starting Air Manifold: Valves, Strainers, & Filters (02-441B)	Modifications	Additional maintenance recommendations. Addition of free flowing drains to the air distributor filter.
Starting Air Manifold: Supports (Large Bore Scope Only) (02-441C-LB)	Modifications	Reinforcement of supports. Refer to Component Design Review Checklist 02-441C-LB for details
Starting Air Manifold: Supports (Small Bore Scope Only) (02-441C-SB)	Modifications	Replace existing two-direction lateral support on the air supply to distributor tubing located adjacent to the right bank filter. Addition of a two-direction lateral restraint to the distributor air supply tubing on the right bank lines between the header filter and distributor.
Starting Air Distributor: Distributor Assembly (02-442A)	Unlimited Life	Additional maintenance requirements. Additional Quality inspections recommended.
Starting Air Distributor: Tubing, Fittings, Gaskets (02-442B)	The tubing, fittings, and gaskets for this component are considered under component Nos. 02-441A&C and 02-307B.	
Starting Air Tank (02-835D)	Unlimited Life	Daily checks for moisture at the drain valve or float trap recom- mended.

CONNECTING RODS

Connecting Rods: Rods and Bushings (02-340A)	Modifications	Additional inspection recommend- ations. Additional Quality inspections recommended. Replacement of two wrist pins and one connecting rod bolt.
Connecting Rod Bearing Shells (02-340B)	Unlimited Life	Additional maintenance recommend- ations. Outstanding NCR's should be closed during reassembly of the engines.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
<u>PISTONS</u>		
Pistons (02-341A)	Unlimited Life	None
Pistons: Rings (02-341B)		Additional maintenance requirements. Evaluate the need to upgrade present engine oil.
Piston: Pin Assembly (02-341C)	Modifications	Replace spiral ring retainers with Waldes snap ring retainers (P/N GE-003-067). Return wrist pin R-2 and R-5 from engine 1A-SA to TDI for reworking or replace with acceptable wrist pins. Retest by material comparator method wrist pin L-4 from engine 1A-SA. Additional maintenance inspections recommended. Additional Quality inspections recommended.

CAMSHAFT & VALVE TRAIN

Tappets and Guides: Intake & Exhaust Tappet Assembly (02-345A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Tappets and Guides: Fuel Tappet Assembly (02-345B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspection recommended.
Tappets and Guides - Fuel Pump Base Assembly (02-345C)	Unlimited Life	None
Camshaft: Camshaft Assembly (02-350A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspection recommendation.
Camshaft: Camshaft Bearing (02-350B)	Unlimited Life	None
Subcover (02-362A)	Unlimited Life	Additional inspections and Quality Revalidation inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Rocker Shaft Assemblies: Intake/ Intermediate & Exhaust (02-390A&B)	Unlimited Life	Hardness tests on the rocker arm shafts recommended for Engine 1B.
Main and Connector Pushrods (02-390C&D)	Unlimited Life	Recommendation for purchase orders to specify destructive verification of weld quality.
Rocker Arms and Pushrods: Bushings (02-390E)	Unlimited Life	Additional maintenance requirements.
Rocker Arms and Pushrod - Misc. Bolts and Drive Studs (02-390F)	Unlimited Life	Additional maintenance requirements. Additional Quality inspections recommended.

IDLER GEAR ASSEMBLY & FRONT GEAR CASE

Front Gearcase - Gasket and Bolting (02-335B)	Unlimited Life	Additional inspections of bolts. Addition of positive locking features (bent tab or lockwire).
Gear Train Assembly (02-350C & 02-355A & B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.

FLYWHEEL

Flywheel (02-330A)	Unlimited Life	None
Flywheel-Bolting (02-330B)	Unlimited Life	None

ENGINE INSTRUMENTATION & WIRING

Pyrometer Conduit Assembly - Thermocouples (02-630D)	Unlimited Life	Additional maintenance requirements.
--	----------------	--------------------------------------

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Engine and Aux. Module Wiring Material and Fittings: Pyrometer conduit, Fittings and Supports (02-688A, 02-630A,B,C)	Unlimited Life	Upgrade conduit supports.
Engine & Auxiliary Module Wiring Material: Wiring & Terminations (02-688B)	Unlimited Life	None
Engine & Aux. - Module Wiring Material - Boxes & Terminals (02-688C)	Unlimited Life	None
On Engine Alarm Sensors (02-688D)	Unlimited Life	None
Off Engine Alarm Sensors (02-689)	Unlimited Life	None
<u>OVERSPEED TRIP & GOVERNOR</u>		
Overspeed Trip: Governor (02-410A)	Unlimited Life	Additional maintenance requirements. Additional Quality inspections recommended.
Overspeed Trip: Governor and Accessory Drive Assembly (02-410B)	Unlimited Life	Additional Quality inspections recommended.
Overspeed Trip: Couplings (02-410C)	Unlimited Life	Additional maintenance requirements. Additional Quality inspections recommended.
Overspeed Trip: Vent Valve (02-410D)	Unlimited Life	Additional maintenance recommendations.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Governor Drive: Governor & Tachometer Drive Gear and Shaft (02-411A)	Unlimited Life	Additional Quality inspections recommended.
Governor Drive: Couplings, Pins, and Keys (02-411B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Governor Linkage (02-413A)	Unlimited Life	Additional maintenance and modification recommendations. Additional Quality inspections recommended.
Governor Assembly - Woodward Governor (02-415A)	Unlimited Life	Additional maintenance requirements.
Governor Assembly - Booster Servomotor (02-415B)	Unlimited Life	Additional Quality inspections recommended.
Governor Assembly - Heat Exchanger (02-415C)	Unlimited Life	Additional Quality inspections recommended.

ENGINE SHUTDOWN & EQUIPMENT

Engine Shutdown Equipment - Tubing/Fittings & Supports (Small Bore Scope Only) (02-695A)	Modifications	Addition of two-way supports. Modify supports on tubing lines that run along the right bank to provide two-direction lateral restraint (Engine 1B only).
Engine Shutdown Equipment - Valves, Regulators, Orifices (02-695B)	Unlimited Life	Additional maintenance inspections recommended.
Engine Shutdown Trip Switches (02-695C)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
<u>JACKET WATER</u>		
Jacket Water Inlet Manifold - (Manifold Assembly with Hardware and Coupling and Gaskets (Large Bore Scope Only) (02-316A&B))	Modifications	The second support west of the 6" TDI Custom Flanges requires stiffening in the lateral direction to accommodate the total support loads.
Jacket Water Inlet Manifold - Vent Line to Discharge Manifold (02-316C)	Modifications	Modify supports to have sufficient moment connection at the support to structural steel interface.
Jacket Water Discharge Manifold/ Piping (Large Bore Scope Only) (02-317A&B)	Modifications	Replace Style 65 Dresser couplings with Style 90 or Style 165 Dresser couplings. Verify proper installation of all jacket water manifold supports.
Water Discharge Manifold: Supports (Large Bore Scope Only) (02-317C)	Modifications	Ensure that the supports pads for the supports on each of the 5-inch jacket water discharge headers, have a minimum weld of 1/4-inch (3 inches long) between the engine block and the longer sides of the support pad. Also ensure that the welds between the engine block and the shorter sides of the support are 1/4-inch.
Engine Driven Jacket Water Pump (02-425A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Jacket Water Fitting - Pipe and Fittings (Large Bore Scope Only) (02-435A)	Modifications	Reinforcement of supports. Refer to DR/QR report 02-435A for details.
Jacket Water Fittings - Pipe and Fittings (Small Bore Scope Only) (02-435A)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>	
Jacket Water Fittings: Supports (Large Bore Scope Only) (02-435B)	Unlimited Life	None	
Jacket Water Inlet Fittings: Valves (02-435C)	Unlimited Life	None	1
Turbo Water Piping: Pipe and Fittings (Large Bore Scope Only) (02-437)	Unlimited Life	None	
Turbo Water Piping: Pipe and Fittings (Small Bore Scope Only) (02-437)	Unlimited Life	None	
Jacket Water Standpipe: Pipe, Fittings, Gaskets (02-700A)	Modifications	Addition of three-directional restraint on the standpipe overflow line. Addition of an anchor on the standpipe fill line. Verification of installation of jacket water vent lines.	1
Jacket Water Standpipe: Valves (02-700B)	Unlimited Life	Additional maintenance requirements.	
Jacket Water Standpipe: Pipe Supports (02-700C)	Modifications	Modify tubing supports to have two-directions of restraint and sufficient moment connection. U-bolts should have a minimum diameter of 3/8-inch. Suitable locking devices should be installed.	
Jacket Water Standpipe: Switches (02-700E)	Unlimited Life	None	
Jacket Water Standpipe and Misc. Bolt-ing (02-700F)	Unlimited Life	Additional Quality inspections recommended.	

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Auxiliary Sub Base & Oil & Water Piping - Jacket Water: Valves (02-717B)	Unlimited Life	Additional maintenance recommendations.
Auxiliary Sub Base & Oil & Water Piping- Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers (Large Bore Scope Only) (02-717D-LB)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers (Small Bore Scope Only) (02-717D-SB)	Unlimited Life	Installation of two and/or three-directional restraints such that the unsupported tubing spans do not exceed a maximum of 4 ft - 6 in. Installation of restraints to allow for thermal expansion.
Auxiliary Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting (02-717E)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping- Jacket Water: Supports (Large Bore Scope Only) (02-717F)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping - Jacket Water Supports (Small Bore Scope Only) (02-717F)	Modifications	Verification or modification of sufficient stiffness and weld of the jacket water cooler drain line supports.
Miscellaneous Equipment - Heater, Jacket Water (02-810A)	Unlimited Life	Additional maintenance requirements.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Jacket Water Heat Exchanger (02-810C)	Unlimited Life	Additional maintenance requirements.
Jacket Water Standby Heater Pump (02-810D)	Unlimited Life	None
Thermostatic Valves (02-810E)	Unlimited Life	Additional maintenance recommendations. Additional inspections recommended.

1

CYLINDER HEADS & VALVES

Cylinder Heads (02-360A)		Additional Quality inspections recommended. Additional maintenance recommendations.
Cylinder Head Valves: Intake and Exhaust Valves (02-360B)	Unlimited Life	Additional inspections recommended. Additional Quality Revalidation inspections recommended.
Cylinder Head and Valves: Bolting and Gaskets (02-360C)	Unlimited Life	Additional Quality Revalidation inspections recommended.
Cylinder Head and Valves: Springs (02-360D)	Unlimited Life	Additional Quality Revalidation inspections recommended.

FUEL OIL INJECTION

Fuel Injection Pump (02-365A)	Unlimited Life	Additional maintenance recommendations.
Fuel Injection Equipment: Fuel Injection Tips (02-365B)	Unlimited Life	Additional maintenance recommendations.
Fuel Injection Equipment Tube Assembly (02-365C)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Fuel Injection Equipment: Supports (Small Bore Scope Only) (02-365D)	Unlimited Life	Inspections of the support elastomer for signs of deterioration or degradation recommended.
Fuel Control Rod Linkage & Bearings (02-371A&B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Fuel Pump Linkage: Automatic Shutdown Cylinder (02-413B)	Unlimited Life	None
Fuel Oil Booster Pump (02-445)	Unlimited Life	None
Fuel Oil Header: Piping/Tubing (02-450A)	Modifications	Addition and/or modification of supports. Refer to DR/QR report 02-450A for details. Replacement of threadolet with a socket welded tee.
Fuel Oil Header - Fuel Oil Supports (Small Bore Scope Only) (02-450B)	Modifications	Addition/Modification of supports and restraints. Refer to DR/QR report 02-450B for details.
Fuel Oil Filters & Strainers: Filters (02-455A)	Unlimited Life	Additional maintenance recommendations.
Fuel Oil Filters & Strainers: Strainers (02-455B)	Unlimited Life	Additional maintenance recommendations. Recommendation to replace strainer with a coarser design.
Fuel Oil Filters & Strainers Mounting Hardware (02-455C)	Unlimited Life	None
Auxiliary Sub Base & Oil & Water Piping - Fuel Oil: Piping and Fittings (Small Bore Scope Only) (02-717M)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>	
Auxiliary Sub Base & Oil & Water Piping - Fuel Oil: Bolting and Gaskets (02-717P)	Unlimited Life	None	
Fuel Oil Day Tank (02-825A)	Unlimited Life	None	1
<u>GENERATOR</u>			
Emergency Diesel Generator (02-650A)	Unlimited Life	None	
Generator Controls (02-650B)	Unlimited Life	Recommendations for temperature monitoring in exciter cabinets. Replace field flashing relay with appropriately rated relay. Provide additional cabinet venti- lation. Additional maintenance recommendations to increase long- term reliability.	
Generator: Shaft and Bearings (02-650C)	Unlimited Life	None	1
<u>CONTROL PANEL ASSEMBLY</u>			
Control Panel Assembly - Cabinet/System (02-500A)	Unlimited Life	None	
Control Panel Assembly - Accumulator (02-500F)	Unlimited Life	None	
Control Panel Assembly-Valves (02-500G)	Unlimited Life	Additional maintenance require- ments	1
Control Panel Assembly - Pressure Switches (02-500H)	Unlimited Life	None	

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Control Panel Assembly - Control Relays (02-500J)	Unlimited Life	None
Control Panel Assembly - Solenoid Valves (02-500K)	Unlimited Life	None
Control Panel Assembly - Piping, Tubing, Fittings (02-500M)	Unlimited Life	None
Control Panel Assembly - Terminal Boards/Switches, Wiring (02-500N)	Unlimited Life	None

ENGINE & AUXILIARY SUB BASE & FOUNDATION BOLTS

Foundation Bolts- Anchor Bolts, Miscellaneous Hardware (02-550)	Unlimited Life	Additional mainenance requirements.
Auxiliary Skid (02-717A)	Unlimited Life	Investigation of the adequacy of the ASME III qualifications as they apply to the auxiliary skid.

4.0 SUMMARY/CONCLUSIONS

The TDI Diesel Generator Owners Group has completed its review of the TDI diesel generators installed at Shearon Harris.

The scope and depth of this review as outlined in this report represents a significant effort by the TDI Diesel Generator Owners Group Technical Staff and Carolina Power & Light Co.

Nuclear standby diesel generator reliability has been a major concern of the industry and the NRC. Although previous programs have been sponsored by the NRC, EPRI, and other industry groups to quantify and improve this reliability, the Design Review and Quality Revalidation effort summarized in this report is unprecedented in its approach and analytical detail. This effort has produced a detailed assessment of 164 TDI diesel generator components. Many of these components have been analyzed using analytical techniques which exceed the detailed engineering effort of the original design. |1

Extensive component inspections are an integral part of the DR/QR program. The performance of these inspections leaves no doubt as to the quality of these critical diesel generator components.

Thus, the TDI Diesel Generator Owners Group effort has gone a long way toward quantifying the reliability of the TDI Diesel Generator by establishing the acceptability of these critical engine components. In many cases, recommendations are made to improve component reliability and therefore improve overall diesel generator reliability.

The TDI Diesel Generator Owners Group believes that this extensive effort verifies the acceptability of the TDI diesel generators for nuclear service.

The results of this review, as outlined in Section 3.0 of this report, show that the important components of the TDI diesel generator have been assessed to be adequate for their intended function. In cases where component adequacy has been judged to be marginal, corrective action is recommended which will ensure the adequacy of the component.

This report supports the conclusion that the TDI diesel generators installed at Shearon Harris are acceptable for their intended safety related function and, in addition, the incorporation of the maintenance and surveillance recommendations into the plant's existing program provides added assurance that these diesel generators will continue to perform their intended function for the life of the plant.

5.0 RECOMMENDATIONS

The purpose of the TDI Diesel Generator Owners Group Program was to assess the acceptability of the TDI Emergency Diesel Generator at Shearon Harris and to make recommendations as required to improve the reliability of given components. These recommendations are summarized in section 3.0 and given in detail in Appendix I.

Additionally, the TDI Diesel Generator Owners Group Program has made recommendations concerning component maintenance and surveillance. These recommendations have been assembled from manufacturers manuals and the component DR/QR summary reports. These maintenance and surveillance recommendations are outlined in Appendix II.

Although the recommendations of this report are not requirements, their adoption by Carolina Power & Light will give added assurance that the TDI Emergency Diesel Generators installed at Shearon Harris will perform their intended function for the life of the plant. These recommendations represent a conservative approach to insuring diesel generator reliability. In some cases, the utility may propose alternate means of insuring the reliability of their emergency diesel engines. Justification of these alternate means is the responsibility of the utility.

6.0 REFERENCES

Component DR/QR Summary Reports list references directly related to that component.

Ref.

1	TDI-3	3- 2-84	TDI Owners Group Program Plan
2	TDI-2	2-27-84	Investigation of Types AF and AE Piston Skirts
3	TDI-4	3-12-84	D.R. of Connecting Rod Bearing Shells
4	TDI-5	3-13-84	TDI D.G. Rocker Arm Capscrew Stress Analysis Report
5	TDI-6	3-23-84	TDI D.G. Air Start Valve Capscrew Dimensional and Stress Analysis Report
6	TDI-8	3-30-84	TDI D.G. Cylinder Head Stud Stress Analysis
7	TDI-14	4-13-84	TDI D.G. Supplement to the Cylinder Head Stud Stress Analysis and Supplement to the Air Start Valve Capscrew Dimension and Stress Analysis
8	TDI-15	4-16-84	TDI D.G. Report on Engine Driven Jacket Water Pump Design Review
9	TDI-16	4-19-84	TDI D.G. Report on Push Rods
10	TDI-17	4-20-84	TDI D.G. Report on the Evaluation of Emergency D.G. Crankshafts at Shoreham
11	TDI-18	4-24-84	TDI D.G. Report on the Evaluation of Emergency D.G. Wiring and Terminations of Shoreham
12	TDI-19	4-24-84	TDI D.G. Supplement to the Rocker Arm Capscrew Stress Analysis
13	OGTP-8	4-27-84	TDI D.G. Report on Fuel Injection Tubing Qualification Analysis
14	OGTP-9	5-14-84	TDI D.G. Report on D.R. of Connecting Rods of Inline DSR-48 Emergency D.G.
15	OGTP-10	4-27-84	TDI D.G. Report on D.R. of Engine Base and Bearing Caps
16	OGTP-25	5-14-84	TDI D.G. Cylinder Head Report

Ref. #

17	OGTP-26	5-14-84	TDI D.G. Turbocharger Report
18	OGTP-39	5-24-84	Evaluation of Emergency D.G. Crankshafts at Shoreham and Grand Gulf Nuclear Power Station
19	OGTP-40	5-24-84	D.R. of Connecting Rods for TDI DSRV-4 Series Diesel Generators
20	OGTP-41	5-24-84	Investigation of Types AF & AE Piston Skirts
21	OGTP-57	6-05-84	Emergency D.G. Aux. Module Control Wiring and Termination Qualification Report for G.G.N.S.
22	OGTP-70	6-13-84	Emergency D.G. Aux. Module Control Wiring and Termination Qualification Report for C.P.S.E.S.
23	OGTP-72	6-14-84	The Influence of Thermal Distortion on the Performance of AF and AE Piston Skirts
24	OGTP-74	6-15-84	EDG Aux. Module Control Wiring and Termination Qualification Report for Shearon Harris Nuclear Power Station Unit I
25	OGTP-76	6-15-84	Evaluation of E.D.G. Crankshafts at Midland and Shearon Harris Nuclear Generating Stations.
26	OGTP-77	6-15-84	DR of Elliott Model 656 Turbocharger used on TDI DSRV-12-4 and DSRV-20-4 EDG sets
27	OGTP-79	6-18-84	DR of Connecting Rods of TDI Inline DSR-48 EDG
28	OGTP-80	6-18-84	DR of Engine Base and Bearing Caps for TDI DSRV-16 Diesel Engines
29	OGTP-90	6-25-84	DR of TDI R-4 and RV-4 series EDG Cylinder Blocks and Liners
30	OGTP-89	6-22-84	DR of Connecting Rod Bearing Shells for Transamerica Delavel Enterprise Engines
31	OGTP-111	7-6-84	Supplement to the Emergency Diesel Generator Engine Driven Jacket Water Pump Design Review
32	OGTP-129	7-24-84	Emergency D.G. Rocker Arm Capscrews Stress Analysis
33	OGTP-140	7-27-84	Report on Emergency D.G. Auxiliary Control Module Control Wiring & Termination Review
34	OGTP-147	8-1-84	Design Review of Elliott Model 65G Turbocharger used on TDI DSRV-12-4 & DSRV-20-4 Emergency D.G. Sets

Ref. #

- | | | | |
|----|----------|---------|---|
| 35 | OGTP-181 | 8-10-84 | Design Review of Engine Base and Bearing Caps for TDI DSRV-16 Diesel Engines |
| 36 | OGTP-190 | 8-14-84 | Design Review of Elliott Model 90G Turbo-charger used on TDI DSR-48 and DSRV-16 Emergency Diesel Generator Sets |
| 37 | OGTP-260 | 9-7-84 | Design Review of Connecting Rods for TDI DSRV-4 Series Diesel Generators |
| 38 | OGTP-261 | 9-7-84 | Design Review of Engine Base and Bearing Caps for TDI Diesel Engines |
| 39 | OGTP-263 | 9-7-84 | Evaluation of Cylinder Heads of TDI Series R-4 Diesel Engines |
| 40 | OGTP-306 | 9-28-84 | Survey of Start Experiences and Cause of Unscheduled Shutdowns of TDI Diesel Engines |