Central Files

MAR 12 1984

Docket Nos.: 50-322
and 50-329/330

MEMORANDUM FOR: Chairman Palladino
Commissioner Gilinsky
Commissioner Roberts
Commissioner Asselstine
Commissioner Bernthal

FROM: Darrell G. Eisenhut, Director
Division of Licensing

SUBJECT: BOARD NOTIFICATION 84-051
TRANSAMERICA DELAVAL, INC. (TDI) DIESEL GENERATORS
OWNERS GROUP PROGRAM PLAN

In accordance with procedures for Board Notifications, the following information is being provided directly to the Commission. The appropriate Boards and parties are being informed by a copy of this memorandum. This information is relevant to all facilities that have diesel generators manufactured by TDI including Midland and Shoreham which are currently before the Commission.

On March 2, 1984, the TDI Owners Group forwarded to the NRC their Program Plan detailing their organization and approach for resolution of concerns with TDI diesel generators. The Program Plan is included as Enclosure 1. The staff will review this submittal as part of its overall assessment of TDI diesel generators.

Original signed by
Darrell G. Eisenhut

Darrell G. Eisenhut, Director
Division of Licensing

Enclosure:
As stated

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*SEE PREVIOUS TISSUE FOR CONCURRENCES.

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MMiller:dk	CBerlinger	RStark	DEisenhut
3/7/84	3/7/84	3/ /84	3/ /84

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Docket Nos.: 50-322
and 50-416

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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EDO
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Catawba (Kelly,Foster,Purdom)
Perry (Bloch,Bright,Kline)
Comanche Peak (Block,Jordan,McCollom)
Midland (Bechhoefer,Cowan,Harbour)

ASLAB
Shoreham (Rosenthal,Edles,Wilber)
Catawba (Rosenthal,Moore,Wilber)
Perry (Kohl,Buck,Edles)

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Shoreham Unit 1, Docket No. 50-322

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D I E S E L G E N E R A T O R S
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P R O G R A M P L A N

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I. EXECUTIVE SUMMARY

Eleven U.S. nuclear utility owners have formed the Transamerica Delaval, Inc (T.D.I.) 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 T.D.I. Diesel Generator Owners Group has established a comprehensive program which, through a combination of design reviews, quality revalidations, engine tests and component inspections, will provide an in-depth assessment of the adequacy of the respective utilities' T.D.I. engines to perform their intended safety related functions. This program document outlines the essential elements of the program which is now under way, provides information regarding the organization, membership and charter of the Owners Group, and describes in detail the technical approaches and actions in progress to resolve the operational and regulatory T.D.I. engine issues.

A. Background

The genesis of the T.D.I. Engine Owners Group occurred on October 25, 1983 when, as a result of a number of diesel generator operating experiences involving various nuclear utility owners and diesel engine types, a technical information exchange meeting hosted by Mississippi Power and Light was held in Atlanta, Georgia. This information exchange meeting involved 59 industry representatives, including

personnel from 26 utilities as well as INPO, NRC and NSAC/EPRI. As a result of the meeting discussions it was decided that an owners group should be organized to address the common diesel generator issues and it was also decided that follow on meetings should be held to work toward resolving the issues.

The present structure of the T.D.I. Owners Group was formalized and approved at an executive meeting held in Atlanta, Georgia on December 21, 1983. Eleven utilities owning T.D.I. engines agreed to participate in a common effort to assess the adequacy of the respective utilities T.D.I. engines. After discussion of the concepts required to adequately address the TDI engines, it was agreed that a common program methodology would be utilized by all owners which embodies three major efforts:

1) Resolution of known generic problems
2) Design Review of important engine components and Quality Revalidation of important attributes for selected engine components
3) Expanded engine testing and inspection

Mr. J. P. McGaughy of Mississippi Power & Light (MP&L) was nominated as Chairman of the group and Mr. W. J. Museler of Long Island Lighting Company (LILCO) was nominated as the Technical Program Director. It was also agreed that the Owners Group Design Review and Quality Revalidation (DR/QR)

program efforts would be undertaken by an organization which is centralized at the Long Island Lighting company Shoreham Nuclear Power Station site. Resident technical representation for the various TDI Diesel Generator owners is provided by the participating utilities.

B. General Program Description

Introduction

The T.D.I. Engine Owners Group Program has been developed to assess the adequacy of the various T.D.I. engine design configurations to perform their intended safety related functions. The program involves three major elements which, by a combined approach involving design reviews and analyses of engine components, quality revalidations of important attributes, and expanded engine testing and component inspections, will provide reasonable assurance of the ability of the T.D.I. engines to provide reliable backup power supplies for nuclear power plant service.

Resources Applied

The T.D.I. Owners Group has employed high quality technical resources in the T.D.I. program. Organizations and individuals with expert knowledge in the various areas requiring investigation, inspection and analysis ensure that the evaluations of the individual T.D.I. engines will be thorough and meaningful.

The major technical resources applied to this program are summarized as follows:

Organization	Role in Owners Group Program
1. Failure Analysis Assoc. (FaAA)	a) Analysis of known problems (Forensic Engineering) b) Manager of Design Review effort c) Design Review Tasks as assigned.
2. Stone & Webster (SWEC)	a) Manager of Quality Revalidation effort b) Design Review Tasks as assigned. c) Licensing and Logistical Support
3. FEV (German Diesel Consulting Firm)	a) Technical Evaluations of known problems b) Review of design Review Tasks
4. Transamerica DeLaval (TDI)	a) Provides technical and experience data to the Owners Group b) Reviews Design Review and Quality Revalidation results
5. Owners Group	a) Provide plant specific technical and experience data b) Provide working level engineers familiar with diesel generator plant specific applications c) Provide overall Program Management
6. Subvendors	a) Provide technical expertise on unique components b) Support investigations and site specific disassembly/reassembly

Generic Known Problem Resolution

The first major program element is characterized as Phase I and involves the resolution of generic known problems. A

significant activity in this area which has been in process since November on behalf of the Owners Group has been the assemblage of documentation operational experience data which is potentially pertinent to the T.D.I. engines. Using input from various nuclear data sources (INPO, SOER's, LER's, 10CFR50.55e's & 10CFR21's, etc.) as well as non-nuclear sources (marine and stationary T.D.I. engine applications), a substantial data base of T.D.I. engine/component operational experiences has been accumulated. While review of applicable experiences will also be routinely factored into the respective utilities' design review/quality revalidation efforts, a review of the experience accumulated to date has resulted in a conclusion by the Owners Group technical staff that a limited number of components warrant prioritization and consideration as significant known problems with potentially generic applicability. Accordingly, these components are receiving priority attention within the Owners Group design review group. A listing of the significant known problem components is shown in Appendix 5. Descriptions of the task plans presently underway for evaluation and resolution of these problems are shown in Appendix 6. As final reports are prepared for specific components, they will be submitted to the NRC by the Owners Group on behalf of the owners of applicable "Lead" (Shoreham and Grand Gulf) engines. Followup reports will be issued for "following" engine owners, modified as appropriate for the specific engine configurations.

These Phase I reports will provide the bases for the licensing of the early T.D.I. plants with the balance of the DR/QR being completed within a few months. The T.D.I. Owners Group presented this proposed licensing basis to the NRC on January 26, 1984 and it is currently being considered by the staff.

Design Review/Quality Revalidation (DR/QR)

The second major program element involves the conduct of Design Review and Quality Revalidation. The Owners Group Design Review/Quality Revalidation effort has been developed to examine the critical components of each owners engine, from both a design and quality attribute viewpoint in order to assess their ability to reliably perform their intended design function. The effort is being conducted by a centralized team of engineering personnel with specialized skills in appropriate engineering fields as well as specific diesel generator design expertise. (An organization chart showing this group is shown in Appendix 2)

The Design Review involves first reviewing and selecting the components of each engine that warrant a detailed design and/or quality revalidation. A component selection committee formally reviews each owners engine components with selection and recommendation being based on the specific components' function and role in the overall operation of the engine, applicable site and industry experience, and the engineering

judgement and experience of the committee. (Additional information regarding the component selection process is provided in Section IV and Appendix 4)

Following component selection, the selected engine components will be subjected to either a design review, a quality revalidation, or both, with appropriate design review and/or quality revalidation requirements specified by the component selection committee. To implement the required actions a task description is prepared by the respective design and/or quality revalidation groups to define the appropriate reviews, inspections, calculations etc. that will be performed for each component. The task descriptions will include any requirement specified in the selection process as well as a more detailed description of procedures, standards or design review approaches to be applied. Following this, the actual design reviews or quality revalidations are implemented by the respective design or quality groups. Upon completion, the inspection results, document packages, design review findings and calculational results will be reviewed and approved by the Owners Group Technical Staff. Where results of these reviews or inspections indicate the need for additional action (component replacement, maintenance recommendation, etc.) followup activities will be initiated.

At the completion of each owners Design Review/Quality Revalidation effort, a final report will be issued to the NRC

which will summarize and transmit the results of the DR/QR reviews, identify any corrective actions or recommendations, and provide conclusions regarding the adequacy of the engines for their intended service.

Engine Testing/Inspections

The third major program element involves the conducting of enhanced engine testing coupled with specific component inspections. The Owners Group technical staff, in evaluating specific engine components, will provide technical recommendations to the Owners regarding special or expanded engine tests and component inspections which may be appropriate to insure the adequacy of the engines and components to perform their intended operational functions. These tests and inspections may be recommended for all engines or they may be recommended for "lead" engine types only, depending on the components under consideration. Results of the "lead" engine tests/inspections will be used by the Owners Group technical staff to determine if test or inspection recommendations should be expanded for "following" engine types.

Generally, the tests and inspections recommended will need to be integrated by the respective owners into their preoperational or post operational engine testing schedules. Therefore, these test plans and schedules will be finalized by direct NRC/Owner interaction.

C. Status/Schedule

The T.D.I. Engine Owners Group Program members and staff have to date participated in three meetings with the United States Nuclear Regulatory Commission and its technical staff to present the overall Owners Group Program concept and schedule, provide briefings on the status of lead engine activities, and provide descriptions of generic problem component analyses in progress. While a great deal of work remains to be done, several significant early milestones have been completed and several others are nearing completion. These activities include:

1. For the lead R-48 engines (Shoreham), a significant amount of engine testing has been completed, including torsiograph and strain gauge testing on one engine and completion of 100 full power hours and post-test engine component inspections on another engine.

2. The component selection process for the lead R-43 engines has been completed and design review task description implementations are in progress.

3. For the lead V engines (Grand Gulf) the component selection process has been completed as have several site-specific component inspections.

4. For Phase I (generic problem components), task

descriptions have been completed and design analyses are in progress. The first final report (on AE pistons) was issued February 28, 1984 and the majority of the Phase I reports are scheduled for March.

More detailed information on overall Owners Group milestone schedules and schedules for generic problem components are provided in Section IV and Appendix 6.

D. Conclusion

The TDI Diesel Generator Owners Group believes that the extensive program outlined herein provides a firm basis for reestablishing confidence in the TDI Diesel Generators in nuclear service.

The program may require modifications or enhancements depending on the findings early in the effort; and early findings may also suggest that physical or procedural modifications to the TDI engines may be required. Successful completion of this program will provide reasonable assurance that the TDI Diesel Generators will perform their intended safety functions reliably.

II. Program Overview

A. Members and Charter

The T.D.I. Engine Owners Group consists of eleven participating United States Nuclear Utility Owners who have installed diesel engines manufactured by Transamerica Delaval, Incorporated (T.D.I.). These engines are installed to provide backup electrical power supplies to the owners' nuclear facilities. The T.D.I. Engine Owners Group members and their nuclear facilities are as follows+:

	Utility	Site
1.	Carolina Power & Light	Shearon Harris
2.	Cleveland Electric Illuminating Co.	Perry Nuclear
3.	Consumers Power Co.	Midland
4.	Duke Power Co.	Catawba
5.	Georgia Power & Light	Vogtle
6.	Gulf States Utilities	River Bend
7.	Long Island Lighting Company	Shoreham
8.	Mississippi Power & Light	Grand Gulf
9.	Sacramento Municipal Utility District	Rancho Seco
10.	Southern California Edison	San Onofre
11.	Texas Utilities Generating Company	Comanche Peak

+ Two additional U.S. Nuclear Utilities owning Transamerica Delaval Inc. engines are not, at present, participating members. They are: Tennessee Valley Authority - Bellefonte Station, and Washington Public Power Supply System - WNP-1.

The commitment of the members of the T.D.I. Engine Owners Group is to participate in and fund the activities described in this program document in order to provide assurance of the T.D.I. engines' ability to perform their intended safety functions. The charter of the T.D.I. Engine Owners Group is provided in Appendix 1.

B. Organization

The T.D.I. Engine Owners Group consists of an executive chair Committee consisting of company officers from each participating utility and a Technical Program Director with supporting technical staff. Mr. J.P. McGaughy (MP&L) is the Chairman, Mr. J. George (TUGCO) is the Vice-Chairman, and Mr. W. J. Museler (LILCO) is the Technical Program Director.

The Owners Group technical staff, under the supervision of the technical program director, is a combined organization consisting of engineering representatives of the member utilities, Failure Analysis Associates specialists in metallurgy and materials analysis, Transamerica Delaval Incorporated, Stone & Webster Engineering Corporation specialists, and a number of expert consultants with substantial diesel generator design expertise. The staff has the necessary expertise to review and select engine components for design and/or quality reviews, perform the necessary design reviews and

quality revalidation inspections and prepare, review and issue the Owner's Group Technical Reports. The organizational charts for T.D.I. Engine Owners Group are shown in Appendix 2.

C. Program Elements Summary

C.1. Known Problem Resolution

The first element of the TDI Diesel Generator Owners Group Program (Phase I) is the resolution of generic known problems. It became apparent in the initial stages of the TDI Diesel Generator Owners Group Program that there were a limited number of engine components which warranted consideration as significant known problems. These components, which exhibit possible generic concern either among engine types or among all TDI engines, are being subjected to a priority review and reporting program.

The initial stages of the TDI Diesel Generator Owners Group Program includes the assembly of experience data regarding diesels. In particular, nuclear industry data is gathered for all engine manufacturers and non-nuclear industry data (stationary diesel generator and marine diesels) is gathered for TDI engines. TDI was instrumental in assuring that the experience data was

accurate regarding TDI engines and provided supplementary data where appropriate.

Another important element of the TDI Diesel Generator Owners Group is the component selection process. As progress was made in this area, considerable information was exchanged among selection committee members including the diesel engine consultants regarding the design of the TDI engine components. This information exchange resulted in the identification of a limited number of components for which specific design and/or manufacturing concerns were identified.

The information available resulted in the identification of the sixteen (16) significant known problems. It was determined that resolution of these significant known problems would provide substantial confidence in the reliability of the TDI engines. Therefore, these components are being subjected to a priority design review to address regulatory concerns, past experience and the design adequacy of these components.

The design review of the significant known problem components will address several key factors in accordance with the Owners Group Program. A detailed design review of each of these components will be conducted to establish the adequacy of the design. An evaluation of

site and industry experience, maintenance requirements, and the preparation of inspection plans developed by the design review group will also form part of the Phase I effort. The component designs in place in the lead plant engines (Grand Gulf and Shoreham) will provide the basis for the design reviews. Reports will be issued after completion of the lead plant engine review, which will form the basis for reviews to be conducted for "following" engine owners. Follow-up reports will include an evaluation of different loading considerations, modified parts and other differences which should be considered as part of the design review of the other engines, as appropriate.

C.2 Design Review/Quality Revalidation

The Design Review/Quality Revalidation Program has been organized to provide a detailed review of TDI engines supplied to nuclear power plants for emergency diesel generator service. This portion of the Owner's Group Program will address all components of the engines supplied to each owner by review of the Parts Manuals supplied by TDI, excluding the Significant Known Problems which are addressed separately as discussed above.

Engine components are individually reviewed based on their significance to engine operation and past

performance (experience data). Considering these factors, components are selected for design reviews or quality revalidations with minimum review requirements specified.

Components selected for design review are assigned to a Task Leader. The Task Leader is generally an engineering specialist in the design discipline associated with that component. A Task Description is prepared to detail the design review which will then be directed by the Task Leader. Design reviews will consider maintenance and inspection programs where appropriate, and in all cases will examine experience data associated with each component.

Components selected for quality revalidation are subjected to inspections specified during the selection process and additional inspection which may be identified by the Design Group. Inspections are performed by qualified personnel in accordance with approved procedures. Where required, inspection results are forwarded to the Design Group for evaluation.

Upon completion of the DR/QR Program on the lead engines, the results of the DR/QR Program for the lead engines will be factored into the follow-on engines. A separate design review will not be required, for example, on a

common component for a follow-on engine. However an inspection may be required to verify that the component is actually the same as the one reviewed for the lead engine. Likewise, quality revalidation inspections completed on a component in a lead engine would serve as a basis for either increasing or decreasing inspections for a follow-on engine, depending on the lead engine inspection results.

A final report will be issued for each plant to provide the results of the DR/QR Program. Components which are acceptable, require replacement, require increased maintenance and/or require follow-up inspection will be clearly identified in the final report. In addition, the final report will identify recommendations regarding improvements for possible future implementation and recommendations regarding future testing.

C.3 Testing/Inspection

In the process of evaluating specific engine components, the Owners Group technical staff will provide recommendations to the owners regarding special or expanded engine or component tests or inspections which may be appropriate to insure the adequacy of the engines and components to perform their intended operational functions. Depending on the circumstances associated

with the specific component, for example prior industry operating experiences, criticality of the known failure modes to continued engine operation, appropriateness of the test/inspection results with respect to accumulated operating engine hours etc., these tests or inspections may be recommended for implementation anytime during preoperational testing, after a certain number of accumulated engine hours at power during preoperational testing, or as a post operational test.

Expanded testing or inspections will generally be focused on "lead" engine types, with less stringent requirements for following engine types if warranted by preceeding results. This approach anticipates favorable inspection and testing results for the "lead" engine. However, if feedback from the "lead" engine inspections or testing programs result in unfavorable conclusions which have applicability to other engines, appropriate expanded testing and/or inspections would be recommended for "following" engines.

As an example of the expanded testing and inspection program, the crankshaft component testing/inspection plan shown in Appendix 6 provides a useful illustration. In order to thoroughly examine and document the dynamic response of the lead R48 engines (Shoreham), strain gauge and torsional testing was conducted on one engine.

Additional instrumentation was also installed to measure dynamic cylinder pressure and dynamic output torque. Confirmatory torsiograph testing will be conducted on a second engine. Following completion of operation at full power for 100 hours, non destructive examination (eddy current) of crankpin fillets for all Shoreham engines will be conducted. For the "following" R48 engines, inspection and testing requirements are lessened based upon their similarity to the lead engines. However, confirmatory torsiograph testing is recommended (1 engine per plant), in addition, as are crankshaft fillet non destructive examinations for River Bend on one engine following 100 hours at full power.

For the "lead" V engines (MP&L), non destructive examination of crankshaft fillets is recommended for one engine, following accumulation of 100 hours at full power. Verification of original torsiograph adequacy is also recommended. For "following" V engines, confirmatory torsiograph testing is recommended for one engine at each site. If torsiograph deflections are not found to be significantly above those determined for the "lead" engines, non destructive examination of crankpin fillets is not recommended.

A similar approach is applicable to most component reviews. The Task descriptions for the later plants will

be modified as required based on the results of the earlier tests and inspections. Consistency of the evaluations and adequate feedback of inspection and testing data is ensured by maintaining the individual Task Description responsibility assignments constant for all engines.

Scheduling of integrated engine testing and inspection activities for those actions recommended by the Owners Group technical staff is the responsibility of each owner. Similarly, the development of a preoperational engine test program, considering the load profiles applicable to each site's engines, is the responsibility of each owner.

C.4 NRC Question Responses

Although it is not a formal program element, one area in which the Owner's Group Staff will provide support to the T.D.I. engine owners will be the receiving and responding to NRC staff Generic Technical questions. It is anticipated that NRC staff questions regarding programmatic aspects of the overall TDI Diesel Generator Owners Group Program Plan, technical bases regarding analyses or testing/inspection approaches to be used to resolve generic known problems, and comments/questions regarding generic Owner's Group submittals will be directed to the

Owner's Group Generic Licensing Manager for coordination and development of Owners Group responses.

NRC questions which deal with plant specific items, such as preoperational testing plans, results and conclusions of individual Owner's DR/QR final reports etc. will not be handled through the Owner's Group and should be directed to and responded by the respective Owner's Group utilities.

D. NRC Submittals

Resolution of the TDI Diesel Generator issues will require a significant number of formal submittals to the Nuclear Regulatory Commission. These submittals will be provided either via the Owners Group Technical Staff and Generic Licensing Organization or via direct utility submittals depending on their generic applicability. In general, the following division of submittals will apply:

Owners' Group Submittals

- Owners' Group program plan
- Generic known problem task descriptions
- Generic known problem final reports - "lead" plants

- Generic known problem final reports - "following" plants
- Responses to NRC staff generic questions

Utility/Plant Specific Submittals

- Documentation of implementation/endorsement of Owners' Group generic known problem reports & report recommendations
- Design Review/Quality Revalidation Task Descriptions
- Design Review/Quality Revalidation final reports
- Engine/Component testing commitments & results
- Responses to NRC staff plant specific questions

E. Schedules

Since its inception, the TDI Diesel Generator Owners Group Design and Quality Revalidation Program has made significant progress in each of the three major on going efforts:

1) Resolution of known generic problems
2) Design review of important engine components and Quality Revalidation of important attributes for selected engine components.
3) Expanded engine testing & inspections.

Resolution of known generic problems are receiving priority attention within the Owners Group design review group. Evaluation of the individual components as specified in the task descriptions is presently underway on each of the components, with the required analysis/evaluation scheduled for completion in late March.

A final report will be prepared for each of the specific components and will be submitted to the NRC on behalf of the owners of the R-48 and V lead engines. Follow-up reports will be issued for "following" engine owners, modified as appropriate for the specific engine configuration. A summary status for the known problems is presented in Appendix 8.

The Owners Group Design Review and Quality Revalidation effort is proceeding, both with implementation of Shoreham Task descriptions and with reviewing and selecting the critical components for the lead V engines. Appendix 8 provides a schedule/status of both the Shoreham and Grand Gulf Engines.

Although evaluation of the known problem components is receiving priority attention, assembly of individual utility site experience is either complete or nearing completion on five other utilities, in addition to

Shoreham. The component selection process, which entails a formal review of each owners engine components, with selection and recommendations made for evaluation of critical engine components, is complete on two owners engines in addition to Shoreham. Five additional utilities engines are scheduled for completion of the component selection process by the end of March.

A summary schedule for the overall owner group Design & Quality Review is provided in Appendix 8. As shown, implementation of task descriptions extends into July 1984, with submittal of final reports for each owners DR/QR effort extending from May to October 1984.

Recommendations for special or expanded engine tests and engine component inspections, provided to the owners by the Owners Group Technical Staff, is expected to be scheduled by the owners with direct NRC/Owner interaction. In the case of the lead R-48 and V engines, a significant amount of engine testing and specific component inspections have been completed. Significantly for the Shoreham engines the torsiograph and strain gauge testing has been completed on one engine. In addition, operational testing on a second engine, including 100 full power hours and a seven day endurance run, with the subsequent engine component inspections, has been completed.

As indicated by the summary schedule, testing and inspections of the lead R-48, Shoreham, is scheduled for completion in April 1984.

III. GENERIC KNOWN PROBLEM RESOLUTIONS

A. Problem Resolution

As described earlier in this report, the first major program element of the TDI Diesel Generator Owners Group is the resolution of generic known problems.

A review of the accumulation of data by the TDI Diesel Generator Owners Group Technical Staff from industry sources(Nuclear, Marine, Stationary) has resulted in conclusions that a limited number of TDI engine components had evidenced sufficient adverse operating experiences 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 have been heavily applied to these problem areas in order to expedite the reviews, tests and/or analyses necessary to resolve these issues.

Resolution of these problems, to the extent they are applicable to each engine, is recommended by the Owners Group technical staff on a priority basis, and in general should be accomplished prior to placing the engines in service to support plant full power operation. Exceptions to this general applicability are permissible

to the extent that interim operation prior to resolution may be justified by any owner.

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 has not been designed adequately. Applicability of the generic known problem listing is to be determined via the Owners Group technical staff reviews. Additionally, the results of ongoing Owners Group design reviews or owners testing/inspection results as part of the DR/QR efforts may result in revision to this listing.

B. Example Description

An example description of the Owners Group approach being used to resolve one of the generic known problem components, which is illustrative of the combined analytical, testing and inspection methods which are applied to develop an understanding of the critical component problem areas and assess their adequacy, will be discussed here. The example utilized will be for AE pistons. (For convenience, copies of the task descriptions for the 16 generic problem component task

descriptions are provided in this section, in addition to Appendix 6)

The piston task description discusses the primary function and functional attributes of interest in the piston design. The evaluation section describes those activities which will be undertaken to assess the adequacy of the piston design(s). The task plan requires the following investigations:

1) Determination of the historical evolution of the various TDI piston designs, including applicable heat treatment, dimensional or materials changes
2) Determination of peak firing pressures and temperatures for the various engine types
3) Development of appropriate finite element modeling to assess the state of stress in areas of interest
4) Conduct of metallurgical examination of prior AF design piston cracking
5) Non destructive examination of AE pistons in prior service
6) Conduct of fracture mechanics analyses of potential crack propagation in AF and AE piston designs
7) Conduct of static strain gauge piston testing

8) Nondestructive examination of lead R48 pistons after operation at 100 full power hours

9) Assessment of the similiarity of AF, AH, AN piston designs to the AE design

The task description also outlines those analyses which will be undertaken by the TDI Diesel Generator Owners Group technical staff for each unit and provides recommendations regarding those tests and/or inspecitons which each owner should conduct in order to confirm the absence of known potential failure mechanisms.

C. Schedule

As the known generic problem items are receiving priority attention within the Owners Group technical staff, the schedules for completion of the Lead Plant reports all fall within the months of February, March and April. Follow-on activities such as post-test site examinations will be scheduled by each utility owner. Following plant reports for applicability or supplemental reports for the generic components are expected to be completed by May.

TURBOCHARGER

MP-017

UNIT	TURBO TYPE	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:				
SHOREHAM	Elliott 90G	Thrust bearing oil film/load/ material analysis; Nozzle ring vane and cap screw thermal/ pressure loading; evaluate effectiveness of prestart thrust bearing lube oil supply	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines 100 starts - 1 engine 23 starts - 2 engines	Inspect end clearance Inspect thrust bearing after 100 Hrs @ 100% power - 3 engi Inspect thrust bearing after starts - 1 engine Inspect end clearance at 23 s - 2 engines
RIVER BEND	Elliott 90G	Verify similarity to SNPS Evaluate differences if any	100 Hrs @ 100% power - 1 engine	Inspect end clearance - 2 eng. Inspect thrust bearing - 1 en
RANCHO SECO	Elliott 90G	Verify similarity to SNPS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
V-16 ENGINES:				
GRAND GULF	Elliott 90G (2)	Verify twin installation similarity to Shoreham. Evaluate auxiliary lube oil system	100 Hrs @ 100% power - 1 engine 100 starts minimum - 1 engine	Inspect end clearance - all engines
CATAWBA	Elliott 90G (2)	Verify similarity t GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
PERRY	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
COMMANCHE PEAK	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
HARRIS	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
VOGTLE	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
V-12 ENGINES:				
MIDLAND	Elliott 65H (2)	Thrust bearing oil film/load material analysis; adequacy of thrust bearing prelube	Normal Preop testing	Inspect end clearance - all eng Inspect thrust bearing - 1 eng
V-20 ENGINES:				
SAN ONOFRE	Elliott 65H (4)	Verify similarity to Midland	Normal Preop testing	Inspect end clearance

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

TURBOCHARGER
PART NO. MP-017

Classification A
Completion 3/20/84

PRIMARY FUNCTIONS: The turbocharger is composed of a gas turbine and centrifugal inducer/impellar mounted on a common shaft and housed by integral castings. It utilizes engine exhaust gasses to pressurize the engine intake manifold air for higher output combustion. Energy from the exhaust gas is extracted by the turbine which drives the compressor through a common shaft.

FUNCTIONAL ATTRIBUTES:

1. The turbocharger components require adequate strength and fatigue resistance to react loads imposed by flowing engine exhaust gasses during the severe startup and transients unique to nuclear standby service in addition to normal operation. In particular, these components include the diffuser, nozzle ring assembly, rotor assembly diffuser bearings (thrust and radial.)
2. The turbine and components must have the ability to withstand a high temperature corrosive environment.
3. The lubrication system must have the ability to:
   a. Supply sufficient oil to the bearings to prevent bearing wiping (prelube) during the repeated startups required by testing.
   b. Ensure a minimum time lapse between start of rotation of the rotor and required pressurized oil in the bearings.
   c. Maintain adequate inlet and discharge oil temperatures.
   d. Provide adequate oil seals.
4. The cooling system must provide sufficient water flow and pressure to maintain adequate component temperatures and allow adequate venting to prevent air or steam pocket formation.
5. External piping must be configured such that there is no unacceptable transmission of thermally induced loads to the turbocharger casings.
6. The turbocharger itself must have sufficient operational performance surge margin to avoid reverse loading damage.

SPECIFIED STANDARDS: None known

EVALUATION:

1. Review the operational history from several users with Elliott model 90G and 65H turbochargers.
2. Review pre-operational test logs to verify performance.
3. Examine possible structural deformation of casings and mounting bolts under startup and operational conditions which could affect bearing performance.
4. Review turbocharger performance data to determine the gas loading of rotating component.
5. Evaluate the bearing loads during normal operating conditions.

6. Conduct rotor dynamics analysis to assess possible startup-induced deflection or rotor instabilities.
7. Stress analysis of bolting components in particular, nozzle ring capscrews.
8. Review material selection.
9. Review bearing lubrication requirements such as thrust bearing during startup and full load.
10. Evaluate the differences between R-48, RV-16, RV-12 and RV-20 auxiliary lube pump configurations and the possible effects on thrust bearings during startup.
11. Evaluate preventative maintenance and possible monitoring techniques.
12. Review specified as-built clearances for bearings and seals.
13. Review specified assembly procedure to verify that all important as-built dimensions are being measured.

REVIEW TDI ANALYSES: Review TDI analyses of thrust bearing drip system configuration.

INFORMATION REQUIRED:

1. Manufacturer's bulletins
2. Component drawings, piping schematics, assembly drawings, installation drawings
3. Material specifications
4. Performance data such as compressor and turbine maps
5. SNPS thrust bearing disassembly and inspection results
6. Lube and cooling system specifications such as flow, pressure, filtration, etc.
7. Engine exhaust gas data

ENGINE BASE AND BEARING CAPS

03-305A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of bearing saddles bearing caps and cap locking loads Evaluation of the adequacy of bolting, studs and nuts, verify use of required preload.	100 hrs @ 100% power and LOOP/ LOCA simulation - 3 engines	LP bearing saddles with highest loads or saddles with maintenance induced indications 2 engines sample basis
RIVER BEND	Verify similarity to SNPS	100 hrs @ 100% power - 1 engine	LP bearing saddles 1 engine sample basis
RANCHO SECO	Verify similarity to SNPS	Normal Preop	None if SNPS acceptable
V-16 ENGINES:			
GRAND GULF	Stress and fatigue analysis of bearing saddles and cap locking loads	100 hrs @ 100% power - 2 engines	None required if loads similar to SNPS and SNPS inspections acceptable and SIM is implemente
CATAWBA	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
PERRY	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
HARRIS	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
VOGTLE	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
V-12 ENGINES:			
MIDLAND	Stress and analysis if required	Normal Preop testing	None if similar to SNPS or GGNS
V-20 ENGINES:			
SAN ONOFRE	Stress analysis if required	Normal Preop testing	None if similar to SNPS or GGNS

DR-03-305A

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

BASE AND BEARING CAPS
PART NO. 03-305A

Classification A
Completion 3/20/84

PRIMARY FUNCTION:

The base assembly supports the crankshaft and the upper engine assembly. It reacts the crankshaft, piston inertia and firing loads at the bearing saddles, reacts the firing force transmitted through the bolting to the upper engine assembly and provides axial restraint to the crankshaft and engine.

The major components of the base assembly are the base casting, the main bearing caps, shells, nuts and studs; and the bolting to the upper assembly or the crankcase (through bolts).

FUNCTIONAL ATTRIBUTES:

1. The base casting bearing saddles must have sufficient strength to carry the lateral loads imposed by the crankshaft inertia and to react the vertical compression and tension loads imposed by the engine firing and the crank/rod/piston inertia loading.
2. The base casting nut pockets for the main bearing studs and through bolts must have sufficient contact strength to carry the nut preload, inertial and dynamic loading from the crankshaft, and firing loads transmitted from the upper engine.
3. The studs, bolts and nuts connecting the base casting to the bearing caps and the upper engine assembly must have sufficient strength to carry the imposed preloads, dynamic loads, and firing loads. The clamping force provided by the main bearing studs and nuts must be sufficient to prevent lateral movement of the main bearing caps under lateral crankshaft loading.
4. The main bearing caps must have sufficient strength to withstand the imposed crankshaft loads.
5. The base must be sufficiently rigid to maintain adequate main bearing alignment during operation.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review information available on industry experience with bearing saddle indications, including those on the R-4B engines at Shoreham Nuclear Power Station, the fractures on the USCG Icebreakers West Wind and North Wind, and the RV-16 base at the ANAMAX mine.
2. Examine the adequacy of the bearing saddle pedestal under vertical and lateral loads imposed by the crankshaft and the bearing cap bolt preloads.
3. Following 100 hrs of operation or normal Preop testing, an NDE inspection of the most heavily loaded bearing pedestals on the DNPS engines and a selected number of other R-4B and RV-16 engines will be conducted and the results evaluated with respect to possible loading mechanisms.

4. An evaluation of the main bearing caps under the crankshaft inertial loads and stud preloads will be performed. This will consider the adequacy of the lateral loading between bearing cap and pedestal to prevent bearing cap movement under crankshaft loading.
5. Analyses of the bearing saddle nut pocket and upper assembly nut pockets will be conducted. The pockets will be modeled as a column with a through hole under a tension load corresponding to the preload; firing pressures and crankshaft inertial loading. These analyses will initially be performed on R48 and RV-16 engines. The need to perform detailed analyses on RV-12 and RV-20 engines will depend on the findings of the former.
6. Industry experience with base assembly bolting problems will be reviewed including through bolt and washer failures at Copper Valley Electric and Valdez, Alaska.
7. The base assembly bolts, studs and nuts will be analyzed for adequate preload.

REVIEW TDI ANALYSES:

1. Any TDI analyses and test experience on the base assembly components will be reviewed.

INFORMATION REQUIRED:

1. Base assembly component drawings and manufacturing specifications
2. Base assembly component material properties, including yield strength of casting in various section thicknesses
3. Main bearing cap and upper assembly bolting torque specifications
4. Engine firing loads
5. Crankshaft loads on main bearings
6. Engine component weights

CRANKSHAFT

03-310A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Holzer analysis Modal Superposition Finite element analysis Strain Gage test data correlation with analysis	100 Hrs @ 100% power and LOOP/LOCA simulation - 3 engines Torsiograph - 2 engines Strain Gage testing crank pin fillets - 1 engine	NDT Crankshaft - 3 engines after 100 Hrs @ 100% power
RIVER BEND	Holzer analysis Modal superposition (If different from SNPS)	100 Hrs @ 100% power - 1 engine Torsiograph - 1 engine	NDT crankshaft - 1 engine after 100 Hrs @ 100% power
RANCHO SECO	Verify similarity to SNPS	Normal Preop testing Torsiograph - 1 engine	None if similar to SNPS
V-16 ENGINES:			
GRAND GULF	Holzer analysis Modal superposition	100 Hrs @ 100% power - 1 engine Verification of torsiograph	NDT crankshaft 1 engine after 100 Hrs @ 100% power
CATAWBA	Verify similarity to GGNS	Normal Preop testing Torsiograph - 1 engine	NDT crankshaft after preop test
PERRY	Verify similarity to GGNS	Normal Preop testing Torsiograph - 1 engine	None if similar to GGNS
COMMANCHE PEAK	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
HARRIS	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
VOGTLE	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
V-12 ENGINES:			
MIDLAND	Holzer analysis Modal superposition	Normal preop testing Torsiograph - 1 engine	None depending on Torsiograph
V-20 ENGINES:			
SAN ONOFRE	Holzer analysis Modal superposition	Normal preop testing Torsiograph - 1 engine	None depending on Torsiograph

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CRANKSHAFT
PART NO. 03-310A

Classification A
Completion 3/5/84

PRIMARY FUNCTION: The crankshaft converts reciprocating motion, component inertial forces and gas pressure piston forces to rotary motion and torque at the output flange.

FUNCTIONAL ATTRIBUTES:

1. Structural stiffness of the crankshaft must be sufficient to maintain acceptable states of stress in the crank pin web and main journal areas and to maintain system natural frequencies which are sufficiently removed from engine operating speeds. The crankshaft design should also be sufficient to withstand main bearing misalignments inherent in service.
2. The journal area of the main and connecting rod (crank pin) bearing must be sufficiently large for acceptable bearing oil film pressure but the overall bearing length must be sufficiently short to minimize end wear of the bearing sleeves.
3. The material of the crankshaft and the surface finish should be sufficient to resist fatigue crack initiation.

SPECIFIED STANDARDS:

1. ASTM
2. DEMA

EVALUATION:

1. Review TDI calculations and tests.
2. Conduct engine test of 13x12 shaft.
3. Conduct modal superposition and Holzer torsional analyses of:
   a. SNPS (R-48)
   b. GGNS (RV-16)
   c. Midland (RV-12)
   d. San Onofre (RV-20)
4. Conduct finite element analysis of R-48 12 inch crank pin fillets.
5. Compare measured and calculated stresses R-48 13x12 shaft.
6. Compare measured and calculated output torque and free end torsiograph traces for R-48.
7. Compare stress levels with endurance limit for R-48.

8a. Compare nominal stresses of R-48 & RV-16 with those recommended by other standards.

b. Compare nominal stresses of RV-12 and RV-20 with those recommended by other standards.

9. Complete final report on SNPS and GGNS crankshaft integrity.
10. Complete final report on Midland RV-12 and San Onofre RV-20.

REVIEW TDI ANALYSES:

1. Experimental stress analysis (static) of DSR-46 crankshaft
2. Torsiograph tests
3. Holzer Table calculations

INFORMATION REQUIRED:

1. TDI drawings for DSR-48 and RV engines
2. Test reports for DSR-48 and RV engines
3. Original Holzer calculations and revisions for R-48 and RV-16, RV-12 and RV-20 engines

4a. Experimental pressure vs. time curve for R-48 and RV-16 engines.

b. Experimental pressure vs. time curve for RV-12 and RV-20 engines.

CYLINDER BLOCK AND LINER
03-315

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Evaluate stresses in liner landing including head stud and thermal loads	100 hrs @ 100% power LOOP/LOCA simulation - 3 engines	LP inspection cylinder block liner landing. Sample Basis: Inspect liner for unacceptable distortion, wear or flaws.
RIVER BEND	Verify similarity to SNPS	100 hrs @ 100% power - 1 engine	Dependent on SNPS results
RANCHO SECO	Verfiy similarity to SNPS	Normal Preops testing	Dependent on SNPS results
V-16 ENGINES:			
GRAND GULF	Verify similarity to SNPS	100 hrs @ 100% load - 1 engine	LP inspection cylinder block liner landing. Sample basis Inspect liner for unacceptable distortion, wear or flaws.
CATAWBA	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
PERRY	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
COMMANCHE PEAK	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
HARRIS	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
VOGTLE	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER BLOCK AND LINER
PART NO. 03-315

Classification A
Completion 3/20/84

PRIMARY FUNCTION: The cylinder block comprises the framework of the liquid cooled engine and provides passage and support for the cylinder liner. The block must provide cooling water passages, provide bores to support the cam shaft assembly, and react the dynamic loads from the cylinder firing pressure and valve assemblies. For the RV engines, the cylinder block is interconnected with an engine crankcase which supports the camshaft and associated bearings. Although these are separate parts, their generic function is similar to the cylinder block of the R-48 engines and will therefore be evaluated as a unit. The liner itself forms the walls of the combustion chamber containing the high temperature gas pressure and must provide a guide for the piston motion while reacting skirt side forces without excessive wear or scuffing.

FUNCTIONAL ATTRIBUTES:

1. The cam galley bearing supports must be designed to maintain concentricity during service and have sufficient structural strength to react the cam/valve train loads without fatigue cracking.
2. The support of the cylinder liner must maintain tight seals, react pressure and stud loads without unacceptable distortion and maintain sufficient load distribution to preclude excessive cracking in the liner counterbore (landing) due to combined thermal, gas pressure and preloaded stud induced states of stress. The cylinder head stud threa configuration is important in determining stress concentrations and stress distributions.
3. The cylinder liner itself must be sufficiently hardened to resist unacceptable wear associated with piston ring action and maintain adequate contact with the block counterbore to prevent high cycle contact stress and fretting. In addition, the compression of the head to the cylinder liner must be sufficient to avoid axial fretting of the liner within the counter bore but not so great as to cause failures of the cylinder block liner landing.
4. The cooling water distribution within the block must be sufficient to preclude overheating of the block and liner and must maintain proper flow conditions to minimize or avoid cavitation or corrosion damage to the liner.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review information concerning previous cracking and distortion of the cylinder block and liners of the R48 and RV engines.
2. Review liquid penetrant inspections of cylinder block in the head stud and liner counter bore regions of the SNPS DSR-48 engines.

3. Evaluate the steady state and alternating stresses in the liner landing/head stud region and compare these to yield and endurance limits for appropriate materials. This examination must consider variations in head stud thread geometries and preload torques.
4. Evaluate the state of stress in the liner in the landing/axial seal region due to gas pressures, thermal growth and head clamping forces and compare to normal fatigue properties for liner material.
5. Evaluate critical flaw size and rate of crack growth considering combined head stud loads and thermal stresses for cracks located between head stud holes and cylinder block counterbore diameter.
6. Evaluate critical flaw size and rate of crack growth for cracks eminating from the corner of the cylinder block landing and counterbore diameter.
7. Evaluate the loading produced on the bearing supports in the cam gear galley and verify the structural adequacy of the design.
8. Review the inspection of the sampled SNPS cylinder liners following 100 hrs at 100% load for evidence of unacceptable scuffing, corrosion, cracking or scoring.

REVIEW TDI ANALYSES:

1. Review any TDI analyses which consider stresses created in the liner counterbore area and any design changes which relate to geometry or material.

INFORMATION REQUIRED:

1. Manufacturer's drawings of R48 and RV cylinder blocks and liners, including material specifications and historical design changes
2. Gas pressures and temperatures for R48 and RV engine designs
3. Cylinder head stud drawings and torque specifications
4. Cylinder head stud drawings showing design changes
5. Liquid penetrant inspection of cylinder block counterbore (landing) on SNPS engines
6. Cam shaft loads due to rocker arms, pushrods and valve springs

CYLINDER HEAD STUDS

03-315E

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress Analysis: Preload and operational (cylinder firing pressure) loads, for necked down stud design, verify lubricant	100 Hrs @ 100% power and LOOP/LOCA Simulation - 3 engines	Visual inspection; verificatio of proper torque; hardness - sample basis
RIVER BEND	Verify similarity to SNPS/GGNS design Evaluate major differences	100 hrs @ 100% power - 1 engine	Visual inspection; verificatio of proper torque
RANCHO SECO	Verify similarity to SNPS/GGNS design Evaluate major differences	Normal Preop testing	Visual inspection; verificatio of proper torque
V-16 ENGINES:			
GRAND GULF	Stress Analysis: Preload and operational loads for uniform cross section design, verify lubricant	100 hrs @ 100% power - 1 engine	Visual inspection; verificatio of proper torque
CATAWBA	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
PERRY	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
COMMANCHE PEAK	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
HARRIS	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
VOGTLE	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS/GGNS Evaluate differences if any	100 hrs @ 100% power - 1 engine Normal operational testing	Visual inspection, verification of proper torque

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER HEAD STUDS
PART NO. 03-315E

Classification B
Completion 3/1/84

PRIMARY FUNCTION: The cylinder head studs transmit cylinder firing pressure forces from the cylinder heads to the engine block and assure a required preload on the cylinder head gasket for combustion gas and water sealing.

FUNCTIONAL ATTRIBUTES:
1. The cylinder head studs must have sufficient strength to withstand the necessary preload and cyclic firing pressure forces without preload relaxation or thread distortion.
2. The thread geometry of the head stud should be such as to provide for an upper thread engagement which is sufficiently below adjacent cylinder liner landings to minimize stress concentration in that area.

SPECIFIED STANDARDS: None

EVALUATION:
1. Review the design dimensional differences between the previous and current head stud designs.

2. For the current design:
   a. Evaluate the stress at the minimum cross-sectional area resulting from the applied preloads assuming uniform lubrication and load distribution. Stress concentration effects of the threads should be included in the evaluation. Verify thread resistance to distortion.
   b. Determine the cylinder firing pressure and resultant force on the cylinder head. Utilizing the cylinder head geometry, determine the alternating load applied to each stud due to the cylinder head resultant forces.
   c. Evaluate whether the total resultant force is sufficient to overcome the bolt preload.
   d. Evaluate the bolt torque/preload technique to determine whether acceptable loading is assured.
3. Perform a similar analysis on the previous TDI design and assess the effect of the material and design differences.

REVIEW TDI ANALYSES:
1. Review TDI stress analyses associated with the design/material changes.

INFORMATION REQUIRED:
1. Maximum cylinder firing pressure
2. Stud geometry and drawings

3. Stud material specifications
4. Cylinder head geometry
5. Stud torque specification and lubrication requirements

CONNECTING RODS

03-340A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of crank pin bore and cap distortion; stress analysis of wrist pin bore and bushing; Evaluate cap bolt torque and design requirements	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines	Inspect crank pin bore and wri pin bore. LP inspect wrist pin bushing - sample basis
RIVER BEND	Verify similarity to SNPS	100 Hrs @ 100% power - 1 engine	None required if SNPS inspecti acceptable
RANCHO SECO	Verify similarity to SNPS	Normal Preop testing	None required if SNPS inspecti acceptable
V-16 ENGINES:			
GRAND GULF	Stress analysis of RV connecting rod; Evaluate cap bolt torque and design requirements Verify implementation of cap bolt torque per SIM64	100 Hrs @ 100% power - 1 engine	Inspect crank pin and link pin bores, bolt holes and parting surfaces - 1 engine - Sample basis depending on stress anal
CATAWBA	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
PERRY	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
HARRIS	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
VOGTLE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
V-12 ENGINES:			
MIDLAND	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptabl

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CONNECTING ROD
PART NO. 03-340A

Classification A
Completion 3/20/84

PRIMARY FUNCTION: The connecting rod transmits engine firing forces from the pistons and piston pins through the rods to the crankshaft such that the reciprocating motion of the pistons induces rotation and output torque of the crankshaft.

FUNCTIONAL ATTRIBUTES:

1. The connecting rod must have sufficient column buckling strength and fatigue resistance to withstand cylinder firing forces and inertial loads.
2. In the RV engine design, the three oscillating bearings two (2) wrist pin bearings and one (1) link pin bearing and the rotating crank pin bearing all require support from the connecting rod. In the R48 design, a single wrist and crank pin bearing are supported The flexure of the rod must be such that bearings are not unacceptably distorted.
3. Passages within the rod must provide cooling and lubricating oil to the bearings and pistons.
4. Stress levels, both mean and alternating, must fall within the endurance limits for the material utilized.
5. In the RV design, the two bolted joints (link rod to link pin and master rod to conrod box) must maintain sufficient contact pressure. The R48 design likewise requires sufficient clamping forces on the crank pin bearing cap.
6. The rod cap bolts must support the necessary preload without yielding, fracture or unacceptable thread distortion.
7. The wrist pin bushing must acceptably support the gas pressure and inertia forces transmitted by the pistons during the unique nuclear standby required starting cycle and normal operation.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the service histories of the connecting rods. In particular, evaluate the two V-style connecting rods (the 1 7/8" bolt diameter connecting rod and the 1 1/2" bolt diameter rod) and the R48 style connecting rod.
2. Incorporate firing load profile data for the crankshaft analysis and the results of the 13" diameter rod bearing analyses to produce a connecting rod static load profile, with the addition of inertia loads for a complete time-load map.
3. Evaluate the significance of possible rod bow as it affects bearing centerline angular misalignment.

4. Review and report on failure of connecting rod at Copper Valley Electric, Glen Allen, Alaska.
5. Conduct journal orbit analysis of the wrist pin bearing.
6. Using examples of fractured rods to focus the area of investigation, develop finite element models of the 1 7/8" bolt diameter V-type rod, to define deformation and the possibility of crack initiation and propagation.
7. Evaluate the necessary preload and acceptable design requirements (yielding, thread distortion) of the rod cap bolts for the R-48 and RV designs.
8. Evaluate the loading, fabrication and installation requirements of the wrist pin bushing for acceptable nuclear standby service.
9. Perform a metallurgical examination of fractured connecting rods in FAAA possession.
10. Complete final report.

REVIEW TDI ANALYSIS:

1. Review any TDI stress analyses or strain gage testing of connecting rods.

INFORMATION REQUIRED:

1. Connecting rod, wrist pin bearing and cap bolt drawings
2. Engine operating parameters (i.e., speed, firing pressure time history, etc.)
3. Component physical parameters (piston weight, connecting rod reciprocating and rotating weights, etc.)
4. TDI specified rod cap bolt torques and installation procedures.
5. TDI failure history of DSR-48 and DSRV connecting rods
6. Bushing and connecting rod material specifications

CONN ROD BEARING SHELLS

03-340B

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Journal Orbit Analysis Finite Element Analysis Fatigue/Fracture Mechanics	100 hrs at 100% Power and LOOP/LOCA Simulations - 3 engines	NDT Inspection of all bearings - 3 engines
RIVER BEND	Journal Orbit Analysis (If different from above)	100 hrs at 100% Power - 1 engine	NDT Inspection of bearings - Sample basis
RANCHO SECO	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-16 ENGINES:			
GRAND GULF	Journal Orbit Analysis Finite Element Analysis Fatigue/Fracture Mechanics	100 hrs at 100% Power - 1 engine	NDT Inspection of bearings sample basis
CATAWBA	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings-sample basis
PERRY	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
COMMANCHE PEAK	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
HARRIS	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
VOGTLE	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-12 ENGINES:			
MIDLAND	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-20 ENGINES:			
SAN ONOFRE	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CONNECTING ROD BEARING SHELLS
PART NO. 03-340B

Classification A
Completion 3/1/84

PRIMARY FUNCTION: The connecting rod bearing shells provide the oscillating sliding surface between the connecting rod and the crank pin through the formation of a hydrodynamic oil film. They transmit the cylinder firing pressure to the crankshaft through the oil film, converting the force into torque.

FUNCTIONAL ATTRIBUTES:

1. The bearing shells must have sufficient fatigue life and wear resistance to tolerate normal operating conditions for the intended service.
2. The bearing material must be of low friction to tolerate possible momentary contact with the crankshaft during starting of the engine and the surface of the bearing shell should be constructed of a material which is tolerant to the presence of foreign particles minimizing journal wear.
3. The dimensions must be manufactured with sufficient accuracy to obtain the proper interference fit in the connecting rod, and to establish the specified clearance between the bearing shell and the crankshaft.
4. The bearing must be designed so that during operation key parameters including oil supply pressure, peak oil film pressure, minimum oil film thickness, and oil film temperature rise are within acceptable limits for the specified diesel engine application and required life.
5. The bearing material should be resistant to possible corrosion due to chemical composition of lube oil.

SPECIFIED STANDARDS: None

EVALUATION:

1. Obtain cylinder pressure vs. crank angle data from DSR-48 test and compare to assumptions for previous bearing shell design review.
2. Review cylinder pressure vs. crank angle for DSRV-16-4 design.
3. Perform journal orbit analysis of DSR-48 design.
4. Perform finite element analysis of DSR-48 design.
5. a. Fracture mechanics life estimate of DSR-48 design.
   b. Determine maximum void size in bearing castings for radiograph inspection acceptance criteria.
6. Journal orbit analysis of DSRV-16-4 design.
7. Finite element analysis of DSRV-16-4 (if required by item 6).
8. a. Fracture mechanics life estimate of DSRV-16-4 design (if required by item 6).

b. Determine maximum void size in bearing castings for radiograph inspection acceptance criteria (if required by item 6).

9. Physical examination of used DSRV-16-4 bearing shells from GGNS to determine elastic deflection patterns.

10. Evaluate effects of babbit adhesion and thickness variations.

11. Complete report on DSR-48 and DSRV-16-4 bearing shells in SNPS and GGNS engines.

12. a. Determine differences, if any, between DSRV-16-4 and DSRV-12-4, DSRV-20-4. Conduct necessary design review steps, issue final report covering all engines.

b. Evaluate possible preventive maintenance and monitoring procedures (i.e., oil sample particulate/chemical analysis, periodic visual inspection).

REVIEW TDI ANALYSES:

1. Obtain any available journal orbit analyses.
2. Review any bearing failure analyses.

INFORMATION REQUIRED:

1. Manufacturer's drawings of bearings, connecting rods, crankpin journals
2. Cylinder firing pressure versus time for DSRV-16-4
3. Lubrication oil specifications
4. Connecting rod rotating and reciprocating weights

PISTONS

03-341

UNIT	PISTON TYPE	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:				
SHOREHAM	AE	Finite Element Analysis Thermo/Mechanical Analysis Fracture Mechanics Analysis on AE-type piston configuration	100 hrs at 100% Power and LOOP/LOCA simulation - 3 engines	NDT Inspection of pistons - sample basis
RIVER BEND	AN	Finite Element Analysis Thermo/Mechanical Analysis Fracture Mechanics Analysis on AN-type piston configuration	100 hrs - 1 engine	NDT Inspection Sample basis
RANCHO SECO	AN	Verify similarity to River Bend Evaluate differences if any	Normal Preop testing	NDT - Sample basis depending on River Bend results
V-16 ENGINES:				
GRAND GULF	AE	Verify Similarity of Operating Parameters to SNPS	100 hrs at 100% power - 2 engines	NDT - Sample basis depending on SNPS, KODIAK and TDI R-5 inspection results
CATAWBA	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
PERRY	AH	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
COMMANCHE PEAK	AH	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
HARRIS	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
VOGTLE	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
V-12 ENGINES:				
MIDLAND	AH/AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
V-20 ENGINES:				
SAN ONOFRE	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal operation	NDT - Sample basis depending on SNPS or River Bend results

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

Classification A
Completion 3/5/84

PISTONS
PART NO. 03-341

PRIMARY FUNCTION: The pistons react the cylinder firing pressure and provide a reciprocating mechanism for converting combined inertia and combustion pressure forces into mechanical torque through the wrist pin, connecting rod and crankshaft.

FUNCTIONAL ATTRIBUTES:

1. The piston crown must have sufficient strength to resist the high temperature and pressure firing loads.
2. The load transfer between the piston crown and skirt structure must not produce alternating stresses sufficient to cause failure of the skirt.
3. The wall structure of the skirt must be resistant to pressure induced deformation which could result in skirt fatigue in proximity to the stiffening ribs.
4. Preload in the crown studs must be sufficient to preclude failures of studs/nuts/washers.
5. The piston skirt must provide a suitable sliding surface against the cylinder liner.
6. The piston ring groove must be sufficiently wear resistant to provide sufficient ring life.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the historical evolution of the AF, AF modified, AH, AN, and AE piston designs, including casting, heat treatment, dimensional and material changes.
2. Determine maximum firing pressures and temperatures for DSR-48, DSRV-16-4, DSRV-12-4, and DSRV-20-4 designs.
3. Develop finite element models for AF modified and AE piston designs with pressure loading (static conditions).
4. Conduct thermo/mechanical analysis to determine thermally induced load transfer due to crown distortion.
5. Perform metallurgical examination of fractured AF piston skirts.
6. Perform eddy current examination of AE piston skirts from TDI DSR46 and R5 engines, and Alaska stationary diesel generator.

7. Conduct fracture mechanics analysis of possible crack propagation in AF modified and AE designs with differing stress conditions.
8. Conduct experimental static isothermal stress distribution test on AE skirt.
9. Evaluate the effect of piston side loading on wear.
10. Perform LP and eddy current inspection of SNPS AE pistons following 100 hrs at 100% load.
11. Assess the similarity of the AF modified, AH, and AN piston designs.
12. Complete report on AF modified, AH, AN and AE pistons.

REVIEW TDI ANALYSES:

1. Examine TDI strain gage testing (static) on skirt stud boss region.

INFORMATION REQUIRED:

1. TDI drawings for AN and AE designs including studs, Belleville washers, preload, material specifications
2. Historical information on casting changes, heat treatment changes
3. Maximum cylinder firing pressure and temperature for DSR-48, DSRV-16-4, DSRV-12-4 and DSRV-20-4

AIRSTART VALVE CAPSCREW

03-359

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Review 10CFR21 notification Evaluate capscrew length-tolerances vs. sylinder head tolerances. Worst case analysis of reaction air loading	100 starts - 1 engine 23 starts - 2 engines	Verification of proper torque and proper length (SIM360)
RIVER BEND	Review 10CFR21 response Verify similarity to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
RANCHO SECO	Review 10CFR21 response Verify similarity to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-16 ENGINES:			
GRAND GULF	Review 10CFR21 response Verify similarity of operating parameters to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
CATAWBA	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
PERRY	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
COMMANCHE PEAK	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
HARRIS	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
VOGTLE	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-12 ENGINES:			
MIDLAND	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-20 ENGINES:			
SAN ONOFRE	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

AIR START VALVE CAPSCREWS
PART NO. 03-359

Classification A
Completion 3/1/84

PRIMARY FUNCTION: The air start valve capscrews provide clamping force to hold air start valves in place on cylinder heads.

FUNCTIONAL ATTRIBUTES:
1. The air start valve capscrews must have sufficient strength to withstand the necessary preload and reaction air loading without yielding and resulting in loss of clamping force on the air start valves.

SPECIFIED STANDARDS: None

EVALUATION:
1. Verify adequacy of new capscrew length to prevent bottoming out of the capscrew during installation. Review to include maximum tolerance of capscrew length coupled with cylinder head minimum hole depth.
2. Evaluate adequacy of specified torque value.
3. Perform worst case analysis of reaction air loading in capscrews.
4. Determine the total restart bolt stress.
5. Evaluate the TDI recommended retorquing requirements after operation due to use of copper gaskets.

REVIEW TDI ANALYSES: Review load and deflection analyses if any.

INFORMATION REQUIRED:
1. Capscrews and washer materials and dimensions
2. Cylinder head drawings
3. Specified torque value and lubrication requirements

CYLINDER HEAD

03-360A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Evaluate evolution of cylinder head casting and fabrication; Evaluate possible fatigue crack growth of fire deck and adjacent valve port casting; Evaluate stellite valve seat fabrication technique and radial cracking	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines	LP inspection of cylinder head fire deck and valve seats - Sample basis Engine barring (all) and check water in cylinder
RIVER BEND	Verify similarity to SNPS Evaluate differences	100 Hrs @ 100% power - 1 engine	LP inspection of cylinder head fire deck and valve seats, UT f deck thickness - Sample basis; Engine barring (all)
RANCHO SECO	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-16 ENGINES:			
GRAND GULF	Verify similarity to SNPS Evaluate differences	100 Hrs @ 100% power - 1 engine	LP inspection of cylinder head fire deck and valve seats, UT f deck thickness - Sample basis; Engine barring (all) and check water in cylinder
CATAWBA	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
PERRY	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
COMMANCHE PEAK	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
HARRIS	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
VOGTLE	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-20 ENGINES:			
SAN ONOFRE	Evaluate effect of lower firing pressure	Normal operational testing	Same as above

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER HEAD
PART NO. 03-360A

Classification B
Completion 3/12/84

PRIMARY FUNCTION: Provide pressure tight cap for engine cylinder and provide passages and sealing for cooling water, lube oil, starting air, intake and exhaust gasses.

FUNCTIONAL ATTRIBUTES:

1. The cylinder head must have sufficient structural stiffness to react the cylinder firing forces without seal leakage or deformation which would produce unacceptable bending loads on the cylinder head studs.
2. The fire deck must be sufficiently stiff with thickness necessary to maintain stresses below endurance limits, however, the firedeck must also be thin enough to provide adequate heat transfer for cooling purposes.
3. The cylinder head must also possess sufficient resistance to thermal and mechanical fatigue to prevent failure.
4. Residual stresses in the cylinder head must be adequately relieved to prevent casting fatigue and fracture.
5. Areas of high contact loading and high gas velocities, such as valve seats, must be resistant to impact and corrosion damage.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review previous failure analyses of cylinder heads with jacket water passage flaws, fire deck flaws and valve seat cracking.
2. Evaluate possible causes of crack initiation.
3. Conduct physical/dimensional examination/comparison of early and current generations of cylinder heads.
4. Determine gas pressure loading and operating parameter differences between R-48 and RV engines.
5. Evaluate the improvements in manufacturing and casting techniques and the adequacy of the head cooling configuration. Identify possible crack propagation mechanisms if any.
6. Review NDT procedures for head castings.
7. Review results of hydrotesting.
8. Review the inspection of sampled SNPS cylinder heads following 4 hours at 112% power, 100 hours at 100% power.
9. Evaluate the adequacy of the engine barring procedure.

REVIEW TDI ANALYSES:

1. Review documents concerning cylinder head cracking including metallurgical examination of castings.
2. Review any stress or strain gage analyses.

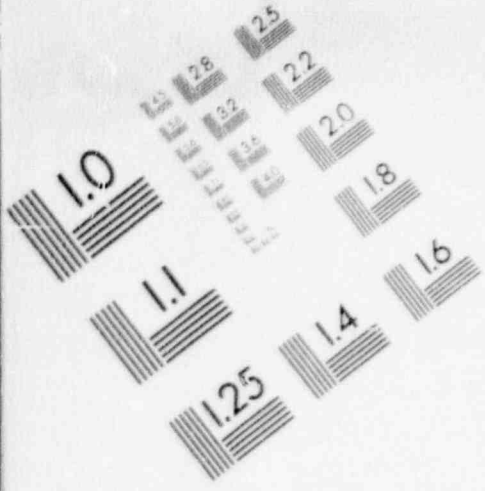
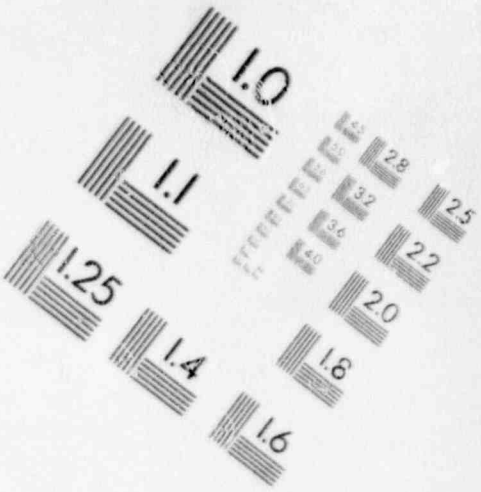
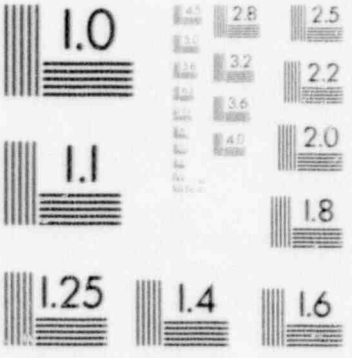
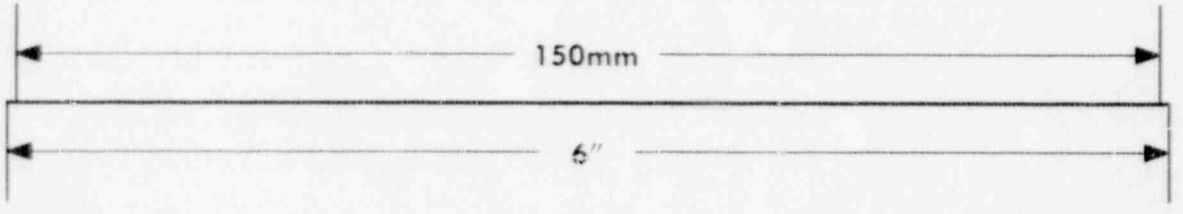
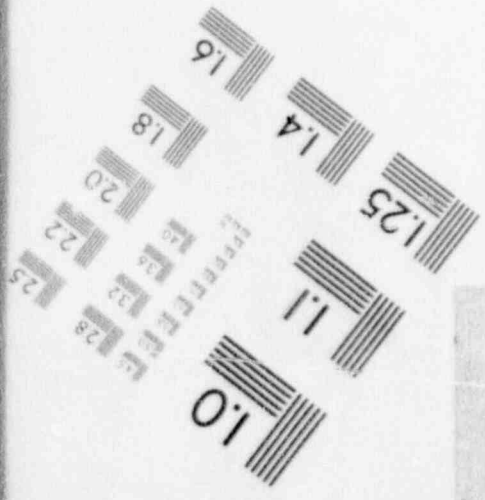


IMAGE EVALUATION TEST TARGET (MT-3)









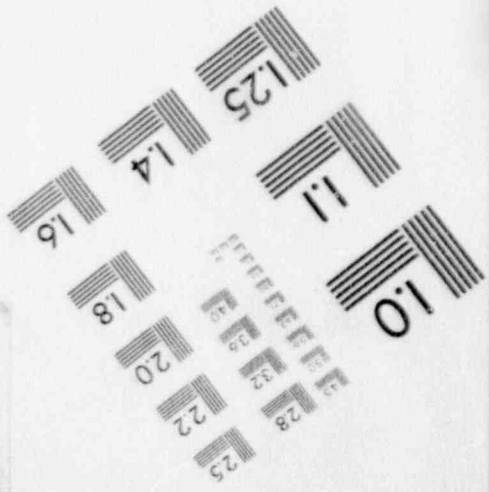
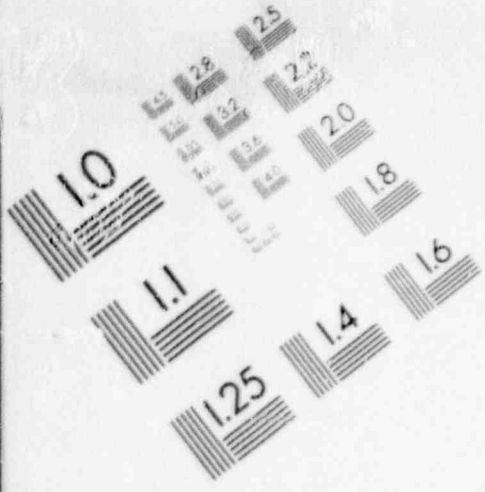
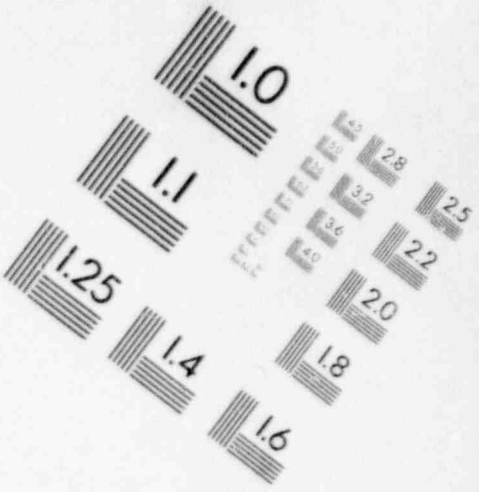
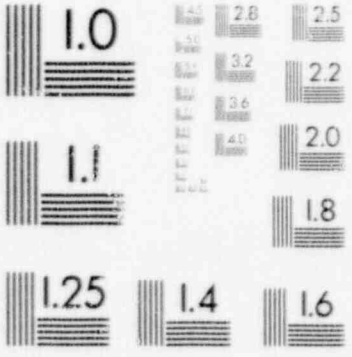
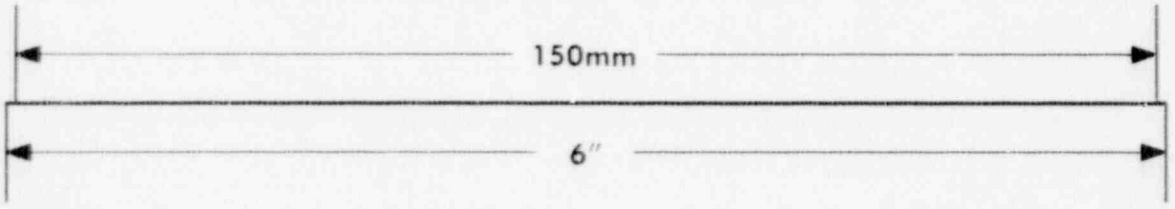


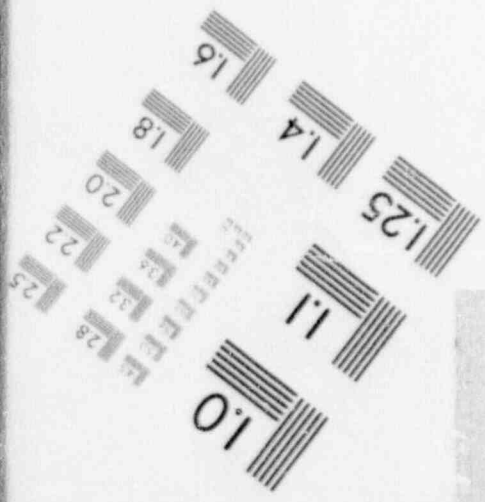
IMAGE EVALUATION
TEST TARGET (MT-3)

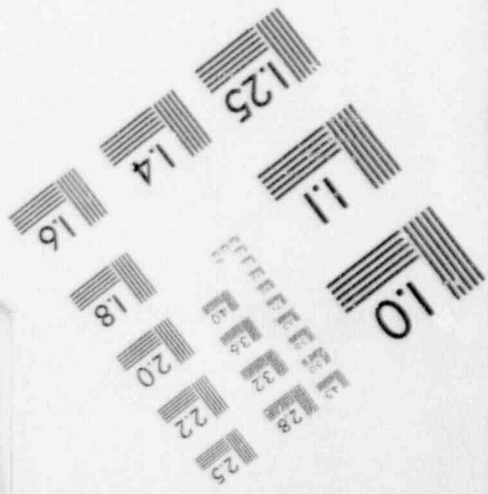












INFORMATION REQUIRED:

1. Manufacturer's drawings of early and current hr ds including any changes in casting practices and process control.
2. Cylinder firing pressure curve for R-48, RV-16, RV-12, RV-20 engines
3. Thermocouple measurement of cylinder head transient and steady state temperatures
4. All documents and reports of cylinder head flaws and possibly cracking for the R48 and RV engines
5. Review information (depositions and affidavits) submitted to date in the cylinder head ASLB litigation.

FUEL OIL INJECTION TUBING

03-365C

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress/fatigue analysis; Fracture mechanics analysis	100 hrs @ 100% load LOOP/LOCA simulation - 3 engines	Visual inspection for signs of leakage
RIVER BEND	Review 10CFR21 response	100 hrs @ 100% load - 1 engine	Visual inspection for signs of leakage
RANCHO SECO	Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-16 ENGINES:			
GRAND GULF	Verify applicability of SNPS analysis Review 10CFR21 response	100 hrs @ 100% load - 1 engine	Visual inspection for signs of leakage
CATAWBA	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
PERRY	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
COMANCHE PEAK	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
HARRIS	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
VOGTLE	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-12 ENGINES:			
MIDLAND	Verify applicability of SNPS analysis Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-20 ENGINES:			
SAN ONOFRE	Verify applicability of SNPS analysis Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage

DR-03-365C

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

FUEL OIL INJECTION TUBING
PART NO. 03-365C

Classification B
Completion 3/1/84

PRIMARY FUNCTIONS: To transfer high pressure fuel from the fuel injection pump to the injection spray nozzle.

FUNCTIONAL ATTRIBUTES:
1. The fuel oil injection tube assembly must have adequate fatigue strength to withstand the cyclic high pressure and vibration stresses without fatigue cracking or failure by yielding.
2. The tube assembly must be resistant to corrosion and erosion on the inside diameter.
3. The connector must also withstand the service induced conditions.

SPECIFIED STANDARDS: None

EVALUATION:
1. Determine maximum stresses incurred in fuel injection tubing by calcualtion per ASME-Section III stress & fatigue analysis - R-48 & V engines.
2. Verify the tube assembly has sufficient strength and life by comparing actual stress levels to yield and endurance limits.
3. Perform fracture mechanics analysis to determine the maximum inner diameter flaw size that will not propagate to tube failure.
4. Evaluate the adequacy of the NDT procedure to guarantee subcritical flaws, if any.
5. Evaluate adequacy of mechanical joints and compression requirements for the Swegelock fittings.
6. Evaluate erosion/corrosion resistance of the tubing to the fuel used in nuclear standby service.

REVIEW TDI ANALYSES:
1. Review TDI R&D test summary report on F.O. injection tubes, RV-005-16.
2. Review any TDI test data on service pressures and flow rates.

INFORMATION REQUIRED:
1. Injection tube assembly drawings and material specifications
2. Manufacturing details; surface finish, required inspections
3. Applicable S/N data for tubing material
4. Service pressures and flow rates

PUSH RODS
03-390

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
[illegible]ORHAM	Stress analysis of plug and friction weld designs Metallurgical examination of friction weld pushrod	100 hrs. @ 100% LOOP/LOCA simulation - 3 engines Experimental endurance test of friction weld pushrod	LP inspection of plug weld - sample basis
RIVER BEND	Verify design type	100 hrs @ 100% 1 engine	LP inspection of plug weld - sample basis
RANCHO SECO	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
V-16 ENGINES:			
GRAND GULF	Verify design type Metallurgical examination of friction weld pushrod	Normal Preop testing Experimental endurance test of friction weld pushrod	LP inspection of plug weld - sample basis
CATAWBA	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
PERRY	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
COMMANCHE PEAK	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
HARRIS	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
VOGTLE	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
[illegible]-12 ENGINES:			
MIDLAND	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
V-20 ENGINES:			
SAN ONOFRE	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

MAIN AND CONNECTOR PUSHRODS
PART NO. 03-390

Classification B
Completion 2/27/84

PRIMARY FUNCTION: The pushrods form portions of a linkage that transmits camshaft lobe motion to the cylinder intake and exhaust valves, thereby controlling the valve opening and closing cycle by reacting against the valve spring and inertial forces.

FUNCTIONAL ATTRIBUTES:
1. The pushrod loading is compressive, so that the pushrods must have sufficient strength to withstand compressive buckling.
2. The pushrod ends must have acceptable wear resistance.
3. The design of the interface between the pushrod tube and end fitting must minimize the possibility of manufacturing defects and adequately react operational loads.

SPECIFIED STANDARDS: None

EVALUATION:
1. Review the historical evolution of pushrods, including dimensional, material and manufacturing changes.
2. Determine maximum compressive loads for DSR-48, DSRV-16-4, DSRV-12-4, and DSRV-20-4 designs.
3. Review metallurgical analysis performed by Midde South Service for Mississippi Power and Light (MP&L), entitled "Metallurgical Evaluation of Diesel Generator", dated October 1983.
4. Review relevant portions of "Grand Gulf Nuclear Station - Unit 1 Interim Report on Division I and II TDI Generators", dated January 1984.
5. Perform metallurgical examination of failed pushrods.
6. Review friction-welded pushrod end configuration from design, manufacturing, and metallurgical standpoints.
7. Complete report on pushrods on LILCO and MP&L engines (DSR-48 and DSRV-16-4).
8. Complete report on DSRV-12-4 and DSRV-20-4 engines.

REVIEW TDI ANALYSES:
1. Review any TDI analyses related to the evolution of the pushrod cap design from plug weld, to the hardened ball and ultimately to the inertial welded cap.

INFORMATION REQUIRED:
1. Manufacturer drawings and material specifications
2. Rocker arm spring and inertia loads
3. Metallurgical reports of previous plug and ball welded connecting rods which experienced fractures.

ROCKER ARM CAPSCREWS

03-390G

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis: preload and operational induced loads for reduced cross section capscrew design.	100 Hrs @ 100% power LOOP/LOCA simulation - 3 engines	Visual examination on 3 sets pe engine, verification of proper torque and current design type
RIVER BEND	Verify similarity to SNPS/GGNS	100 Hrs @ 100% power - 1 engine	Verify proper torque and design type
RANCHO SECO	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-16 ENGINES:			
GRAND GULF	Stress analysis: preload and operational induced loads for uniform cross section capscrew design.	100 Hrs @ 100% power - 1 engine	Verify proper torque and design type
CATAWBA	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
PERRY	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
COMMANCHE PEAK	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
HARRIS	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
VOGTLE	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

ROCKER ARM CAPSCREWS
PART NO. 03-3906

Classification B
Completion 3/1/84

PRIMARY FUNCTION: The rocker arm capscrews transmit resultant loads from the valve springs, valve opening pressure pushrods, and rocker arm assemblies to the sub cover and cylinder heads.

FUNCTIONAL ATTRIBUTES:

1. The rocker arm capscrews must have sufficient strength to withstand the necessary preload and oscillation loads without fatigue cracking, unacceptable preload relaxation or thread distortion.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the stud dimensions from existing design drawings and evaluate the stress at the minimum cross-sectional area resulting from the applied preloads assuming uniform thread lubrication and load distribution. Stress concentration factors for the thread root area will be included in the analysis for the previous TDI design.
2. Determine the stresses experienced at the minimum area resulting from push rod motion, valve spring deflection and valve opening pressure.
3. Determine the total resultant bolt stress and compare to yield and endurance limits.
4. Compare capscrew design and material specification to ASTM A-193.
5. Evaluate the thread specification for resistance to distortion and creep.
6. Perform similar analysis on the previous uniform cross section capscrew design.

REVIEW TDI ANALYSES:

1. Review any TDI stress analyses associated with design/material changes.

INFORMATION REQUIRED:

1. Capscrew preload (hold-down force)
2. Capscrew lubrication
3. Capscrew design drawings and material specifications
4. Rocker arm geometry and drawings
5. Valve spring constants, free length, compressed length
6. Operating loads on the capscrews
7. Valve pop-open pressure in cylinder

JACKET WATER PUMP

03-425

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of impeller/shaft connection, Evaluation of torsional oscillation effect Tapered ductile iron impeller	100 Hrs @ 100% power LOOP/LOCA simulation	Disassemble and LP inspection pump shaft, impeller and gear after 100 Hrs @ 100% power - 1 engine
RIVER BEND	Stress analysis of impeller/shaft/key connection, Evaluation of torsional oscillation effects Tapered bronze impeller with key	100 Hrs @ 100% power - 1 engine	Disassemble and LP inspection pump shaft, impeller and gear after 100 Hrs @ 100% power - 1 engine
RANCHO SECO	Verify similarity to River Bend Evaluate differences	Normal Preop testing	None if River Bend and SNPS inspections acceptable
V-16 ENGINES:			
GRAND GULF	Stress analysis of impeller/shaft/key connection (larger than R48) Evaluation of torsional oscillation effects Tapered bronze impeller with key	100 Hrs @ 100% power - 1 engine	None if analysis shows sufficient factors of safety compared to SNPS/River Bend and inspections are acceptable
CATAWBA	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
PERRY	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
HARRIS	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
VOGTLE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
V-12 ENGINES:			
MIDLAND	Verify similarity to GGNS Evaluate different torque oscill.	Normal Preop testing	None if analysis shows sufficient factors of safety
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to GGNS Evaluate different torque oscill.	Normal Preop testing	None if analysis shows sufficient factors of safety

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

JACKET WATER PUMP
PART NO. 03-425

Classification A
Completion 3/18/84

PRIMARY FUNCTION: This pump takes suction from the jacket water standpipe and delivers the required flow of treated jacket water at the required pressure to the engine jacket water header. The jacket water circulates through the engine cylinder jackets, exhaust manifold, the turbocharger intercooler, turbocharger lube oil and jacket water cooler. The Reactor Building Service Water System heat exchanger interfaces with the jacket water system for the ultimate heat removal.

FUNCTIONAL ATTRIBUTES:
1. The pressure boundary must maintain integrity to prevent unacceptable water leaks.
2. The jacket water pump must deliver required flow at normal operating pressure during engine operation.
3. The mechanical seal must be adequately designed for appropriate wear life.
4. The pump shaft must be able to deliver required torque to pump impeller with fluctuating torque input through gear train.
5. Pump drive gear must be adequate to transmit steady state and transient loads.

SPECIFIED STANDARDS: None

EVALUATION:
1. Evaluate design and hydrotest pressures for casing and impeller supplied by Berkeley Pump Co. for the R48 and Pacific Pump for the RV engines.
2. Verify that pumps have run to date with no unacceptable leaks in pressure boundary components.
3. Verify that jacket water pump has provided sufficient flow and pressure such that the cooling water temperature has not exceeded acceptable limits in the absence of other system problems, at rated load and speed.
4. Evaluate pump performance tests.
5. Verify that there have been no unacceptable mechanical seal conditions to date.
6. Analyze stresses in pump shaft due to bending, torque and nut tension on gear and impeller end (R-48 and RV engines).
7. Evaluate the effects of the fluctuating torque input from engine gear train.

REVIEW TDI ANALYSES:
1. Review any TDI analyses associated with changes in impeller attachment configurations.

INFORMATION REQUIRED:

1. Maintenance records associated with pump casing and mechanical seals
2. Start up and operational logs which identify cooling water system temperatures.
3. Design and hydrotest pressure for the casings provided by Berkeley & Pacific Pump Companies
4. Detailed drawings of pump rotors including fits and tolerances on impeller and gear and materials
5. Steady state and transient torque oscillations input to the jacket water pump from the drive gear assembly
6. Pump performance data including mechanical efficiency
7. Gear ratio on pump gear and crank gear
8. LP and visual inspection results of the SNPS jacket water pump assembly following 100 hours at full load and a LOOP/LOCA simulation
9. TDI specified procedures for installing gear and impeller or shaft including percent contact required, torque on gear and impeller nut

UNIT	ANALYSIS	TESTING	INSPECTION
R-/8 ENGINES:			
SHOREHAM	Review test report or other approved qualification method for each cable type supplied by TDI; IAW IEEE 383	None required	Visual examination to identif adequate wiring/terminations industry standards
RIVER BEND	Review 10CFR21 response	None required	Visual examination to identif adequate wiring/terminations industry standards
RANCHO SECO	Review 10CFR21 response	None required	Visual examination to identif adequate wiring/terminations industry standards
V-16 ENGINES:			
GRAND GULF	Review 10CFR21 response	None required	Visual examination to identify adequate wiring/terminations p industry standards
CATAWBA	Review 10CFR21 response	None required	Visual examination (etc.)
PERRY	Review 10CFR21 response	None required	Visual examination (etc.)
COMMANCHE PEAK	Review 10CFR21 response	None required	Visual examination (etc.)
HARRIS	Review 10CFR21 response	None required	Visual examination (etc.)
VOGTLE	Review 10CFR21 response	None required	Visual examination (etc.)
V-12 ENGINES:			
MIDLAND	Review 10CFR21 response	None required	Visual examination (etc.)
V-20 ENGINES:			
SAN ONOFRE	Review 10CFR21 response	None required	Visual examination (etc.)

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

WIRING & TERMINATION
PART NO. 03-688B

Classification A
Completion 2/27/84

PRIMARY FUNCTION: The wiring and terminations interconnect instrument, control and power circuits on diesel generator itself and within the control panels.

FUNCTIONAL ATTRIBUTES:
1. Conductors, insulation, and termination must be suitable for specified amp rating.
2. Conductors and insulation must be flame retardant.
3. Material and insulation rating should be appropriate for engine and generator applications.

SPECIFIED STANDARDS: IEEE-383

EVALUATION:
1. Review wiring insulation for compatability with circuit requirements.
2. Flame retardant insulation:
   a. Determine whether insulation is qualified to IEEE-383, UL or some other industry standard.
   b. Determine whether insulation is a material known to have generic fire retardant characteristics.
   c. Determine whether wiring need be installed in individual conduit to minimize insulation damage.
3. Evaluate any special circuit requirements, such as shielded cable.
4. Compare termination type, material, size and insulation ratings with characteristics required for application.

REVIEW TDI ANALYSES: Review if available

INFORMATION REQUIRED:
1. Cable type test reports or other approved qualification method for each cable type supplied with the engine

IV. DESIGN REVIEW/QUALITY REVALIDATION

The Design Review/Quality Revalidation (DR/QR) Program has been established to conduct a detailed review of the Transamerica Delaval (TDI) engine/generator design and to subject individual engine/generator pairs to a rigorous quality revalidation which is capable of providing reasonable assurance that the TDI engines will perform their intended function. The DR/QR Program objective is to identify important components of the TDI diesel engine and to assure that these components are properly designed and fabricated. Selected components will be subject to a detailed design and/or quality revalidation review. Any potential deficiencies identified by the Program will be evaluated and/or corrected as appropriate. Appendix 4 includes procedure DG-1, "Diesel Generator Design Review and Quality Revalidation Program Description", which provides more details on the Program and its organization.

It is significant to note, that, while TDI drawings and certain TDI information is being used as input to the DR/QR Program, the actual technical evaluations are being performed independent of TDI thereby providing an independent verification. TDI will be kept in the review and comment cycle in order to take into account their engine and component specific expertise.

The DR/QR Program is divided into five major steps:

Component Selection

Preparation of Task Descriptions

Design Review

Quality Revalidation

Preparation of the Final Report

Component Selection

A Component Selection Committee designates the diesel generator components to be subjected to the DR/QR Program. Selection is based on the component's function and role in the overall operation of the engine, industry experience, and the engineering judgment and experience of the committee. The selection process includes review of available operating information on TDI diesels to ensure that relevant experience was adequately considered.

As part of the component selection process, components are 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. 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 then specifies appropriate design review and quality revalidation requirements. This information is forwarded to the Design Review Group and Quality Revalidation Group for preparation of task descriptions. Procedure DG 2 "Diesel Generator Component Selection Procedure", Appendix 4, provides additional details of the selection process.

Component selection has been completed for the lead engines; GGNS (MP&L) for the V engines and SNPS (LILCO) for the in-line engines. The results of the component selection (ie. design review and/or quality revalidation, where appropriate) are provided in Table IV.1 and IV.2.

Preparation of Task Descriptions

The Design Review Group and Quality Revalidation Group prepare task descriptions to define the reviews, inspections, calculations, etc. that will be performed for each component. The task descriptions include any requirements specified in the selection process as well as a more detailed explanation of the methodology, procedures and standards which apply. This task description provides, as applicable:

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),
6. Final documentation requirements, and
7. Schedule for completion.

Appendix 6 and Section III include the sixteen task descriptions for Phase I components that have been prepared at this time. Task leaders prepare and complete these task descriptions as described in procedures DG-3, "Diesel Generator Component Design Review Procedure" and DG-4, "Diesel Generator Quality Revalidation Procedure" (Appendix 4).

In addition to providing a more detailed outline of the specific review on an individual component, the task descriptions list the information or equipment (such as drawings, design information, NDE equipment, etc.) which are necessary to complete the Design Review or Quality Revalidation.

Design Review

Completion of the Design Review in accordance with the task descriptions is the responsibility of the Design Group. Due to the number and diversity of the components and standards involved, the design review must be tailored to each component, and the Group must utilize their experience and

professional judgement where necessary. The actual Design Review may be accomplished using any of the following methods, including: a) an independent calculation performed by the Design Group; b) an independent review of the adequacy, appropriateness or correctness of existing vendor and/or subvendor calculations; c) analysis performed by the Design Group; d) testing specified by the Design Group; or, e) other methods specified and approved in the task descriptions.

Design calculations, when required, are signed by the preparer and the checker to indicate concurrence with the calculation and are individually reviewed. Upon completion, the Component Design Review results shall be filed and summaries submitted for incorporation into the final report.

In addition to completion of the task descriptions, the Design Group has two other important functions. It specifies quality attributes important from a design standpoint (in addition to those identified during the component selection process) which are to be reviewed by the Quality Group. The Design Group also identifies any components which may require corrective action to improve reliability of the diesel generators. This will include appropriate recommendations such as increased frequency of replacement and/or maintenance, or additional in-service inspection These recommendations may also include Quality Revalidation inspections, tests or reviews.

Quality Revalidation

The Component Quality Revalidation Group will be provided with the quality attributes which must be validated. The resulting task descriptions includes applicable component descriptions, attributes to be verified, methodology, acceptance criteria, type of documentation to be provided, and the completion schedule.

Each component to undergo Quality Revalidation will be subject to a documentation review. This process will identify and catalogue all appropriate documentation (such as material test reports, NDE, vendor/subvendor records, etc.) associated with the component. With assistance from Quality Engineering, each document will be reviewed for acceptability. These document packages will be available to the Design Group to assist in the engineering review. Important attributes identified by the Design Group, for which acceptable documentation does not exist, will be verified by tests and/or inspections performed by the Quality Group.

Tests or inspections required to be performed on components will be forwarded to Quality Engineering to identify methodology and procedures to be followed. These instructions will be issued to Quality Inspection via a task description. Field inspections and tests will be performed by qualified personnel. Deperding upon the specified test or inspection,

spare parts, or surplus parts may be used in lieu of installed parts as the test/inspection article. Results of inspections and tests will be reviewed by the Design Group as required.

Preparation of the Final Report

Upon completion of the DR/QR Program, a final report will be issued for each utility. The final report will contain the following information:

1. Executive Summary
2. Program Description
3. Methodology for Selecting Components
4. Summary List of Components and Classification
5. Methodology for Component Design Review
6. Result of the Component Design Review
7. Methodology for Component Quality Revalidation
8. Results of Component Quality Revalidation
9. Tabulation and Discussion of any Discrepancies
10. Corrective Actions and Recommendations.

TABLE IV - 1

LILCO Component Selection Results

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Requested
F-068	Intercooler		X	
F-139	Tools Turbo			X
F-161	Pyrometer Wire			X
MP-017	Turbocharger	X	X	
00-420	Lube Oil Pressure Regulating Valve	X	X	
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: Adapter			X
00-495B	Turbocharger-Air Outlet Adapter: Mounting Hardware			X
00-520	Warning Plate			X
00-700A	Jacket Water Stand Pipe: Pipe, Fittings & Gaskets	X	X	
00-700B	Jacket Water Stand Pipe: Valves		X	
00-700C	Jacket Water Stand Pipe: Supports	X	X	
00-700D	Jacket Water Stand Pipe: Gauges			X
00-700E	Jacket Water Stand Pipe: Switches	X	X	
00-700F	Jacket Water Stand Pipe: Misc. Bolting Materials	X	X	
03-CFR	Turbocharger Thrust Bearing	X	X	
03-305A	Base & Bearing Caps: Base Assembly	X	X	
03-305B	Base & Bearing Caps: Dowels			X

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-305C	Base & Bearing Caps: Main Bearing Studs & Nuts	X	X	
03-305D	Base & Bearing Caps: Main Bearing Caps	X	X	
03-305E	Base & Bearing Caps: Thru Bolting	X	X	
03-305F	Base & Bearing Caps: Seals, Gaskets & Covers			X
03-307A	Lube Oil Fittings - Internal: Headers	X	X	
03-307B	Lube Oil Fittings - Internal: Tubing & Fittings	X	X	
03-307C	Lube Oil Fittings - Internal: Seals			X
03-307D	Lube Oil Fittings - Internal: Supports	X		
03-310A	Crankshaft & Bearings: Crankshaft & Turning Gear	X	X	
03-310B	Crankshaft & Bearings: Bearing Shells	X	X	
03-310C	Crankshaft & Bearings: Thrust Bearing Ring	X	X	
03-315A	Cylinder Block - Liners & Water Manifold: Cylinder Block	X	X	
03-315B	Cylinder Block - Liners & Water Manifold: Cam Bearing Caps & Dowels			X
03-315C	Cylinder Block - Liners & Water Manifold: Cylinder Liner	X	X	
03-315D	Cylinder Block - Liners & Water Manifold: Jacket Water Manifold & Piping	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-315E	Cylinder Block - Liners & Water Manifold: Studs	X	X	
03-315F	Cylinder Block - Liners & Water Manifold: Nuts	X	X	
03-315G	Cylinder Block - Liners & Water Manifold: Seals & Gaskets	X	X	
03-317A	Water Discharge Manifold: Jacket Water Discharge Manifold	X	X	
03-317B	Water Discharge Manifold: Coupling & Seals	X	X	
03-317C	Water Dishcarge Manifold: Supports	X		
03-330A	Flywheel	X		
03-330B	Flywheel: Bolting	X	X	
03-331A	Guards: Flywheel Guard Assembly			X
03-331B	Guards: Rear Coil Guard			X
03-335A	Front Gear Case			X
03-335B	Front Gear Case: Gaskets & Bolting		X	
03-340A	Connecting Rods: Connecting Rods & Bushing	X	X	
03-340B	Connecting Rods: Bearing Shells	X	X	
03-341A	Pistons	X	X	
03-341B	Pistons: Rings	X	X	
03-341C	Pistons: Pin Assembly	X	X	
03-345A	Tappets & Guides: Intake Tappet Assembly	X	X	
03-345B	Tappets & Guides: Fuel Tappet Assembly	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-345C	Tappets & Guides: Fuel Pump Base Assembly	X		
03-350A	Camshaft: Camshaft Assembly	X	X	
03-350B	Camshaft: Camshaft Bearing	X		
03-350C	Camshaft: Supports, Bolting, & Gears	X	X	
03-355A	Idler Gear Assembly: Crank to Pump Gear	X	X	
03-355B	Idler Gear Assembly	X	X	
03-355C	Idler Gear Assembly: Gaskets & Bolting		X	
03-359	Air Start Valve	X	X	
03-360A	Cylinder Head Valves: Cylinder Heads	X	X	
03-360B	Cylinder Head Valves: Intake & Exhaust Valves	X	X	
03-360C	Cylinder Head Valves: Bolting & Gaskets	X	X	
03-360D	Cylinder Head Valves: Springs & Retainers	X	X	
03-361	Indicating Cocks			X
03-362A	Cylinder Head Covers: Sub Cover Assembly	X	X	
03-362B	Cylinder Head Covers: Gaskets & Bolting			X
03-365A	Fuel Injection Equipment: Fuel Injection Pump	X		
03-365B	Fuel Injection Equipment: Fuel Injection Tips	X		
03-365C	Fuel Injection Equipment: Tube Assembly	X		
03-365D	Fuel Injection Equipment: Supports	X		

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	X	X	
03-371B	Fuel Pump Linkage: Linkage Assembly & Bearings	X	X	
03-371C	Fuel Pump Linkage: Automatic Shutdown	X		
03-375	Intake Manifold	X	X	
03-380A	Exhaust Manifold	X	X	
03-380B	Exhaust Manifold: Gaskets & Bolting	X	X	
03-385A	Cylinder Block Covers			X
03-385B	Cylinder Block Covers: Gaskets & Bolts	X	X	
03-387A	Crankcase Ventilator: Crankcase Vacuum Fan	X		
03-387B	Crankcase Ventilator: Crankcase Oil Separator	X		
03-387C	Crankcase Ventilator: Fittings, Bolting, Supports			X
03-387D	Crankcase Ventilator: Crankcase & Fluid Manometer			X
03-390A	Rocker Arms & Pushrods: Intake & Intermediate Rocker Shaft Assembly	X	X	
03-390B	Rocker Arms & Pushrods: Exhaust Rocker Shaft Assembly	X	X	
03-390C	Rocker Arms & Pushrods: Pushrods - Intake & Exhaust	X	X	
03-390D	Rocker Arms & Pushrods: Pushrod - Connector	X		
03-390E	Rocker Arms & Pushrods: Bushings	X		
03-390F	Rocker Arms & Pushrods: Lifters	X		

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-390G	Rocker Arms & Pushrods: Bolts, Drive Studs	X	X	
03-402A	Governor Drive: Governor & Tachometer Drive Gear & Shaft	X	X	
03-402B	Governor Drive: Couplings, Pins & Keys	X	X	
03-410A	Overspeed Trip: Governor	X	X	
03-410B	Overspeed Trip: Governor & Accessory Drive Assembly	X	X	
03-410C	Overspeed Trip: Couplings (Flexible & Spider)	X	X	
03-410D	Overspeed Trip: Vent Valves	X	X	
03-413	Governor Linkage	X	X	
03-415A	Governor Assembly: Woodward Governor	X	X	
03-415B	Governor Assembly: Booster Servomotor	X		
03-415C	Governor Assembly: Heat Exchangers	X	X	
03-420	Lube Oil Pumps	X	X	
03-425A	Jacket Water Pump	X	X	
03-425B	Jacket Water Pump: Cover			X
03-435A	Jacket Water Fittings: Pipe & Fittings	X	X	
03-435B	Jacket Water Fittings: Supports	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-437A	Turbo Water Piping: Pipe & Fittings	X	X	
03-437B	Turbo Water Piping: Supports	X	X	
03-441A	Starting Air Manifold: Piping, Tubing & Fittings	X	X	
03-441B	Starting Air Manifold: Valves, Strainers, Filters	X	X	
03-441C	Starting Air Manifold: Supports	X	X	
03-442A	Starting Air Distributor: Distributor Assembly	X	X	
03-442B	Starting Air Distributor: Tubing, Fittings & Gaskets	X	X	
03-445	Fuel Oil Booster Pump - Pump Assembly	X	X	
03-450A	Fuel Oil Header: Ejector Assemblies			X
03-450B	Fuel Oil Header: Piping & Tubing	X	X	
03-450C	Fuel Oil Header: Fuel Oil Filters, Strainers	X	X	
03-450D	Fuel Oil Header: Supports	X	X	
03-455A	Fuel Oil Filters & Strainers: Filters	X		
03-455B	Fuel Oil Filters & Strainers: Strainers	X		
03-455C	Fuel Oil Filters & Strainers: Mounting Hardware	X	X	
03-465A	Lube Oil Liner - External: Tubings, Fittings, Coupling	X	X	
03-465B	Lube Oil Liner - External: Supports	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-467A	Turbocharger - Lube Oil Fitting: Piping	X	X	
03-467B	Turbocharger - Lube Oil Fitting: Supports	X	X	
03-475A	Turbocharger - Bracket	X	X	
03-475B	Turbocharger - Bracket: Air Butterfly Valve Assembly (w/Actuator)	X	X	
03-475C	Turbocharger - Bracket: Air Intake Piping	X		
03-475D	Turbocharger - Bracket: Bolting & Gaskets	X	X	
03-475E	Turbocharger - Bracket: Pipe Supports	X		
03-500A	Control Panel Assembly: Cabinet/System	X	X	
03-500B	Control Panel Assembly: Annunciators	X		
03-500C	Control Panel Assembly: Circuit Breakers/Contact Blocks			X
03-500D	Control Panel Assembly: Pressure Gauges			X
03-500E	Control Panel Assembly: Hourmeter			X
03-500F	Control Panel Assembly: Accumulator	X	X	
03-500G	Control Panel Assembly: Valves	X	X	
03-500H	Control Panel Assembly: Pressure Switch		X	
03-500I	Control Panel Assembly: Pyrometers			X
03-500J	Control Panel Assembly: Relays	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-500K	Control Panel Assembly: Solenoid Valve	X	X	
03-500L	Control Panel Assembly: Tachometer			X
03-500M	Control Panel Assembly: Piping, Tubing, Fittings		X	
03-500N	Control Panel Assembly: Terminal Board/Switches/ Wiring		X	
03-515	Thermostatic Valve	X	X	
03-520	Nameplates			X
03-525A	Barring Device - Pneumatic: Barring Device Assembly			X
03-525B	Barring Device - Pneumatic: Regulator Valve/Shut off Valve	X	X	
03-525C	Barring Device - Pneumatic: Misc. Fittings, Hose, Filters, Tubing	X	X	
03-525D	Barring Device - Pneumatic: Mounting Bracket/Supports		X	
03-530A	Platform - Front & Side: Side Platform Assembly			X
03-530B	Platform - Front & Side: Front Platform Assembly			X
03-530C	Platform - Front & Side: Bracing (with Attachments)			X
03-531A	Platform Ladder Front: Platform Assembly			X
03-531B	Platform Ladder Front: Bracing			X
03-531C	Platform Ladder Front: Sub-Base			X
03-540A	Lube Oil Sump Tank: Tank with Strainer Assembly		X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valve	X	X	
03-540C	Lube Oil Sump Tank: Mounting Hardware	X	X	
03-550	Foundation Bolts - Anchors, Bolts, Misc. Hardware	X	X	
03-590	Special Tools - Asst. Engine Assembly Tools			X
03-630A	Pyrometer Conduit Assembly: Conduit			X
03-630B	Pyrometer Conduit Assembly: Conduit Fittings			X
03-630C	Pyrometer Conduit Assembly: Supports			X
03-630D	Pyrometer Conduit Assembly: Thermocouples	X		
03-630E	Pyrometer Conduit Assembly: Gaskets			X
03-650A	Generator	X	X	
03-650B	Generator: Generator Control	X	X	
03-650C	Generator: Shaft & Bearings	X		
03-688A	Engine & Aux. Module Wiring Material: Conduit & Fittings	X		
03-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	X	X	
03-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals		X	
03-690	Engine Alarm Sensors - Temperature & Level Switches	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-695A	Engine Shut Down Equipment: Tubing & Fittings	X	X	
03-695B	Engine Shut Down Equipment: Valves, Regulator, Orifices	X	X	
03-695C	Engine Shut Down Equipment: Trip Switches	X	X	
03-715A	Sub Base: Engine Generator	X	X	
03-715B	Sub Base: Bolting	X	X	
03-717A	Aux. Sub Base & Oil & Water Piping: Aux. Sub Base	X		
03-717B	Aux. Sub Base & Oil & Water Piping: Jacket Water - Valves	X		
03-717C	Aux. Sub Base & Oil & Water Piping: Jacket Water - Actuator	X		
03-717D	Aux. Sub Base & Oil & Water Piping: Jacket Water - Pipe, Coupling, Fittings, Orifices, & Strainers	X	X	
03-717F	Aux. Sub Base & Oil & Water Piping: Jacket Water - Gaskets & Bolting		X	
03-717G	Aux. Sub Base & Oil & Water Piping: Jacket Water - Supports	X	X	
03-717H	Aux. Sub Base & Oil & Water Piping: Lube Oil - Pipe & Fittings	X	X	
03-717I	Aux. Sub Base & Oil & Water Piping: Lube Oil - Valves	X	X	

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-717J	Aux. Sub Base & Oil & Water Piping: Lube Oil - Gaskets & Bolting	X	X	
03-717K	Aux. Sub Base & Oil & Water Piping: Lube Oil - Supports & Mounting Hardware	X	X	
03-717L	Aux. Sub Base & Oil & Water Piping: Lube Oil - Switch Over Assy.	X	X	
03-717M	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Pipe & Fittings	X	X	
03-717N	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Valves	X	X	
03-717O	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Gaskets & Bolting	X	X	
03-717P	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Supports	X	X	
03-800A	Misc. Equipment: Heater, Jacket Water	X	X	
03-800B	Misc. Equipment: Heater, Lube Oil Sump Tank	X		
03-800C	Misc. Equipment: Air Starter Tank Relief Valves			X
03-800D	Misc. Equipment: Electrolytic Conductivity Cell			X
03-800E	Misc. Equipment: Electrolytic Conductivity Monitor			X
03-800F	Misc. Equipment: Relief Valve - Booster Pump		X	
03-835A	Misc. Equipment: After Cooler Support			X
03-835B	Misc. Equipment: After Cooler			X

Component Number	Component Description	Design-Review Required	Quality-Review Required	No Review Required
03-805C	Misc. Equipment: After Cooler Bolting			X
04-000	Lube Oil Full Pressure Strainer	X	X	
10-100	Misc. Components:			
10-103	Jacket Water Heat Exchanger	X	X	
10-104	Lube Oil Heat Exchanger	X	X	
10-105	Exhaust Silencer			X
10-106	Full Flow Lube Oil Filter	X	X	
10-107	Jacket Water Standby Heater Pump		X	
10-108	Fuel Oil Booster Pump			X
10-109	Flex Connections	X	X	
10-111	Starting Air Tank	X	X	
10-112	Starting Air Compressor	X		
10-113	Before & After Lube Oil Pump	X	X	
10-114	Intake Air Filter	X		
10-115	DC Magnetic Starter			X
10-116	Air Dryer			X
10-117	Oil Prelube Filter	X	X	

MP&L COMPONENT SELECTION RESULTS

CROSSREF. COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
F-068	F-068	Intercooler	X	X	
F-139		Tools Turbo			
F-161		Pyrometer Wire			
MP-017	MP-022/23	Turbocharger	X	X	
00-420	00-420	Lube Oil Pressure Regulating Valve	X	X	
00-491A	00-491A	Turbocharger-Air Inlet Adapter: Adapter			X
00-491B	00-491B	Turbocharger-Air Inlet Adapter: Mounting Hardware w/Flexible Connector			X
-495A	00-495A	Turbocharger-Air Outlet Adapter: Adapter			X
00-495B	00-495B	Turbocharger-Air Outlet Adapter: Mounting Hardware			X
00-520	00-520	Warning Plate			X
00-700A	00-700A	Jacket Water Stand Pipe: Pipe, Fittings & Gaskets	X	X	
00-700B	00-700B	Jacket Water Stand Pipe: Valves			X
00-700C	00-700C	Jacket Water Stand Pipe: Supports	X	X	
00-700D	00-700D	Jacket Water Stand Pipe: Gauges			X
00-700E	00-700E	Jacket Water Stand Pipe: Switches	X	X	
00-700F	00-700F	Jacket Water Stand Pipe: Misc. Bolting Materials			X

OSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-CFR	02-CFR	Turbocharger Thrust Bearing	X	X	
03-305A	02-305A	Base & Bearing Caps: Base Assembly	X	X	
03-305B	02-305B	Base & Bearing Caps: Dowels			
03-305C	02-305C	Base & Bearing Caps: Main Bearing Studs & Nuts	X	X	
03-305D	02-305D	Base & Bearing Caps: Main Bearing Caps			X
03-305E	02-305E	Base & Bearing Caps: Thru Bolting	X		
03-305F	02-305F	Base & Bearing Caps: Seals, Gaskets & Covers			
03-307A	02-307A	Lube Oil Fittings - Internal: Headers		X	
03-307B	02-307B	Lube Oil Fittings - Internal: Tubing & Fittings		X	
03-307C	02-307C	Lube Oil Fittings - Internal: Seals			X
03-307D	02-307D	Lube Oil Fittings - Internal: Supports	X	X	
03-310A	02-310A	Crankshaft & Bearings: Crankshaft & Turning Gear	X	X	
03-310B	02-310B	Crankshaft & Bearings: Bearing Shells	X	X	
03-310C	02-310C	Crankshaft & Bearings: Thrust Bearing Ring		X	
03-315A	02-315A	Cylinder Block - Liners & Water Manifold: Cylinder Block	X	X	

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-315B	02-311B	Cylinder Block - Liners & Water Manifold: Cam Bearing Caps & Dowels			X
03-315C	02-315C	Cylinder Block - Liners & Water Manifold: Cylinder Liner	X	X	
03-315D	02-315D	Cylinder Block - Liners & Water Manifold: Jacket Water Manifold & Piping	X	X	
03-315E	02-315E	Cylinder Block - Liners & Water Manifold: Studs	X	X	
03-315F	02-315F	Cylinder Block - Liners & Water Manifold: nuts		X	
03-315G	02-315G	Cylinder Block - Liners & Water Manifold: Seals & Gaskets		X	
03-317A	02-317A	Water Discharge Manifold: Jacket Water Discharge Manifold	X	X	
03-317B	02-317B	Water Discharge Manifold: Coupling & Seals	X	X	
03-317C	02-317C	Water Discharge Manifold: Supports	X	X	
03-330A	02-330A	Flywheel			X
03-330B	02-330B	Flywheel: Bolting	X	X	
03-331A	02-331A	Guards: Flywheel Guard Assembly			X
03-331B	02-331B	Guards: Rear Coil Guard			X
03-335A	02-335A	Front Gear Case	X	X	
03-335B	02-335B	Front Gear Case: Gaskets & Bolting			
03-340A	02-340A	Connecting Rods: Connecting Rods & Bushings	X	X	

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-340B	02-340B	Connecting Rods: Bearing Shells	X	X	
03-341A	02-340C	Pistons	X	X	
03-341B	02-340D	Pistons: Rings	X	X	
03-341C	02-340E	Pistons: Pin Assembly	X	X	
03-345A	02-345A	Tappets & Guides: Intake Tappets Assembly		X	
03-345B	02-345B	Tappets & Guides: Fuel Tappets Assembly		X	
03-345C	02-345C	Tappets & Guides: Fuel Pump Base Assembly			X
0-350A	02-350A	Camshaft: Camshaft Assy.		X	
03-350B	02-350B	Camshaft: Camshaft Bearing	X		
-350C	02-350C	Camshaft: Supports, Bolting & Gears	X	X	
03-355A	02-355A	Idler Gear Assembly: Crank to Pump Gear	X	X	
03-355B	02-355B	Idler Gear Assembly	X	X	
03-355C	02-355C	Idler Gear Assembly: Gaskets & Bolting			X
03-359	02-359	Air Start Valve	X	X	
03-360A	02-360A	Cylinder Head Valves: Cylinder Heads	X	X	
03-360B	02-360B	Cylinder Head Valves: Intake & Exhaust Valves		X	
03-360C	02-360C	Cylinder Head Valves: Bolting & Gaskets			X
03-360D	02-360D	Cylinder Head Valves: Springs & Retainers		X	

CROSSREF MPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-361	02-361	Indicating Cocks			X
03-362A	02-362A	Cylinder Head Covers: Sub Cover Assembly			X
03-362B	02-362B	Cylinder Head Covers: Gaskets & Bolting			X
03-365A	02-365A	Fuel Injection Equipment: Fuel Injection Pump			X
03-365B	02-365B	Fuel Injection Equipment: Fuel Injection Tips			X
03-365C	02-365C	Fuel Injection Equipment: Tube Assembly	X	X	
03-365D	02-365D	Fuel Injection Equipment: Supports		X	
03-371A	02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft			X
03-371B	02-371B	Fuel Pump Linkage: Linkage Assembly & Bearings		X	
03-371C	02-413B	Fuel Pump Linkage: Automatic Shutdown	X		
03-375	02-375	Intake Manifold	X	X	
03-380A	02-380A	Exhaust Manifold	X	X	
03-380B	02-380B	Exhaust Manifold: Gaskets & Bolting		X	
03-385A	02-385A	Cylinder Block Covers			X
03-385B	02-385B	Cylinder Block Covers: Gaskets & Bolts	X	X	
03-387A	02-387A	Crankcase Ventilator: Crankcase Vacuum Fan			X
03-387B	02-387B	Crankcase Ventilator: Crankcase Oil Separator			X
03-387C	02-387C	Crankcase Ventilator: Fittings, Bolting, Supports			X

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-387D	02-387D	Crankcase Ventilator: Crankcase & Fluid Manometer			X
03-390A	02-390A	Rocker Arms & Pushrods: Intake & Intermediate Rocker Shaft Assembly		X	
03-390B	02-390B	Rocker Arms & Pushrods: Exhaust Rocker Shaft Assembly		X	
03-390C	02-390C	Rocker Arms & Pushrods: Pushrods - Intake & Exhaust	X	X	
03-390D	02-390D	Rocker Arms & Pushrods: Pushrods - Connector	X	X	
03-390E	02-390E	Rocker Arms & Pushrods: Bushings			X
03-390F	02-390F	Rocker Arms & Pushrods: Lifters		X	
03-390G	02-390G	Rocker Arms & Pushrods: Bolts, Drive Studs	X	X	
03-402A	02-411A	Governor Drive: Governor & Tachometer Drive Gear & Shaft	X	X	
03-402B	02-411B	Governor Drive: Couplings, Pins & Keys		X	
03-410A	02-410A	Overspeed Trip: Governor		X	
03-410B	02-410B	Overspeed Trip: Governor & Accessory Drive Assembly	X	X	
03-410C	02-410C	Overspeed Trip: Couplings (Flexible & Spider)	X	X	
03-410D	02-410D	Overspeed Trip: Vent Valves	X	X	
03-413	02-413	Governor Linkage		X	
03-415A	02-415A	Governor Assembly: Woodward Governor	X	X	

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-415B	02-415B	Governor Assembly: Booster Servomotor	X		
03-415C	02-415C	Governor Assembly: Heat Exchangers		X	
03-420	02-420	Lube Oil Pumps	X	X	
03-425A	02-425A	Jacket Water Pump	X	X	
03-425B	02-425B	Jacket Water Pump: Cover			X
03-435A	02-717C	Jacket Water Fittings: Pipe & Fittings	X	X	
03-435B	02-717E	Jacket Water Fittings: Supports	X	X	
03-437A	02-437	Turbo Water Piping: Pipe & Fittings	X	X	
03-441A	02-441A	Starting Air Manifold: Piping, Tubing & Fittings	X	X	
03-441B	02-441B	Starting Air Manifold: Valves, Strainers, Filters	X	X	
03-441C	02-441C	Starting Air Manifold: Supports	X	X	
03-442A	02-442A	Starting Air Distributor: Distributor Assembly	X	X	
03-442B	02-442B	Starting Air Distributor: Tubing, Fittings & Gaskets	X	X	
03-445	02-445	Fuel Oil Booster Pump - Pump Assembly	X	X	
03-450B	02-450A	Fuel Oil Header: Piping & Tubing	X	X	
03-450D	02-450B	Fuel Oil Header: Supports	X	X	
03-455A	02-455A	Fuel Oil Filters & Strainers: Filters	X		

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-445B	02-445B	Fuel Oil Filters & Strainers: Strainers			X
03-445C	02-445C	Fuel Oil Filters & Strainers: Mounting Hardware	X	X	
03-465A	02-465A	Lube Oil Liner - External: Tubings, Fittings, Coupling	X	X	
03-465B	02-465B	Lube Oil Liner - External: Supports	X	X	
03-467A	02-467A	Turbocharger - Lube Oil Fitting: Piping	X	X	
03-467B	02-467B	Turbocharger - Lube Oil Fitting: Supports	X	X	
03-475A	02-475A	Turbocharger - Bracket	X	X	
03-475B	02-475B	Turbocharger - Bracket: Air Butterfly Valve Assembly (w/Actuator)	X	X	
03-475D	02-475C	Turbocharger - Bracket: Bolting & Gaskets	X	X	
03-500A	02-500A	Control Panel Assembly: Cabinet/System	X	X	
03-500B	02-500B	Control Panel Assembly: Annunciators			X
03-500C	02-500C	Control Panel Assembly: Circuit Breakers/Contact Blocks			X
03-500D	02-500	Control Panel Assembly: Pressure Gauges			X
03-500E	02-500E	Control Panel Assembly: Hourmeter			X

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-500F	02-500F	Control Panel Assembly: Accumulator	X	X	
03-500G	02-500G	Control Panel Assembly: Valves	X	X	
03-500H	02-500H	Control Panel Assembly: Pressure Switch	X	X	
03-500I	02-500I	Control Panel Assembly: Pyrometers			X
03-500J	02-500J	Control Panel Assembly: Relays	X	X	
03-500K	02-500K	Control Panel Assembly: Solenoid Valve	X	X	
03-500L	02-500L	Control Panel Assembly: Tachometer			X
03-500M	02-500M	Control Panel Assembly: Piping, Tubing, Fittings			X
03-500N	02-500N	Control Panel Assembly: Terminal Board/Switches/ Wiring			X
03-515	02-515	Thermostatic Valve	X	X	
03-520	02-520	Nameplates			X
03-525A	02-525A	Barring Device - Pneumatic: Barring Device Assembly			X
03-525B	02-525B	Barring Device - Pneumatic: Regulator Vavle Shut Off Valve	X	X	
03-525C	02-525C	Barring Device - Pneumatic: Misc, Fittings, Hose, Filters, Tubing			X

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-525D	02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports			X
03-530A	02-530A	Platform - Front & Side: Side Plantform Assembly			
03-530B	02-530B	Platform- Front & Side Front Platform Assembly			X
03-530C	02-530C	Platform - Front & Side Bracing (w/Attachments)			X
03-531A	02-530D	Platform Ladder Front: Platform Assembly			X
03-531B	02-530E	Platform Ladder Front: Bracing			X
03-540A	02-540A	Lube Oil Sump Tank: Tank w/Strainer Assy.		X	
03-540B	02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valve	X	X	
03-540C	02-540C	Lube Oil Sump Tank: Mounting Hardware	X	X	
03-550	02-550	Foundation Bolts - Anchors, Bolts, Misc. Hardware	X	X	
03-590	02-590	Special Tools - Asst. Engine Assembly Tools			X
03-630A	02-630A	Pyrometer Conduit Assembly: Conduit	X	X	
03-630B	02-630B	Pyrometer Conduit Assembly: Conduit Fittings	X	X	
03-630C	02-630C	Pyrometer Conduit Assembly: Supports	X	X	
03-630D	02-630D	Pyrometer Conduit Assembly: Thermocouples			X

CROSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-630E	02-630E	Pyrometer Conduit Assembly: Gaskets			X
03-650A	GG-101A	Generator	X	X	
03-650B	GG-119	Generator: Generator Control	X	X	
03-650C	GG-101B	Generator: Shaft & Bearings	X	X	
03-688A	02-688A	Engine & Aux. Module Wiring Material: Conduit & Fittings	X	X	
03-688B	02-688B	Engine & Aux. Module Wiring Material: Wiring & Terminations	X	X	
03-688C	02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals			X
03-690	02-690	Engine Alarm Sensors - Temperature & Level Switches	X	X	
03-695A	02-695A	Engine Shut Down Equipment: Tubing & Fittings	X	X	
03-695B	02-695B	Engine Shut Down Equipment: Valves, Regulator, Orifices	X	X	
03-695C	02-695C	Engine Shut Down Equipment: Trip Switches	X	X	
03-717A	02-717A	Aux. Sub Base & Oil & Water Piping: Aux. Sub Base	X	X	
03-717B	02-717B	Aux. Sub Base & Oil & Water Piping: Jacket Water - Valves	X	X	

DSSREF COMPONENT NUMBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-717D	02-717C	Aux. Sub Base & Oil & Water Piping: Jacket Water - Pipe, Coupling, Fittings, Orifices & Strainers	X	X	
03-717F	02-717D	Aux. Sub Base & Oil & Water Piping: Jacket Water - Gaskets & Bolting			X
03-717G	02-717E	Aux. Sub Base & Oil & Water Piping: Jacket Water - Supports	X	X	
03-717H	02-717F	Aux. Sub Base & Oil & Water Piping: Lube Oil - Pipe & Fittings	X	X	
03-717I	02-717G	Aux. Sub Base & Oil & Water Piping: Lube Oil - Valves	X	X	
03-717J	02-717H	Aux. Sub Base & Oil & Water Piping: Lube Oil - Gaskets & Bolting			X
03-717K	02-717I	Aux. Sub Base & Oil & Water Piping: Lube Oil - Supports & Mtg. Hardware	X	X	
03-717M	02-717J	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Pipe & Fittings	X	X	
03-717N	02-717K	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Valves	X	X	
03-717O	02-717L	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Gaskets & Bolting			X
03-717P	02-717M	Aux. Sub Base & Oil & Water Piping: Fuel Oil: Supports	X	X	
03-800A	02-810A	Misc. Equipment: Heater, Jacket Water		X	

CROSSREF COMPONENT MBER	MPL COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
03-800B	02-820A	Misc. Equipment: Heater, Lube Oil Sump Tank		X	
03-835B	GG-123	Misc. Equipment: After Cooler			X
04-000	SE-025	Lube Oil Full Pressure Strainer	X	X	
101-103	GG-103	Jacket Water Heat Exchanger	X	X	
101-104	GG-104	Lube Oil Heat Exhanger	X	X	
10-105	GG-117	Exhaust Silencer			X
10-106	02-820B	Full Flow Lube Oil Filter	X	X	
10-107	GG-107	Jacket Water Standby Heater Pump	X	X	
10-108	GG-105	Fuel Oil Booster Pump			X
J-109	GG-111	Flex Connections	X	X	
10-111	GG-112	Starting Air Tank	X	X	
10-112	GG-113/14	Starting Air Compressor			X
10-113	GG-109	Before - After Lube Oil Pump	X	X	
10-114	GG-118	Intake Air Filter	X	X	
10-115	GG-137	DC Magnetic Starter			X
10-116	GG-115	Air Dryer			X
10-117	GG-121	Oil Prelube Filter	X	X	
99-621A	00-621A	Fuel Oil Drip Tank Assy	X	X	
99-621B	00-621B	Fuel Oil Drip Tank Assy Misc. Hardware Gasket Switch			X

SSREF PONENT MBER	MPI COMPONENT NUMBER	COMPONENT DESCRIPTION	DESIGN REVIEW REQUIRED	QUALITY REVIEW REQUIRED	NO REVIEW REQUESTED
99-311A	02-311A	Crankcase Crankcase Assy	X	X	
99-311B	02-311C	Crankcase Crankcase Seal			X
99-311C	02-311D	Crankcase Crankcase Mtg. Hardware	X	X	
99-316B	02-316B	JKT Water Inlet Man. Coupling Gasket	X	X	
99-316A	02-316A	JKT Water Inlet Man Water Inlet Adapter & Mounting Hardware	X	X	
99-386B	02-386B	Crankcase Covers Crankcase Gaskets & Mounting Hardware	X	X	
-465A	02-465C	Lube Oil Liner External Valves	X	X	
99-503	02-503	Thermometer			X
99-691A	02-691	Off Eng. Sys Alarms Sensors Level & Pressure Switches	X	X	
99-436A	02-717N	Intercooler Piping:Pipe	X	X	
99-436B	02-717P	Intercooler Piping Coupling,Gasket,Bolting	X	X	
99-810	GG-106	J.W. Heater Pump	X	X	
99-820A	GG-108	Aux. L.O. Pump		X	
99-825C	GG-132	Fuel Oil Sys. Fuel Oil Drip Return Pump			X

V. CONCLUSIONS

The TDI Owners Group Program has been designed to reestablish confidence in the TDI Diesel Generators in Nuclear Service through a comprehensive review of the engines' design, a quality review coupled with extensive component inspections, and significantly increased testing requirements. High priority items are being addressed at the front end of the program in order to provide an early indication of the adequacy of the TDI engines. For example, the evaluations of crankshafts, pistons and bearings are all well along and final reports on these issues are expected in March. The completion of the overall Design Review and Quality Revalidation (DR/QR) for each utility will provide added assurance on a confirmatory basis that the engines will perform reliably in the long term.

In order to expedite resolution of certain issues, the Owners Group may focus initially on demonstrating that certain components will have a sufficient (though perhaps not unlimited) service life to permit plant licensing and plant operation for several years. In cases where this approach is used, the Group will recommend component replacement or further analysis or testing to go beyond the specified operating period. Also, more frequent maintenance or inspection intervals may be specified in appropriate cases. Finally, in those areas where the Owners Group Technical Staff

believes that modifications to the TDI engines may provide increased reliability, recommendations will be made to the individual utilities to implement any proposed changes.

As noted above, final conclusions cannot be drawn at this time with regard to the reliability of the TDI diesel engines currently in nuclear service. However, based on the considerable amount of analytical and testing work already performed, along with a review of the extensive operating history data base which has been compiled by the Owners Group, a number of preliminary statements can be made:

1. The most significant TDI engine component failure in nuclear service remains the Shoreham crank shaft failure. We believe this failure to be unique to Shoreham because the original 13"x11" Shoreham crankshaft was not used anywhere else. Analytical work done to date, coupled with inspections of the Grand Gulf crankshaft, led the Group to conclude that the Shoreham 13"x12" replacement crankshaft and all of the other TDI crankshafts in nuclear service are adequate.

2. The connecting rod bearing failures observed on the Shoreham engines are the result of a connecting rod and connecting rod bearing design associated with the 13"x11" crankshaft originally used at Shoreham. While additional bearing inspections and additional analytical work are underway, the Group's preliminary conclusion is that the

replacement connecting rod bearings at Shoreham and the balance of the connecting rod bearings in TDI engines in nuclear service will be shown to be adequate.

3. Cracks in AF type pistons appear to be generic to the piston type and are therefore potentially applicable to all TDI engines having this type of piston skirt. Analytical and experimental work on the AE type pistons (now installed in Shoreham and Grand Gulf, and planned to be installed in Comanche Peak) show that these pistons should be adequate to perform their intended function. Inspections of pistons from three separate engines (Shoreham, Kodiak, Alaska, and TDI's developement engine, all showed no indications after significant service periods including 6000 hours in the Kodiak engine. The AN piston type, which is common to a large number of the Owners Group plants, is currently being evaluated.

4. The significant data assembled by the Owners Group indicates that the other problems identified on TDI diesel engines are not atypical of the problems identified by other diesel generator manufacturers in nuclear and nonnuclear service. We cannot comment, however, on the relative number of the events on TDI engines vs. the events on other manufacturers engines since our data base is necessarily focused on TDI engines.

Another facet of the Owners Group Program has been to investigate the testing programs for emergency diesel generators and several important preliminary conclusions have been reached by the group, with particular input from the diesel generator specialists involved in the program. Specifically, the conclusions are:

1. The preoperational testing requirements with regard to numerous fast start tests and high load runs are much more severe than the diesel generators would actually see even in the unlikely event of an accident.
2. Fast start and fast loading tests are detrimental to long term engine reliability and should be minimized. While an engine should be able to demonstrate its fast start capability (since it would have to do this during an accident), the severe thermal and pressure transients experienced by the engines during these fast starts mitigate strongly towards reducing the number of tests of this attribute to a minimum.
3. Subjecting a nuclear standby diesel generator to high load runs (including overload running) for significant amounts of time also results in a potential reduction in the long term reliability of the engines. The situation is analogous to the fast starting testing requirements because the actual requirements of emergency diesel generators (in the unlikely event of an accident), are significantly below the testing requirements they must meet. It is worthy of note that in other critical

portions of nuclear power plants, this testing relationship is clearly addressed. With respect to the reactor pressure vessel, for example, only the initial Cold Hydro is done at a pressure above the design point. All subsequent hydros are done at the operating point thereby insuring that the "life" of the vessel is maximized.

The Owners Group plans to make specific recommendations to the NRC in these, and possibly other areas at the conclusion of the program in late 1984.

The Owners Group has concluded that, subject to successful completion of this program, and the implementation of any program recommendations required to insure the adequacy of the diesel generators, this program will provide reasonable assurance that the TDI Diesel Generators in nuclear service will perform their intended safety functions reliably and that the health and safety of the public in this regard will be assured.

T D I
D I E S E L G E N E R A T O R S
O W N E R S ' G R O U P
P R O G R A M P L A N

A P P E N D I C E S

DG

APPENDICES

1. OWNERS GROUP CHARTER
2. ORGANIZATION CHART
3. QUALITY ASSURANCE PROGRAM
4. DR/QR PROCEDURES
5. PHASE I GENERIC PROBLEM LIST
6. GENERIC PROBLEM TASK DESCRIPTIONS
7. COMPONENT DATA BASE
8. SCHEDULES

DG

Appendix 1

CHARTER FOR

NUCLEAR PLANT TDI DIESEL GENERATOR OWNERS GROUP

The Nuclear Plant-TDI Diesel Generator Owners Group has been established by representatives from utilities which own nuclear power plants that are operating or are under Construction. Any U.S. utility who owns a nuclear power plant and owns Transamerica Delaval, Inc., manufactured and supplied diesel/generators may be a member ("Member") and have representation on the TDI Diesel Generator Owners Group Executive Committee.

BY LAWS

OF THE NUCLEAR PLANT DIESEL GENERATOR COMMITTEE

ARTICLE I.

PURPOSE AND OBJECTIVE

The purpose and objectives of the TDI Diesel Generator Owners Group and Executive Committee are: (1) to provide utilities with a forum for exchanging technical information relative to TDI Diesel Generator experience in nuclear plant applications, e.g., (a) provide overviews of industry experience, (b) identify specific problem area, and (c) investigate ways to improve D/G subsystem reliability; (2) to formulate plans to correct unacceptable diesel/generator (D/G) deficiencies; (3) to establish a coordinated approach toward addressing generic D/G reliability issues; and (4)

to provide feedback information to D/G users, vendors and A/E's on design, operations and maintenance problems; (5) to prepare recommendations to the Member Executives for bringing nuclear plant D/G systems to an acceptable level of performance; and (6) to review regulatory issuances and to establish bases for providing appropriate generic responses.

ARTICLE II.

MEMBERSHIP

All U.S. utilities which own a Nuclear Electric Generating plant or are prospective owners of a Nuclear Electric Generating Plant and who own or operate TDI diesel generators, whether operating or under construction, are invited to become members of the D/G committee.

This Charter gives the Committee authority to levy a fee or general assessment against members and to incur expenses on behalf of the D/G Committee and members. Any plan by the D/G Committee to assess its members will require approval by each utility so assessed.

Each utility member shall designate an Executive and Alternate representative to the D/G Committee. Both the decision by a utility to be a member of the D/G Committee and the selection of the voting representative shall be approved by a corporate officer of the Member. Written notification to the Owners Group Chairman

by a Member corporate officer will be considered authoritative in all matters dealing with membership.

The D/G Committee may elect to authorize the attendance of other industry members, such as AIF, ANS, EEI, EPRI, INPO or the NSSS Owners Group. The D/G Committee may authorize presentations from other individuals or organizations.

ARTICLE III.

EXECUTIVE CHAIR COMMITTEE

An Executive Chair Committee having three (3) members (Chairman, Vice-Chairman, Alternate Vice Chairman), shall be elected by the membership and shall serve for the duration of the D/G Committee's existence. Any vacancy in the Chair Committee shall be filled by election, at the next meeting of the D/G Committee. The Chair Committee shall be empowered to act for the members when, because of urgency, it is impractical to assemble a majority of the members and shall have such additional powers and responsibilities as are granted by the Committee members. The Chair Committee may in the course of its duties:

1. Appoint persons to serve on standing committees.
2. Establish special committees.
3. Approve admission of new members.

ARTICLE IV.

MEMBER EXECUTIVES

Each Member (utility) will designate a corporate officer (Member Executive) who will have final Member authority relative to the affairs of the D/G Committee. The names of the Member Executives and Alternates will be provided to the D/G Committee.

A Member Executive may delegate such authority as he deems appropriate to others in the Member organization.

There will be no other formal organization to encompass the activities of the Member Executives. The purpose of having the Member Executives identified is to provide a point of contact with the Member for matters of the greatest importance that should receive executive attention.

ARTICLE V

FUNDING

The D/G Committee shall have the authority to levy financial charges on the Members upon approval of each utility. The D/G Committee can also act as a forum in which the Members can join together, on an individual voluntary basis, to undertake whatever efforts are agreed upon. In such an arrangement, the contractor providing the service will directly bill the participating Members in the percentages they have agreed upon.

ARTICLE VI.

VOTING

On each voting issue, each U.S. utility represented in the meeting in which the vote is taken shall have one vote. Proxy and absentee voting is not allowed.

A motion shall be considered to be adopted when the motion has been approved by the majority of the members voting at the meeting in which the motion is voted on.

The chairman may elect to conduct a vote by mail. The vote is affirmative upon receipt of positive votes by one-half or more of the members.

ARTICLE VII.

MEETINGS

Meetings of the D/G Committee shall be scheduled by the Chairman of the Executive Committee as required to advance the work of the D/G Owners Group.

The Members will share in the cost of holding meetings by taking turns in providing the funds needed to pay for meeting facilities, meeting supplies, and special disbursements reasonably incurred in the normal conduct and affairs of the Committee. When possible, meetings may be held at utility-owned facilities.

ARTICLE VIII.

REGULATORY LIAISON

Neither the D/G Committee nor its officers is empowered to speak with the Nuclear Regulatory Commission for any individual member or the Owners Group or commit such member or the Group to any action without the member's or Group's specific consent.

ARTICLE IX.

AMENDMENT OF BY LAWS

These by laws, with the exception of ARTICLES II and V, may be amended by a majority of the total voting membership. Any changes in ARTICLES II and V will require a revision to this charter. Proposed amendments to the by laws shall be mailed to the members at least thirty (30) days prior to the date on which balloting is scheduled to take place.

FIGURE 1

TDI DIESEL GENERATOR OWNERS GROUP

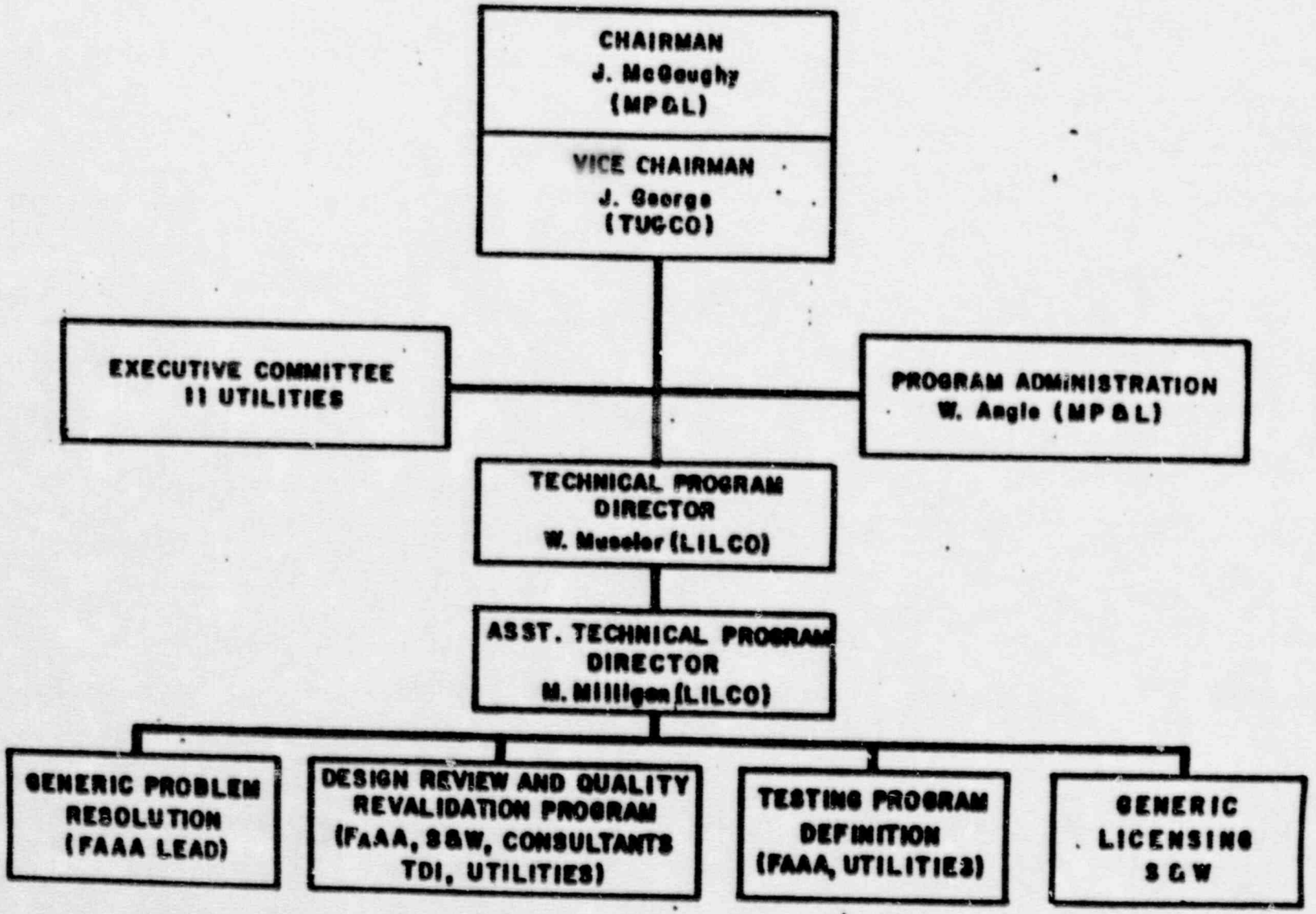
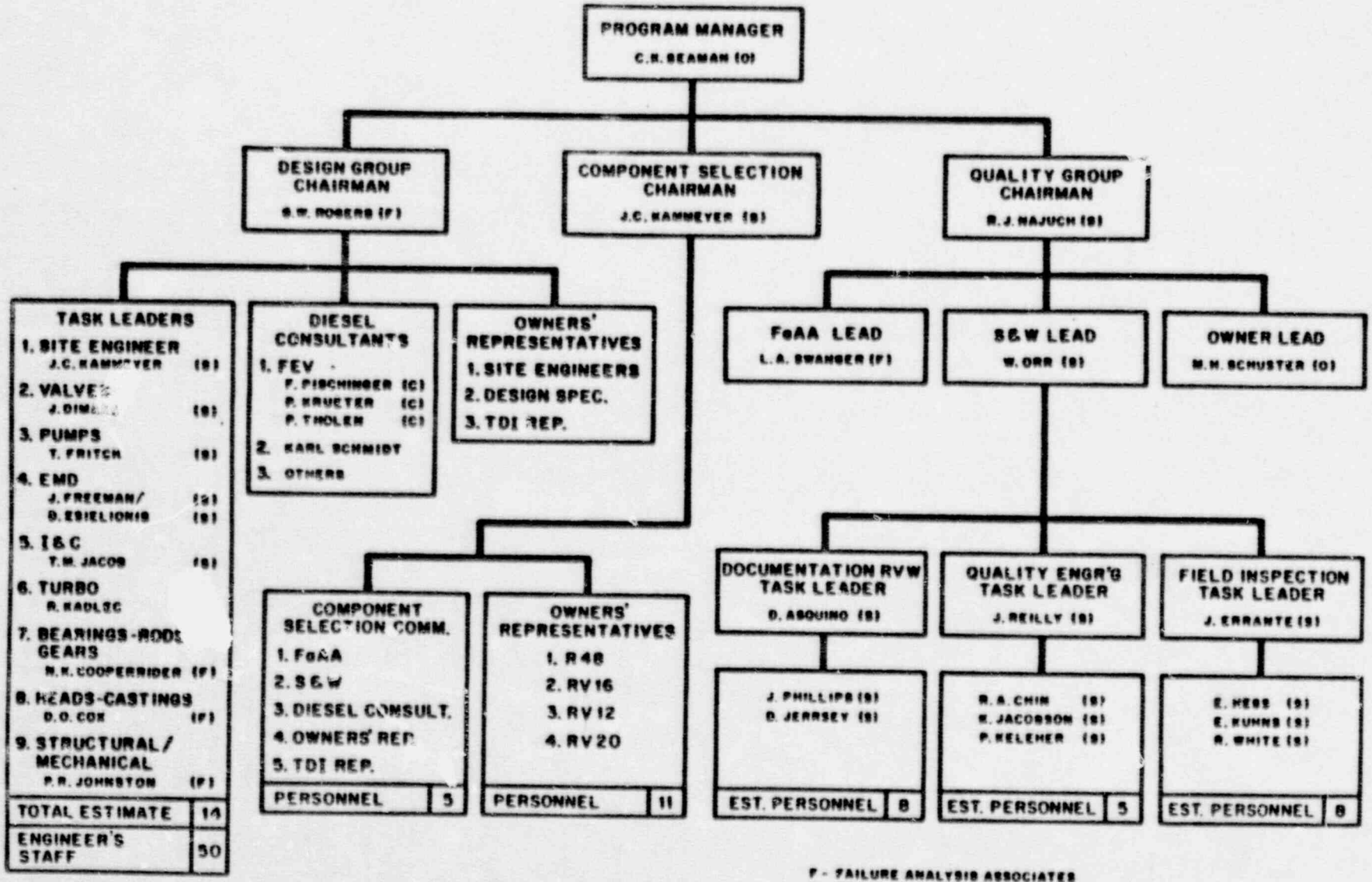


FIGURE 2

D.G. DESIGN REVIEW QUALITY REVALIDATION PROGRAM



120 - TOTAL PERSONNEL

F - FAILURE ANALYSIS ASSOCIATES
S - STONE & WEBSTER
O - OWNER REPRESENTATIVE
C - CONSULTANTS

Appendix 3

QUALITY ASSURANCE PROGRAM

Activities being performed in the TDI Diesel Generator Owners Group Design Review & Quality Revalidation Program (DR/QR) must meet the appropriate requirements. Appropriate elements of the Quality Assurance Program applied to each activity will assure compliance with the applicable portions of 10CFR50, Appendix B. In order to assure full compliance with program requirements, the following approach is being taken.

LILCO's Quality Assurance Department is providing the overall QA Program for the (DR/QR). A LILCO Quality Assurance Plan (QAP) has been developed to identify applicable portions of the program which apply to this effort and to define areas of responsibility for all other QA organizations. This QAP identifies procedures to be followed for implementation of the Quality Assurance Program.

As the DR/QR organization is presently centralized at the Shoreham site, LILCO will retain overall audit responsibility for the Program. This audit responsibility will be supplemented by other Quality Assurance Organizations (SWEC, FaAA, Owners, etc.) as appropriate. This program will verify implementation of all appropriate procedures including, but not limited to DG-1, DG-2, DG-3, and DG-4; Project Procedures; referenced LILCO QA Procedures; and other Owner Procedures as appropriate.

A Stone & Webster Quality Assurance Plan has been developed for those DR/QR efforts which are being conducted by SWEC. All SWEC activities shall be in accordance with the SWEC Project QA Manual, Field Quality Control Manual, Engineering Assurance Manual, and others as referenced by the QA Plan. Specific procedures have been identified for the Quality Revalidation portion of the DR/QR which include document review, quality engineering, inspection functions and engineering support activities. Special Process Inspection activities such as nondestructive testing are governed by SWEC procedures or procedures supplied by each owner under his own Quality Assurance Program.

FaAA has provided a QA Plan for their scope of work and the implementation of quality procedures for FaAA's activities will be verified by audit. These activities will be audited under the LILCO Program. Stone & Webster engineering functions in support of the design review will be controlled by SWEC Engineering Assurance Procedures (EAP) in accordance with the SWEC QA Plan and will be audited by SWEC Engineering Assurance.

The development and implementation of operational Tests and Inspections will be in accordance with the Stone & Webster Quality Assurance Program or, at the respective Owner's option, his own QA Program. LILCO will retain audit responsibility on behalf of the Owner's Group and other owner Qa organizations may participate in these audits.

A typical QA document precedence chart for the DR/QR is attached.

DR/QR QA Document Precedence Chart

I.	LILCO Quality Assurance Program Manual
II.	DG-1, DG-2, DG-3, DG-4 LILCO QA Procedures Project unique
III.	SWEC Quality Assurance Pr ram Manual FAA Quality Plan
IV.	SWEC FQC Manual SWEC EA Procedures SWEC or Owner Inspection Procedures FAA Procedures
V.	Project Unique Implementation Procedures

DIESEL GENERATOR DESIGN REVIEW

AND QUALITY REVALIDATION

PROGRAM DESCRIPTION

DG - 1

Component Selection Chairperson _____ Date_____

Quality Group Chairperson _____ Date_____

Design Group Chairperson _____ Date_____

Program Manager _____ Date_____

1.0 Purpose

This document establishes the administrative guidelines for the Diesel Generator Design Review and Quality Revalidation Program.

2.0 Scope

The scope of the Design Review and Quality Revalidation Program is to identify important components of the Transamerica DeLaval (TDI) Diesel Generator and assure that these components are properly designed and fabricated. To accomplish this objective, selected components will be subjected to a detailed design and/or quality revalidation review as specified by the Component Selection Group. Any deficiencies identified by the program will be evaluated and/or corrected as appropriate. This program provides assurance that the TDI Diesel Generators will perform their intended function.

3.0 Instructions

The Program Manager shall have overall responsibility for this program. Chairpersons for the Component Selection, Component Design Review and Quality Revalidation Groups shall report to him. An overall organization chart identifying responsible personnel and their function is shown in Figure 1-1.

The organization and instructions for performing this review are discussed below.

3.1 Component Selection

The base document for component selection shall be the TDI Parts Manual of each utility/owner. A comprehensive Component Data Base (CDB) of parts will be generated for each plant. This CDB will contain TDI group parts list numbers and parts descriptions.

A separate CDB shall be prepared for each plant. A matrix will be prepared to identify common parts. Any part not included in the Shoreham CDB will be assigned a Shoreham "dummy" part number for tracking purposes.

3.1.1 The Shoreham specific Component Selection Group shall consist of eight (8) members, representing the following organizations; Long Island Lighting Company (LILCO), Stone & Webster (SWEC), and Failure Analysis Associates (FaAA). Titles of the Group members are listed below.

- Program Manager
- SWEC Lead
- FaAA Lead
- LILCO QA
- Diesel Generator Specialist
- LILCO Engineering Specialist

- SWEC Site Engineer
- SWEC Specialists

The Component Selection Group for other utilities will contain the following:

- SWEC Lead
- TDI Representative
- Diesel Generator specialist
- FaAA Lead
- Owner's Representative
- Component Selectic.. chairperson.

3.1.2 Generally, component selection shall be by consensus of the Selection Group. However, if the need arises, the selection or classification of a component to be included in the design review/quality revalidation program shall be by a majority vote. Each organization represented in the Selection Group shall have one vote as follows.

- Owner Rep as applicable
- SWEC
- FaAA
- Diesel Generator Specialist

The Program Manager or, in the case of utilities other than LILCO, the Component Selection Chairperson shall have the deciding vote in order to effect the consensus.

Component selection for utilities other than LILCO will be based on the LILCO selection or classification. The utility specific Component Selection Group shall review the Shoreham selection for applicability to the plant specific diesels.

3.1.3 A Quorum is required when any selection or classification decisions are to be made. A Quorum exists when at least three of the groups listed in section 3.1.2 are represented if the Owner Rep. is one of the three.

3.1.4 In addition to classification and selection for review responsibilities, the Component Selection Group shall provide minimum review requirements for the Design Review and Quality Revalidation Groups. These groups shall develop Task Descriptions from these requirements in accordance with the Design Review and Quality Revalidation Procedure Requirements.

3.1.5 Detailed instructions on the selection of components are delineated in the "Diesel Generator Design and Quality Revalidation Component Selection Procedure".

3.2 Component Design Review

An outline of the design review to be performed on individual components will be provided by the Component Selection Group. Applicable Codes and Standards shall be identified for the design review by the Component Selection

Group wherever possible. The detailed design review plans will be developed and implemented by the Component Design Review Group.

3.2.1 The Component Design Review Group will be chaired by the FaAA Lead. He will be assisted by the appropriate engineering and design personnel, including, but not limited to:

- o LILCO Engineering Specialist
- o SWEC Site Engineer
- o Diesel Generator Specialist
- o Other Owner's Rep, as applicable.

3.2.2 Detailed Instructions on the Component Design Review are contained in the "Diesel Generator Component Design Review Procedure".

3.3 Component Quality Revalidation

The quality attributes to be reviewed in the quality revalidation program will be outlined by the Component Selection Group or the Component Design Review Group. The development of detailed plans for quality revalidation of individual components and plan implementation is the responsibility of the Component Quality Revalidation Group.

3.3.1 The Component Quality Revalidation Group will be chaired by the SWEC Lead. He will be assisted by appropriate quality and engineering personnel, including, but not limited to:

- o Owners' QA Representative, as applicable
- o SWEC
- o FaAA

3.3.2 Detailed Instructions on the Component Quality Revalidation Review are delineated in the "Diesel Generator Component Quality Revalidation Procedure"

4.0 Final Report

Upon completion of the review for each utility, a final report will be issued. It will contain as a minimum, the following information:

- o Executive Summary
- o Program Description
- o Methodology for selecting components
- o Summary list of components and classification
- o Methodology for Component Design Review
- o Results of the Component Design Review
- o Methodology for Component Quality Revalidation
- o Results of Component Quality Revalidation
- o Tabulation and discussion on any deviations that were found
- o Corrective actions and recommendations

As each additional utility in the Owner's Group completes it's review, a separate report will be issued, containing the above information and documenting utility specific or unique information.

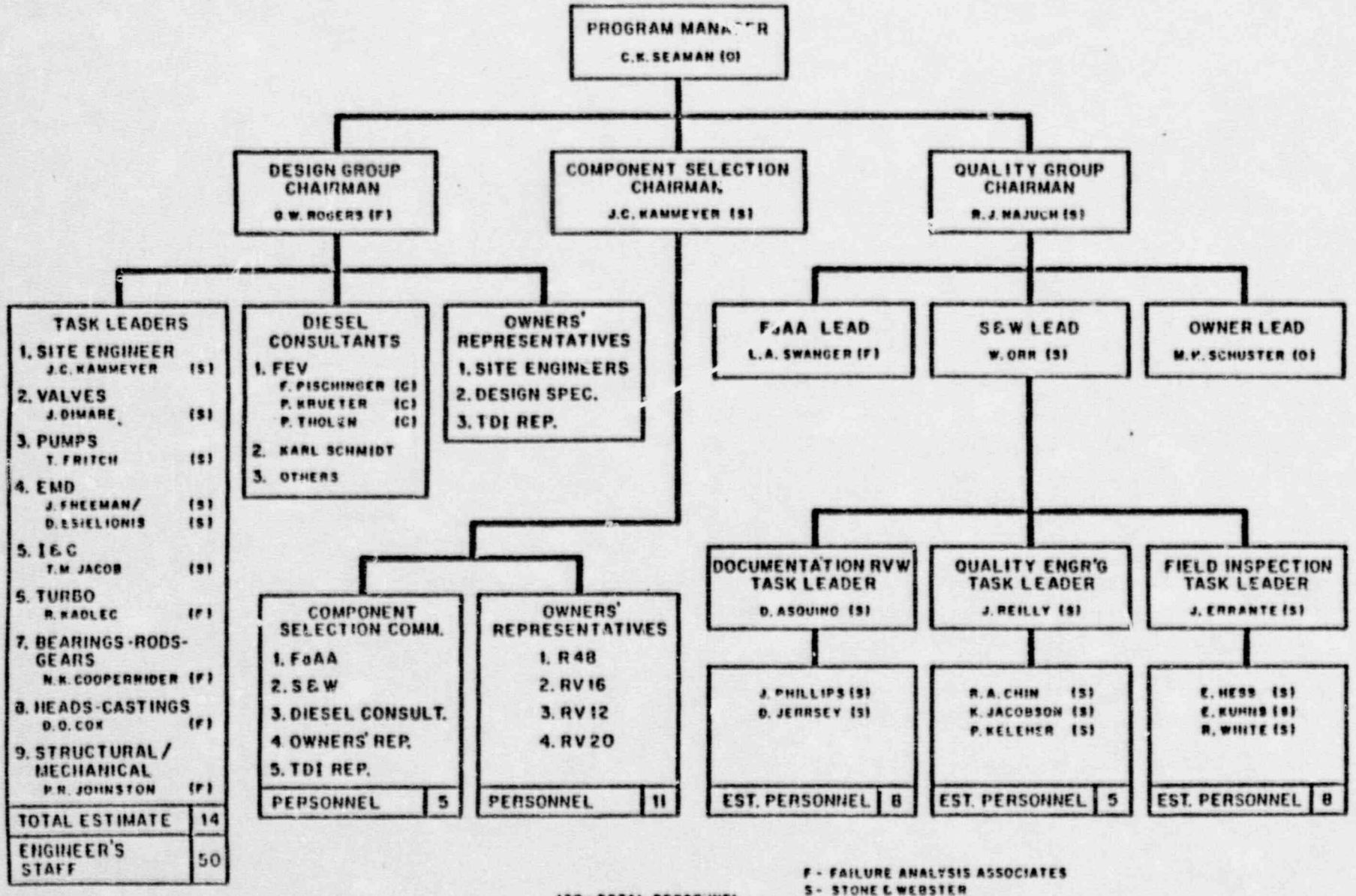
5.0 References

5.1 Diesel Generator Component Selection Procedure

5.2 Diesel Generator Component Design Review Procedure

5.3 Diesel Generator Component Quality Revalidation Procedure

D.G. DESIGN REVIEW QUALITY REVALIDATION PROGRAM



120 - TOTAL PERSONNEL

F - FAILURE ANALYSIS ASSOCIATES
S - STONE & WEBSTER
O - OWNER REPRESENTATIVE
C - CONSULTANTS

DIESEL GENERATOR COMPONENT

SELECTION PROCEDURE

DG - 2

Component Selection Chairperson _____ Date_____

Quality Group Chairperson _____ Date_____

Design Group Chairperson _____ Date_____

Program Manager _____ Date_____

1.0 Purpose

This procedure provides the methodology for the classification of diesel generator components and the selection process for the components which will be subjected to design review and quality revalidation.

2.0 Scope

The scope of this procedure is to identify the procedural requirements for each of the five steps involved in selecting and documenting the components to be included in the design review and quality revalidation:

- Generation of Component Data Base (CDB)
- Classification of components
- Determination of components operating experience (Site Specific and Industry wide).
- Selection of components
- Completion of input to the CDB using the computer data sheet

3.0 Instructions

The methodology and guidelines for selecting diesel generator components for design review and quality revalidation are provided below.

It is important to note that steps may be performed simultaneously on the various components. For example, the classification and experience data gathering may proceed simultaneously.

3.1 Component Data Base Generation

3.1.1 The Component Data Base (CDB) is a computer summary listing of the selected diesel generator components. This listing is generated by using the "TDI Parts Manual", which is the base document for the Diesel Generator Design Review and Quality Revalidation Program.

3.1.2 A separate CDB is developed for each utility in the Owners' Group, using the Shoreham CDB and the plant-specific "TDI Parts Manual" as the basis. The CDB for each plant is updated to reflect site specific differences including the substitution of specific site experiences for Shoreham's site experience, and to include the input of site attribute sheets.

3.2 Component Classification

3.2.1 Components are classified either type A, B or C. These classifications are based on the effect of the component's failure on the diesel generator performance. The definitions of these classifications are as follows:

Type A Component - A component, based on the judgement and experience of the Component Selection Group, whose failure would result in immediate diesel generator shutdown or prevent startup under emergency conditions.

Type B Component - A component, based on the judgement and experience of the Component Selection Group, whose failure would result in reduced capacity of the diesel generator or the eventual failure of a Type A component if not detected.

Type C Component - A component, based on the judgement and experience of the Component Selection Group, whose failure has little bearing on the effective use or operation of the diesel generator.

3.2.2 In most instances, the classification for each plants' components shall be based on corresponding Shoreham parts if applicable to other engine types. If no corresponding Shoreham part exists, a classification shall be assigned based on the definitions in 3.2.1.

3.2.3 Record classification type on Selection Committee Component Input Data Sheet (see Appendix 5.1 of this procedure).

3.3 Component Experience

The experience of the specific components or similar type components is gathered and reviewed by the Component Selection Group. This review will be divided into four

sections: Shoreham specific experience, Nuclear Industry experience, Non-Nuclear Industry experience and other utility site specific experience. This data will be used to aid in the decision making process to determine if a design review or quality revalidation is required.

3.3.1 Shoreham Specific Experience

Shoreham specific experience for components shall be gathered and input into the Component Data Base to assist the Component Selection Group in its review. Sources of information include but are not limited to:

Engineering & Design Change Request (E&DCRs)
Repair/Rework Requests (RRRs)
LILCO Deficiency Reports (LDRs)
Diesel Generator Disassembly Inspection Results (DGDIRs)
Non-Conformance & Disposition Reports (N&Ds)

A summary of each "experience" is provided and appropriate references are recorded on the Shoreham-Based Component Event Data Sheet (see Appendix 5.2 of this procedure).

3.3.2 Nuclear Industry Experience

The industry experience of each component (grouped by TDI and other manufacturers) shall be gathered and entered into the Component Data Base to assist the Component Selection Group in its review . Sources of information include but are not limited to:

Licensee Events Reports (LERs)
Significant Event Reports (SERs)
INPO Significant Operating Event Reports (SOERs)
10CFR50.55(e) reports
10CFR21 reports
Nuclear Plant Reliability Data System (NPRDS)
EPRI reports
I&E bulletins, notices, circulars
TDI Service Information Memos (SIMs)

A summary of each experience is provided and appropriate references are recorded on the Industry-Based Component Event Data sheet (see Appendix 5.3 of this procedure).

3.3.3 Non-Nuclear Industry Experience

The non-nuclear industry experience (eg., marine and/or stationary experience) of the component is gathered and entered into the Component Data Base to assist the

Component Selection Group in its review. This information shall be limited to engines manufactured by TDI. Sources of information shall include, but are not limited to:

TDI Stationary/Marine Engine Experience
Correspondence between TDI and purchasers
Ships Logs
Engine Inspection Reports

A summary of each experience and the appropriate references is provided on the Non-Nuclear Based Component Event Input Data Sheet (see Appendix 5.5 attached).

3.3.4 Other Utility Site Specific Experience

Each utility in the Owners' Group shall gather site specific experience for components. This is entered into the Component Data Base to assist the Component Selection Group in its review.

Sources of information include, but are not limited to:

Design Change Documents
Repair/Rework Documentation
Deficiency Reports
Inspection Reports
Maintenance Logs

A summary of each experience is provided and appropriate references are recorded on the site specific component event data sheet, which is similar to Appendix 5.2.

3.4 Component Selection

The Component Selection Group shall select the components to be subjected to a design review and/or quality revalidation. Selection shall be based on component criticality and past Shoreham, industry, or other site experience as inputted into the Component Data Base, and the engineering judgement and experience of the Component Selection Group. Absense of adverse experience does not necessarily exclude a component from review. The following shall be used as a guideline for selection:

Type A Components - Design Review and/or Quality Revalidation normally required

Type B Components - Component Selection Group determines if Design Review and/or Quality Revalidation is required.

Type C Components - Design Review and Quality Revalidation not required

The results of this review and any comments are recorded on the Selection Committee Component Input Data Sheet (see Appendix 5.1 of this procedure).

3.5 Components Selected for Design Review

Once a component is selected for design review, the Component Selection Group provides minimum review requirements. These requirements shall then be used by the Component Design Review Group to generate a task description.

The task description shall detail the methodology to be used for the design review. It shall be approved by the Design Review Group Chairperson and the Program Manager. Any unique problems encountered by the Design Review Group during the implementation of the design review shall be documented with recommendations (including recommendations to perform a quality revalidation) on a Component Task Evaluation Report (see Appendix 5.4 of this procedure) and returned to the Program Manager through the Design Review Group Chairperson for disposition.

3.6 Components Selected for Quality Revalidation

Once a component is selected for quality revalidation, the Component Selection Group shall provide minimum revalidation requirements (ref. Appendix 5.1). These requirements are used by the Component Quality Revalidation Group to generate a task description.

The task description shall detail the methodology to be used for the quality revalidation. It shall be approved by the Quality Review Group Chairperson and the Program Manager. Any unique problems encountered by the Quality Revalidation Group shall be documented with recommendations on a Component Task Evaluation Report (see Appendix 5.4 of this procedure) and returned to the Program Manager through the Quality Revalidation Group Chairperson for disposition.

4.0 References

4.1 Diesel Generator Design and Quality Revalidation Program

4.2 Transamerica Delaval Parts Manual

5.0 Appendices

5.1 Selection Committee Component Input Data Sheet

5.2 Shoreham-based Component Event Data Sheet

5.3 Industry-based Component Event Data Sheet

5.4 Component Task Evaluation Report (TER)

5.5 Non-Nuclear Based Component Event Data Input Sheet

Appendix 5.1

STATUS DATE XX/XX/XX

COMPONENT NO. XX-XXX-X

INPUT BY (NAME/INITIALS)

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

(PLANT NAME)

SELECTION COMMITTEE COMPONENT INPUT DATA SHEET

COMPONENT DESCRIPTION:

COMPONENT CLASSIFICATION:

SWEC MARK NO. (IF APPLICABLE):

TDI PART NO. (IF APPLICABLE):

SELECTION COMMITTEE DISPOSITION

DESIGN REVIEW	QUALITY REVALIDATION	DESIGN AND QUALITY REVIEW	NO REVIEW
☐	☐	☐	☐

RECOMMENDED DESIGN REVIEW ATTRIBUTES:

1. ...
2. ...
3. ...

:

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:

1. ...
2. ...
3. ...

:

APPENDIX 5.2

STATUS DATE XX/XX/XX PAGE NO. XXX

COMPONENT NO. XX-XXX-X

INPUT BY (NAME/INITIALS)

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

(PLANT NAME)

(PLANT NAME) COMPONENT EVENT DATA SHEET

(PLANT NAME) SPECIFIC EXPERIENCE

DESCRIPTION: (MAXIMUM TEXT LENGTH 96 CHARACTERS X 5 LINES)

SOURCE NOS.

___E&DCR
___RRR
___LDR
___DGDIR
___N&D

(MAXIMUM FIELD LENGTH 41 CHARACTERS/LINE)

SPECIFIC PLANT DOCUMENT ACRONYM

___OTHER

Repeat format until all event descriptions are completed

STATUS DATE XX/XX/XX

COMPONENT NO. XX-XXX-X

INPUT BY (NAME/INITIALS)

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM
SHOREHAM NUCLEAR POWER STATION - UNIT NO. 1

INDUSTRY-BASED COMPONENT EVENT DATA SYSTEM

INDUSTRY EXPERIENCE

DESCRIPTION: (MAXIMUM TEXT LENGTH 96 CHARACTERS X 5 LINES)

SOURCE NOS.

___LER (MAXIMUM FIELD LENGTH 41 CHARACTERS/LINE)

___SER

___SOER

___10CFR50.55e

___10CFR21

___NPRDS

___NUREG

___EPRI

___I&E

___NOMIS

___TDI

___OTHER

:
:

Repeat format until all event descriptions are completed

APPENDIX 5.4

TER # _____

COMPONENT TASK EVALUATION REPORT

SYSTEM/COMPONENT NO.	TDI PART NO.	INITIATOR SIGNATURE	DATE	ORGANIZATION ☐ ENGINEERING ☐ QUALITY

CONDITION DETAILS:

RECOMMENDATIONS:

REQUIRED COMPLETION DATE:

ASSIGNMENT

DISPOSITION ASSIGNED TO ☐ ENGINEERING ☐ QUALITY	RESPONSIBLE CHAIRPERSON SIGNATURE	DATE

DISPOSITION

DISPOSITION DETAILS:

IMPLEMENTATION ASSIGNED TO ☐ ENGINEERING ☐ QUALITY ☐ NONE REQUIRED

SUPPLIED BY	DATE	REVIEWED BY RESP. CHAIRPERSON	DATE	APPROVED BY PROGRAM MANAGER	DATE

ACTION

ACTION ASSIGNED TO	ACTION COMPLETED BY	DATE

CC: CKS/GWR/RJN/EPM
TER LOG

APPENDIX 5.5

STATUS DATE: _____ Page No. _____

COMPONENT NO. _____

INPUT BY (NAME/INITIALS) _____

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

(PLANT NAME)

NON-NUCLEAR-BASED COMPONENT EVENT DATA SYSTEM

INDUSTRY EXPERIENCE
DESCRIPTION: _____

SOURCE: NOS.

_____ Other _____

DIESEL GENERATOR COMPONENT

DESIGN REVIEW PROCEDURE

DG-3

Component Selection Chairperson _____ Date_____

Quality Group Chairperson _____ Date_____

Design Group Chairperson _____ Date_____

Program Manager _____ Date_____

1.0 PURPOSE

This procedure provides the methodology for performing a design review for the components that have been selected by the component selection process.

2.0 SCOPE

This procedure provides direction for the design review of those components selected for review by the Component Selection Group. The Design Review Group will be chaired by the FaAA Lead. He will be assisted by appropriate engineering and design personnel, including, but not limited to:

- Utility (as appropriate) Engineering Specialist
- SWEC Site Engineer
- Diesel Generator Specialist
- Other Owners' Rep, as applicable

The Component Selection Group determines minimum design review requirements requiring design analysis and may also specify an appropriate mechanism for performing this analysis.

3.0 INSTRUCTIONS

These instructions provide guidance on the steps which may be used in the design review of a component. Due to the number and diversity of the components and standards involved, the design review must be tailored to each component, and the group must utilize its experience and professional judgement as necessary. Steps may be deleted, or added at the discretion of the Design Review Group Chairperson and the Program Manager.

The Design Review Group shall prepare a task description for each component selected. A Task Leader shall be assigned to each component. A task description shall be generated by the Task Leader for each component and approved by the Design Review Group Chairperson and the Program Manager.

If questions arise that cannot be resolved by the personnel conducting the design review, they shall be transmitted with recommended resolutions on the Component Task Evaluation Report (TER) Form to the Group Chairperson and the Program Manager for resolution.

Upon completion, the Component Design Review Package, i.e. results of analysis, shall be filed and summaries submitted for incorporation into the final report.

3.1 Preparation of Task Description

As noted above, the Design Review Group is provided with the minimum design requirements which must be reviewed. The task description is generated and provides as applicable, the following:

a) Primary component function and required attributes
b) Specified codes and standards (where applicable)
c) Specified alternative codes, standards, or analytical techniques
d) Analysis or evaluation to be performed to assure satisfactory design
e) Verification of TDI analysis (if available).
f) Final documentation requirements
g) Schedule for implementation

As task descriptions are completed for each plant, the schedules for implementation shall be forwarded to the Program Manager.

A sample Component Design Review Checklist is shown in Appendix 5.1 of this procedure. All results are recorded.

For each plant, the Owners' Group uses the site specific diesel generator specification and other applicable design documents as the base documents.

Design calculations, when required, shall be individually numbered, have statements of purpose, assumptions, methodology, results and conclusions. Design calculations are signed by the preparer and checker to indicate concurrence with the calculation.

3.2 Primary Function/Attributes

The primary function of the component and attributes necessary for accomplishing the primary function shall be defined on the Component Design Review Checklist.

3.3 Specified Standards

The standards specified or referenced in plant specific documents, which ensure that the required attributes are met shall be determined and identified. If there are no specified standards, determine if there are acceptable alternative standards.

3.4 Standards Used

The actual standards used by TDI shall be determined and identified. These standards could be: 1) those specified in plant specific documents, 2) industry standards, or 3) TDI standards. The following sources of information, as well as any other sources deemed appropriate may be used:

a) Vendor Design Documents

b) Component Documentation Packages

c) Vendor Analysis

The Quality Revalidation Group may be requested to validate that certain standards were used. This request is made by the Design Review Group through the Program Manager. The request describes the confirmation methods to be used.

3.5 Design Analysis

If the specified or actual standards used cannot be determined, a design analysis may be required.

If a standard analytical technique or approach is used, the analysis shall be performed, checked and reviewed.

If a non-standard analytical technique or approach must be used, a description of the analysis shall be submitted to the Program Manager via the group Chairperson for approval. If performed it shall be checked and reviewed.

If the results of an analysis indicate an impact on the engine maintenance intervals, this shall be reviewed with appropriate personnel and input to the maintenance program where applicable.

3.6 Consultant Expertise

In cases where an analysis is required, the expertise and experience of a diesel generator expert may be used to determine the type and the extent of analysis necessary.

3.7 Specified vs. Actual Standard Comparison

The actual standards used are compared to the specified standards. If the actual standards used do not comply with the specified standards, a problem description with recommendations shall be transmitted on a TER to the Program Manager via the group Chairperson.

3.8 Compare Actual Components to Requirements

The actual component attributes are identified and compared to the required attributes. The required attributes may be derived from the specifications or the analysis, as appropriate.

In some cases actual component data may be required. The Design Review Group shall determine what attributes require revalidation and request such action from the Program Manager.

3.9 Results and Conclusions

The results of the design review shall be documented and transmitted to the Program Manager. Additionally, summaries shall be provided for incorporation into the final report.

4.0 REFERENCES

4.1 Shoreham specification SH1-89 entitled "Specification for Diesel Generator Sets"

4.2 Utility Specific Diesel Generator Design Documents

5.0 APPENDICES

5.1 Component Design Review Checklist

TASK DESCRIPTION NO: DR-_____

COMPONENT DESIGN REVIEW CHECKLIST

COMPONENT _____ Classification Type _____

PART NUMBER _____ Scheduled for Completion _____

TASK DESCRIPTION:

PRIMARY FUNCTION:

ATTRIBUTE TO BE VERIFIED:

SPECIFIED STANDARDS:

REFERENCES:

DOCUMENTATION REQUIRED:

GROUP CHAIRPERSON_____ PROGRAM MANAGER_____

COMPONENT REVIEW:

RESULTS AND CONCLUSIONS:

Group Chairperson _____Program Manager_____

DIESEL GENERATOR COMPONENT

QUALITY REVALIDATION PROCEDURE

DG-4

Component Selection Chairperson _____ Date_____

Quality Group Chairperson _____ Date_____

Design Group Chairperson _____ Date_____

Program Manager _____ Date_____

1.0 PURPOSE

This procedure provides the methodology for performing a quality revalidation for components that have been selected by the component selection process.

2.0 SCOPE

This procedure provides direction on the review of existing documentation, inspections to be performed, and identification of recommendations and/or conclusions as applicable, for components that were selected for quality revalidation. The Quality Revalidation Group will be chaired by the SWEC Lead. He will be assisted by appropriate engineering and quality assurance personnel, including, but not limited to:

- Owner's QA Rep, as applicable
- FaAA
- SWEC QA
- SWEC Engineering

The Component Selection Group determines minimum design review requirements requiring quality revalidation and may also specify an appropriate mechanism for performing this revalidation.

3.0 INSTRUCTIONS

These instructions provide guidance on the steps which may be used in the quality revalidation of a component. Due to the number and diversity of the components and standards involved, the quality revalidation process must be tailored to the individual component. Steps may be deleted or added at the discretion of the Component Quality Revalidation Group Chairperson and the Program Manager.

Quality attribute review requirements shall be provided by the component selection group or the design review group through the Program Manager. Upon receipt of these requirements, a task description shall be generated by the component quality revalidation group. This task description shall be approved by the Quality Review Group Chairperson and the Program Manager.

If questions arise that cannot be resolved by the personnel conducting the quality revalidation, they shall be transmitted with the recommended resolutions on the Component Task Evaluation Report form (TER) to the Group Chairperson and the Program Manager for resolution.

Upon completion, the component quality revalidation documentation shall be filed and summaries provided for incorporation into the final report.

3.1 Preparation of Task Description

As noted above, the Quality Revalidation Group is provided with the quality attributes which must be validated. Based on this information, a task description shall be generated. It shall contain, as applicable, the following:

- The Component to be Validated
- Attributes to be Verified
- Methodology to be Used
- Acceptance Criteria to be Used (if available)
- Type of Documentation to be Provided
- Schedule for Completion

Based on the approved task description, a detailed inspection plan shall be generated for use in performing the actual inspections.

A sample component revalidation form is shown in Appendix 5.1 of this procedure. All results shall be recorded.

In those cases where another plant requires quality task descriptions, Shoreham task descriptions and inspection results will be used as the basis for new task descriptions, as applicable.

Any additional inspections resulting from the design review will be identified in TER's. New task descriptions will be written based on subsequent design review required inputs, e.g., as-built configurations, verification of part identification.

As task descriptions are completed for each plant, the proposed schedules for implementation shall be forwarded to the Program Manager. The actual implementation is based on plant specific requirements.

3.2 Types of Revalidation that May be Required

The following are typical of quality revalidations that may be required:

Documentation Review - A review of existing documentation will be performed for each component selected for either a quality or design review. Areas from which this data may be gathered include, but are not limited to, the following:

- o Purchase Order Files
- o Receipt Inspection Reports
- o Startup Files (RRR's)
- o Procurement Quality Assurance Files
- o Site Inspection Records
- o Deficiency Reports/Engineering Change Documents

Component Material - The material specified, or required by analysis is verified to be in accordance with the attributes provided by the component selection group. This is accomplished by reviewing material certificates against attributes provided. In cases where no material certifications are available or a material certification requires revalidation, a task description is generated to verify the material properties, using spare, replaced parts and non-destructive methods wherever possible. A comparison of tested spare parts to as-installed components will be done where possible.

Component Material Testing - The material testing specified is verified to be in accordance with the attributes provided by the Component Selection Group or required by analysis. This is accomplished by reviewing component material test results against the attributes provided. In cases where no documentation is available or where additional testing is required by analysis, a task description is generated, to perform this testing using spare, replaced parts and non-destructive methods wherever possible. A comparison of tested spare parts to as-installed components will be done where possible.

Component Dimensions - Specified dimensional attributes may be obtained from but are not limited to the following:

- o Manufacturer's Data
- o Receiving Inspection Data
- o Assembly Data
- o Disassembly Data
- o Actual Measurements

3.3 Results and Conclusions

Upon task completion, the results of the quality revalidation review shall be documented on the component revalidation form and transmitted to the Program Manager. Additionally, summaries will be prepared for the final report.

4.0 REFERENCES

5.0 APPENDICES

5.1 Component Revalidation Checklist

TASK DESCRIPTION NO. QR-_____

COMPONENT REVALIDATION CHECKLIST

COMPONENT _____ DOCUMENT NO. _____

PART NUMBER _____ Scheduled for Completion _____

TASK DESCRIPTION:

ATTRIBUTE TO BE VERIFIED:

ACCEPTANCE CRITERIA:

REFERENCES:

DOCUMENTATION REQUIRED:

GROUP CHAIRPERSON_____ PROGRAM MANAGER_____

COMPONENT REVIEW:

RESULTS AND CONCLUSIONS:

Group Chairperson _____Program Manager _____

APPENDIX 5

SIGNIFICANT KNOWN PROBLEMS

1. Crankshaft
2. Connecting Rod Bearings
3. Pistons
4. Cylinder Heads
5. Cylinder Liners
6. Cylinder Block
7. Engine Base
8. Head Studs
9. Push Rods
10. Rocker Arm Capscrews
11. Connecting Rods
12. Engine Mounted Electrical Cable
13. Fuel Injection Lines
14. Turbocharger
15. Jacket Water Pumps
16. Air Start Valve Capscrews

TURBOCHARGER

MP-017

UNIT	TURBO TYPE	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:				
SHOREHAM	Elliott 90G	Thrust bearing oil film/load/ material analysis; Nozzle ring vane and cap screw thermal/ pressure loading; evaluate effectiveness of prestart thrust bearing lube oil supply	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines 100 starts - 1 engine 23 starts - 2 engines	Inspect end clearance Inspect thrust bearing after 100 Hrs @ 100% power - 2 engines Inspect thrust bearing after 100 starts - 1 engine Inspect end clearance at 23 star - 2 engines
RIVER BEND	Elliott 90G	Verify similarity to SNPS Evaluate differences if any	100 Hrs @ 100% power - 1 engine	Inspect end clearance - 2 engine Inspect thrust bearing - 1 engin
RANCHO SECO	Elliott 90G	Verify similarity to SNPS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
V-16 ENGINES:				
GRAND GULF	Elliott 90G (2)	Verify twin installation similarity to Shoreham. Evaluate auxiliary lube oil system	100 Hrs @ 100% power - 1 engine 100 starts minimum - 1 engine	Inspect end clearance - all engines
CATAWBA	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
PERRY	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
COMMANCHE PEAK	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
HARRIS	Elliott 90G (2)	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	Inspect end clearance - all engines
VOGTLE	Elliott 90G (2)	Verify similarity to GGNS Evaluate ditferences if any	Normal Preop testing	Inspect end clearance - all engines
V-12 ENGINES:				
MIDLAND	Elliott 65H (2)	Thrust bearing oil film/load material analysis; adequacy of thrust bearing prelube	Normal Preop testing	Inspect end clearance - all engine Inspect thrust bearing - 1 engin
V-20 ENGINES:				
SAN ONOFRE	Elliott 65H (4)	Verify similarity to Midland	Normal Preop testing	Inspect end clearance

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

TURBOCHARGER
PART NO. MP-017

Classification A
Completion 3/20/84

PRIMARY FUNCTIONS: The turbocharger is composed of a gas turbine and centrifugal inducer/impeller mounted on a common shaft and housed by integral castings. It utilizes engine exhaust gasses to pressurize the engine intake manifold air for higher output combustion. Energy from the exhaust gas is extracted by the turbine which drives the compressor through a common shaft.

FUNCTIONAL ATTRIBUTES:

1. The turbocharger components require adequate strength and fatigue resistance to react loads imposed by flowing engine exhaust gasses during the severe startup and transients unique to nuclear standby service in addition to normal operation. In particular, these components include the diffuser, nozzle ring assembly, rotor assembly diffuser bearings (thrust and radial.)
2. The turbine and components must have the ability to withstand a high temperature corrosive environment.
3. The lubrication system must have the ability to:
   a. Supply sufficient oil to the bearings to prevent bearing wiping (prelube) during the repeated startups required by testing.
   b. Ensure a minimum time lapse between start of rotation of the rotor and required pressurized oil in the bearings.
   c. Maintain adequate inlet and discharge oil temperatures.
   d. Provide adequate oil seals.
4. The cooling system must provide sufficient water flow and pressure to maintain adequate component temperatures and allow adequate venting to prevent air or steam pocket formation.
5. External piping must be configured such that there is no unacceptable transmission of thermally induced loads to the turbocharger casings.
6. The turbocharger itself must have sufficient operational performance surge margin to avoid reverse loading damage.

SPECIFIED STANDARDS: None known

EVALUATION:

1. Review the operational history from several users with Elliott model 90G and 65H turbochargers.
2. Review pre-operational test logs to verify performance.
3. Examine possible structural deformation of casings and mounting bolts under startup and operational conditions which could affect bearing performance.
4. Review turbocharger performance data to determine the gas loading of rotating component.
5. Evaluate the bearing loads during normal operating conditions.

6. Conduct rotor dynamics analysis to assess possible startup-induced deflection or rotor instabilities.
7. Stress analysis of bolting components in particular, nozzle ring capscrews.
8. Review material selection.
9. Review bearing lubrication requirements such as thrust bearing during startup and full load.
10. Evaluate the differences between R-48, RV-16, RV-12 and RV-20 auxiliary lube pump configurations and the possible effects on thrust bearings during startup.
11. Evaluate preventative maintenance and possible monitoring techniques.
12. Review specified as-built clearances for bearings and seals.
13. Review specified assembly procedure to verify that all important as-built dimensions are being measured.

REVIEW TDI ANALYSES: Review TDI analyses of thrust bearing drip system configuration.

INFORMATION REQUIRED:
1. Manufacturer's bulletins
2. Component drawings, piping schematics, assembly drawings, installation drawings
3. Material specifications
4. Performance data such as compressor and turbine maps
5. SNPS thrust bearing disassembly and inspection results
6. Lube and cooling system specifications such as flow, pressure, filtration, etc.
7. Engine exhaust gas data

ENGINE BASE AND BEARING CAPS

01-305A

UNIT	ANALYSIS	TESTING	INSPECTION
S-48 ENGINES:			
SHOREHAM	Stress analysis of bearing saddles bearing caps and cap locking loads Evaluation of the adequacy of bolting, studs and nuts, verify use of required preload.	100 hrs @ 100% power and LOOP/ LOCA simulation - 3 engines	LP bearing saddles with highest loads or saddles with maintenance induced indications 2 engines sample basis
RIVER BEND	Verify similarity to SNPS	100 hrs @ 100% power - 1 engine	LP bearing saddles 1 engine sample basis
RANCHO SECO	Verify similarity to SNPS	Normal Preop	None if SNPS acceptable
V-16 ENGINES:			
GRAND GULF	Stress and fatigue analysis of bearing saddles and cap locking loads	100 hrs @ 100% power - 2 engines	None required if loads similar to SNPS and SNPS inspections acceptable and SIM is implemente
CATAWBA	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
PERRY	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
HARRIS	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
VOGTLE	Verify similarity to GGNS Evaluate differences if any	Normal Preop testing	None if similar to GGNS
V-12 ENGINES:			
MIDLAND	Stress and analysis if required	Normal Preop testing	None if similar to SNPS or GGNS
V-20 ENGINES:			
SAN ONOFRE	Stress analysis if required	Normal Preop testing	None if similar to SNPS or GGNS

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

BASE AND BEARING CAPS
PART NO. 03-305A

Classification A
Completion 3/20/84

PRIMARY FUNCTION:

The base assembly supports the crankshaft and the upper engine assembly. It reacts the crankshaft, piston inertia and firing loads at the bearing saddles, reacts the firing force transmitted through the bolting to the upper engine assembly and provides axial restraint to the crankshaft and engine.

The major components of the base assembly are the base casting, the main bearing caps, shells, nuts and studs; and the bolting to the upper assembly or the crankcase (through bolts).

FUNCTIONAL ATTRIBUTES:

1. The base casting bearing saddles must have sufficient strength to carry the lateral loads imposed by the crankshaft inertia and to react the vertical compression and tension loads imposed by the engine firing and the crank/rod/piston inertia loading.
2. The base casting nut pockets for the main bearing studs and through bolts must have sufficient contact strength to carry the nut preload, inertial and dynamic loading from the crankshaft, and firing loads transmitted from the upper engine.
3. The studs, bolts and nuts connecting the base casting to the bearing caps and the upper engine assembly must have sufficient strength to carry the imposed preloads, dynamic loads, and firing loads. The clamping force provided by the main bearing studs and nuts must be sufficient to prevent lateral movement of the main bearing caps under natural crankshaft loading.
4. The main bearing caps must have sufficient strength to withstand the imposed crankshaft loads.
5. The base must be sufficiently rigid to maintain adequate main bearing alignment during operation.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review information available on industry experience with bearing saddle indications, including those on the R-4B engines at Shoreham Nuclear Power Station, the fractures on the USCG Icebreakers West Wind and North Wind, and the RV-16 base at the ANAMAX mine.
2. Examine the adequacy of the bearing saddle pedestal under vertical and lateral loads imposed by the crankshaft and the bearing cap bolt preloads.
3. Following 100 hrs of operation or normal Preop testing, an NDE inspection of the most heavily loaded bearing pedestals on the ONPD engines and a selected number of other R-4B and RV-16 engines will be conducted and the results evaluated with respect to possible loading mechanisms.

4. An evaluation of the main bearing caps under the crankshaft inertial loads and stud preloads will be performed. This will consider the adequacy of the lateral loading between bearing cap and pedestal to prevent bearing cap movement under crankshaft loading.
5. Analyses of the bearing saddle nut pocket and upper assembly nut pockets will be conducted. The pockets will be modeled as a column with a through hole under a tension load corresponding to the preload; firing pressures and crankshaft inertial loading. These analyses will initially be performed on R48 and RV-16 engines. The need to perform detailed analyses on RV-12 and RV-20 engines will depend on the findings of the former.
6. Industry experience with base assembly bolting problems will be reviewed including through bolt and washer failures at Copper Valley Electric and Valdez, Alaska.
7. The base assembly bolts, studs and nuts will be analyzed for adequate preload.

STUDY TDI ANALYSES:

1. The TDI analyses and test experience on the base assembly components will be reviewed.

INFORMATION REQUIRED:

1. Base assembly component drawings and manufacturing specifications
2. Base assembly component material properties, including yield strength of casting in various section thicknesses
3. Main bearing cap and upper assembly bolting torque specifications
4. Engine firing loads
5. Crankshaft loads on main bearings
6. Engine component weights

CRANKSHAFT

03-310A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	[illegible] analysis [illegible] test data correlation [illegible] analysis	100 Hrs @ 100% power and LOOP/LOCA simulation - 3 engines Torsiograph - 2 engines Strain Gage testing crank pin fillets - 1 engine	NDT Crankshaft - 3 engines after 100 Hrs @ 100% power
RIVER BEND	Holzer analysis Modal superposition (If different from SNPS)	100 Hrs @ 100% power - 1 engine Torsiograph - 1 engine	NDT crankshaft - 1 engine after 100 Hrs @ 100% power
RANCHO SECO	Verify similarity to SNPS	Normal Preop testing Torsiograph - 1 engine	None if similar to SNPS
V-16 ENGINES:			
GRAND GULF	Holzer analysis Modal superposition	100 Hrs @ 100% power - 1 engine Verification of torsiograph	NDT crankshaft 1 engine after 100 Hrs @ 100% power
CATAWBA	Verify similarity to GGNS	Normal Preop testing Torsiograph - 1 engine	NDT crankshaft after preop test
PERRY	Verify similarity to GGNS	Normal Preop testing Torsiograph - 1 engine	None if similar to GGNS
COMMANCHE PEAK	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
HARRIS	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
VOGTLE	Verify similarity to GGNS	Normal preop testing Torsiograph - 1 engine	None if similar to GGNS
V-12 ENGINES:			
MIDLAND	Holzer analysis Modal superposition	Normal preop testing Torsiograph - 1 engine	None depending on Torsiograph
V-20 ENGINES:			
SAN ONOFRE	Holzer analysis Modal superposition	Normal preop testing Torsiograph - 1 engine	None depending on Torsiograph

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CRANKSHAFT
PART NO. 03-310A

Classification A
Completion 3/5/84

PRIMARY FUNCTION: The crankshaft converts reciprocating motion, component inertial forces and gas pressure piston forces to rotary motion and torque at the output flange.

FUNCTIONAL ATTRIBUTES:

1. Structural stiffness of the crankshaft must be sufficient to maintain acceptable states of stress in the crank pin web and main journal areas and to maintain system natural frequencies which are sufficiently removed from engine operating speeds. The crankshaft design should also be sufficient to withstand main bearing misalignments inherent in service.
2. The journal area of the main and connecting rod (crank pin) bearing must be sufficiently large for acceptable bearing oil film pressure but the overall bearing length must be sufficiently short to minimize end wear of the bearing sleeves.
3. The material of the crankshaft and the surface finish should be sufficient to resist fatigue crack initiation.

SPECIFIED STANDARDS:

1. ASTM
2. DEMA

EVALUATION:

1. Review TDI calculations and tests.
2. Conduct engine test of 13x12 shaft.
3. Conduct modal superposition and Holzer torsional analyses of:
   a. SNPS (R-48)
   b. GGNS (RV-16)
   c. Midland (RV-12)
   d. San Onofre (RV-20)
4. Conduct finite element analysis of R-48 12 inch crank pin fillets.
5. Compare measured and calculated stresses R-48 13x12 shaft.
6. Compare measured and calculated output torque and free end torsiograph traces for R-48.
7. Compare stress levels with endurance limit for R-48.

8a. Compare nominal stresses of R-48 & RV-16 with those recommended by other standards.

b. Compare nominal stresses of RV-12 and RV-20 with those recommended by other standards.

9. Complete final report on SNPS and GGNS crankshaft integrity.
10. Complete final report on Midland RV-12 and San Onofre RV-20.

REVIEW TDI ANALYSES:
1. Experimental stress analysis (static) of DSR-48 crankshaft
2. Torsiograph tests
3. Holzer Table calculations

INFORMATION REQUIRED:
1. TDI drawings for DSR-48 and RV engines
2. Test reports for DSR-48 and RV engines
3. Original Holzer calculations and revisions for R-48 and RV-16, RV-12 and RV-20 engines
4a. Experimental pressure vs. time curve for R-48 and RV-16 engines.
b. Experimental pressure vs. time curve for RV-12 and RV-20 engines.

CYLINDER BLOCK AND LINER
03-315

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Evaluate stresses in liner landing includ.ng head stud and thermal loads	100 hrs @ 100% power LOOP/LOCA simulation - 3 engines	LP inspection cylinder block liner landing. Sample Basis; Inspect liner for unacceptable distortion, wear or flaws.
RIVER BEND	Verify similarity to SNPS	100 hrs @ 100% power - 1 engine	Dependent on SNPS results
RANCHO SECO	Verfiy similarity to SNPS	Normal Preops testing	Dependent on SNPS results
V-16 ENGINES:			
GRAND GULF	Verify similarity to SNPS	100 hrs @ 100% load - 1 engine	LP inspection cylinder block liner landing. Sample basis Inspect liner for unacceptable distortion, wear or flaws.
CATAWBA	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
PERRY	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
COMMANCHE PEAK	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
HARRIS	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
VOGTLE	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS	Normal Preops testing	Dependent on GGNS results

DR-03-315

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER BLOCK AND LINER
PART NO. 03-315

Classification A
Completion 3/20/84

PRIMARY FUNCTION: The cylinder block comprises the framework of the liquid cooled engine and provides passage and support for the cylinder liner. The block must provide cooling water passages, provide bores to support the cam shaft assembly, and react the dynamic loads from the cylinder firing pressure and valve assemblies. For the RV engines, the cylinder block is interconnected with an engine crankcase which supports the camshaft and associated bearings. Although these are separate parts, their generic function is similar to the cylinder block of the R-48 engines and will therefore be evaluated as a unit. The liner itself forms the walls of the combustion chamber containing the high temperature gas pressure and must provide a guide for the piston motion while reacting skirt side forces without excessive wear or scuffing.

FUNCTIONAL ATTRIBUTES:

1. The cam galley bearing supports must be designed to maintain concentricity during service and have sufficient structural strength to react the cam/valve train loads without fatigue cracking.
2. The support of the cylinder liner must maintain tight seals, react pressure and stud loads without unacceptable distortion and maintain sufficient load distribution to preclude excessive cracking in the liner counterbore (landing) due to combined thermal, gas pressure and preloaded stud irduced states of stress. The cylinder head stud three configuration is important in determining stress concentrations and stress distributions.
3. The cylinder liner itself must be sufficiently hardened to resist unacceptable wear associated with piston ring action and maintain adequate contact with the block counterbore to prevent high cycle contact stress and fretting. In addition, the compression of the head to the cylinder liner must be sufficient to avoid axial fretting of the liner within the counter bore but not so great as to cause failures of the cylinder block liner landing.
4. The cooling water distribution within the block must be sufficient to preclude overheating of the block and liner and must maintain prope flow conditions to minimize or avoid cavitation or corrosion damage to the liner.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review information concerning previous cracking and distortion of the cylinder block and liners of the R48 and RV engines.
2. Review liquid penetrant inspections of cylinder block in the head stud and liner counter bore regions of the SNPS DSR-48 engines.

3. Evaluate the steady state and alternating stresses in the liner landing/head stud region and compare these to yield and endurance limits for appropriate materials. This examination must consider variations in head stud thread geometries and preload torques.
4. Evaluate the state of stress in the liner in the landing/axial seal region due to gas pressures, thermal growth and head clamping forces and compare to normal fatigue properties for liner material.
5. Evaluate critical flaw size and rate of crack growth considering combined head stud loads and thermal stresses for cracks located between head stud holes and cylinder block counterbore diameter.
6. Evaluate critical flaw size and rate of crack growth for cracks eminating from the corner of the cylinder block landing and counterbore diameter.
7. Evaluate the loading produced on the bearing supports in the cam gear galley and verify the structural adequacy of the design.
8. Review the inspection of the sampled SNPS cylinder liners following 100 hrs at 100% load for evidence of unacceptable scuffing, corrosion, cracking or scoring.

REVIEW TDI ANALYSES:

1. Review any TDI analyses which consider stresses created in the liner counterbore area and any design changes which relate to geometry or material.

INFORMATION REQUIRED:

1. Manufacturer's drawings of R48 and RV cylinder blocks and liners, including material specifications and historical design changes
2. Bmc pressures and temperatures for R48 and RV engine designs
3. Cylinder head stud drawings and torque specifications
4. Cylinder head stud drawings showing design changes
5. Liquid penetrant inspection of cylinder block counterbore (landing) on SNPS engines
6. Cam shaft loads due to rocker arms, pushrods and valve springs

CYLINDER HEAD STUDS

03-315E

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress Analysis: Preload and operational (cylinder firing pressure) loads, for necked down stud design, verify lubricant	100 Hrs @ 100% power and LOCA/LOCA Simulation - 3 engines	Visual inspection; verification of proper torque; hardness - sample basis
RIVER BEND	Verify similarity to SNPS/GGNS design Evaluate major differences	100 hrs @ 100% power - 1 engine	Visual inspection; verification of proper torque
RANCHO SECO	Verify similarity to SNPS/GGNS design Evaluate major differences	Normal Preop testing	Visual inspection; verification of proper torque
V-16 ENGINES:			
GRAND GULF	Stress Analysis: Preload and operational loads for uniform cross section design, verify lubricant	100 hrs @ 100% power - 1 engine	Visual inspection; verification of proper torque
CATAWBA	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
PERRY	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
COMMANCHE PEAK	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
HARRIS	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
VOGTLE	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS/GGNS Evaluate differences if any	Normal Preop testing	Visual inspection; verification of proper torque
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS/GGNS Evaluate differences if any	100 hrs @ 100% power - 1 engine Normal operational testing	Visual inspection; verification of proper torque

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER HEAD STUDS
PART NO. 03-315E

Classification E
Completion 3/1/84

PRIMARY FUNCTION: The cylinder head studs transmit cylinder firing pressure forces from the cylinder heads to the engine block and assure a required preload on the cylinder head gasket for combustion gas and water sealing.

FUNCTIONAL ATTRIBUTES:

1. The cylinder head studs must have sufficient strength to withstand the necessary preload and cyclic firing pressure forces without preload relaxation or thread distortion.
2. The thread geometry of the head stud should be such as to provide for an upper thread engagement which is sufficiently below adjacent cylinder liner landings to minimize stress concentration in that area.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review the design dimensional differences between the previous and current head stud designs.

2. For the current design:
   a. Evaluate the stress at the minimum cross-sectional area resulting from the applied preloads assuming uniform lubrication and load distribution. Stress concentration effects of the threads should be included in the evaluation. Verify thread resistance to distortion.
   b. Determine the cylinder firing pressure and resultant force on the cylinder head. Utilizing the cylinder head geometry, determine the alternating load applied to each stud due to the cylinder head resultant forces.
   c. Evaluate whether the total resultant force is sufficient to overcome the bolt preload.
   d. Evaluate the bolt torque/preload technique to determine whether acceptable loading is assured.
3. Perform a similar analysis on the previous TDI design and assess the effect of the material and design differences.

REVIEW TDI ANALYSES:

1. Review TDI stress analyses associated with the design/material changes.

INFORMATION REQUIRED:

1. Maximum cylinder firing pressure
2. Stud geometry and drawings

3. Stud material specifications
4. Cylinder head geometry
5. Stud torque specification and lubrication requirements

CONNECTING RODS

03-340A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of crank pin bore and cap distortion; stress analysis of wrist pin bore and bushing; Evaluate cap bolt torque and design requirements	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines	Inspect crank pin bore and wri pin bore. LP inspect wrist pin bushing - sample basis
RIVER BEND	Verify similarity to SNPS	100 Hrs @ 100% power - 1 engine	None required if SNPS inspecti acceptable
RANCHO SECO	Verify similarity to SNPS	Normal Preop testing	None required if SNPS inspecti acceptable
V-16 ENGINES:			
GRAND GULF	Stress analysis of RV connecting rod; Evaluate cap bolt torque and design requirements Verify implementation of cap bolt torque per SIM64	100 Hrs @ 100% power - 1 engine	Inspect crank pin and link pin bores, bolt holes and parting surfaces - 1 engine - Sample basis depending on stress anal
CATAWBA	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
PERRY	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
HARRIS	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None require. if GGNS acceptab.
VOGTLE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
V-12 ENGINES:			
MIDLAND	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptab
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None required if GGNS acceptabl

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CONNECTING ROD
PART NO. 03-340A

Classification A
Completion 3/20/84

PRIMARY FUNCTION: The connecting rod transmits engine firing forces from the pistons and piston pins through the rods to the crankshaft such that the reciprocating motion of the pistons induces rotation and output torque of the crankshaft.

FUNCTIONAL ATTRIBUTES:

1. The connecting rod must have sufficient column buckling strength and fatigue resistance to withstand cylinder firing forces and inertial loads.
2. In the RV engine design, the three oscillating bearings two (2) wrist pin bearings and one (1) link pin bearing and the rotating crank pin bearing all require support from the connecting rod. In the R48 design, a single wrist and crank pin bearing are supported The flexure of the rod must be such that bearings are not unacceptably distorted.
3. Passages within the rod must provide cooling and lubricating oil to the bearings and pistons.
4. Stress levels, both mean and alternating, must fall within the endurance limits for the material utilized.
5. In the RV design, the two bolted joints (link rod to link pin and master rod to conrod box) must maintain sufficient contact pressure. The R48 design likewise requires sufficient clamping forces on the crank pin bearing cap.
6. The rod cap bolts must support the necessary preload without yielding, fracture or unacceptable thread distortion.
7. The wrist pin bushing must acceptably support the gas pressure and inertia forces transmitted by the pistons during the unique nuclear standby required starting cycle and normal operation.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the service histories of the connecting rods. In particular, evaluate the two V-style connecting rods (the 1 7/8" bolt diameter connecting rod and the 1 1/2" bolt diameter rod) and the R48 style connecting rod.
2. Incorporate firing load profile data for the crankshaft analysis and the results of the 13" diameter rod bearing analyses to produce a connecting rod static load profile, with the addition of inertia loads for a complete time-load map.
3. Evaluate the significance of possible rod bow as it affects bearing centerline angular misalignment.

4. Review and report on failure of connecting rod at Copper Valley Electric, Glen Allen, Alaska.
5. Conduct journal orbit analysis of the wrist pin bearing.
6. Using examples of fractured rods to focus the area of investigation, develop finite element models of the 1 7/8" bolt diameter V-type rod, to define deformation and the possibility of crack initiation and propagation.
7. Evaluate the necessary preload and acceptable design requirements (yielding, thread distortion) of the rod cap bolts for the R-48 and RV designs.
8. Evaluate the loading, fabrication and installation requirements of the wrist pin bushing for acceptable nuclear standby service.
9. Perform a metallurgical examination of fractured connecting rods in FaAA possession.
10. Complete final report.

REVIEW TDI ANALYSIS:

1. Review any TDI stress analyses or strain gage testing of connecting rods.

INFORMATION REQUIRED:

1. Connecting rod, wrist pin bearing and cap bolt drawings
2. Engine operating parameters (i.e., speed, firing pressure time history, etc.)
3. Component physical parameters (piston weight, connecting rod reciprocating and rotating weights, etc.)
4. TDI specified rod cap bolt torques and installation procedures.
5. TDI failure history of DSR-48 and DSRV connecting rods
6. Bushing and connecting rod material specifications

CONN ROD BEARING SHELLS

03-340B

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Journal Orbit Analysis Finite Element Analysis Fatigue/Fracture Mechanics	100 hrs at 100% Power and LOOP/LOCA Simulations - 3 engines	NDT Inspection of all bearings - 3 engines
RIVER BEND	Journal Orbit Analysis (If different from above)	100 hrs at 100% Power - 1 engine	NDT Inspection of bearings - Sample basis
RANCHO SECO	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-16 ENGINES:			
GRAND GULF	Journal Orbit Analysis Finite Element Analysis Fatigue/Fracture Mechanics	100 hrs at 100% Power - 1 engine	NDT Inspection of bearings sample basis
CATAWBA	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings-sample basis
PERRY	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
COMMANCHE PEAK	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
HARRIS	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
VOGTLE	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-12 ENGINES:			
MIDLAND	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis
V-20 ENGINES:			
SAN ONOFRE	Journal Orbit Analysis (If different from above)	Normal Preop Testing	NDT Inspection of bearings sample basis

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CONNECTING ROD BEARING SHELLS
PART NO. 03-340B

Classification A
Completion 3/1/84

PRIMARY FUNCTION: The connecting rod bearing shells provide the oscillating sliding surface between the connecting rod and the crank pin through the formation of a hydrodynamic oil film. They transmit the cylinder firing pressure to the crankshaft through the oil film, converting the force into torque.

FUNCTIONAL ATTRIBUTES:

1. The bearing shells must have sufficient fatigue life and wear resistance to tolerate normal operating conditions for the intended service.
2. The bearing material must be of low friction to tolerate possible momentary contact with the crankshaft during starting of the engine and the surface of the bearing shell should be constructed of a material which is tolerant to the presence of foreign particles minimizing journal wear.
3. The dimensions must be manufactured with sufficient accuracy to obtain the proper interference fit in the connecting rod, and to establish the specified clearance between the bearing shell and the crankshaft.
4. The bearing must be designed so that during operation key parameters including oil supply pressure, peak oil film pressure, minimum oil film thickness, and oil film temperature rise are within acceptable limits for the specified diesel engine application and required life.
5. The bearing material should be resistant to possible corrosion due to chemical composition of lube oil.

SPECIFIED STANDARDS: None

EVALUATION:

1. Obtain cylinder pressure vs. crank angle data from DSR-48 test and compare to assumptions for previous bearing shell design review.
2. Review cylinder pressure vs. crank angle for DSRV-16-4 design.
3. Perform journal orbit analysis of DSR-48 design.
4. Perform finite element analysis of DSR-48 design.
5. a. Fracture mechanics life estimate of DSR-48 design.
   b. Determine maximum void size in bearing castings for radiograph inspection acceptance criteria.
6. Journal orbit analysis of DSRV-16-4 design.
7. Finite element analysis of DSRV-16-4 (if required by item 6).
8. a. Fracture mechanics life estimate of DSRV-16-4 design (if required by item 6).

b. Determine maximum void size in bearing castings for radiograph inspection acceptance criteria (if required by item 6).

9. Physical examination of used DSRV-16-4 bearing shells from GGNS to determine elastic deflection patterns.

10. Evaluate effects of babbit adhesion and thickness variations.

11. Complete report on DSR-48 and DSRV-16-4 bearing shells in SNPS and GGNS engines.

12. a. Determine differences, if any, between DSRV-16-4 and DSRV-12-4, DSRV-20-4. Conduct necessary design review steps, issue final report covering all engines.

b. Evaluate possible preventive maintenance and monitoring procedures (i.e., oil sample particulate/ chemical analysis, periodic visual inspection).

REVIEW TDI ANALYSES:

1. Obtain any available journal orbit analyses.
2. Review any bearing failure analyses.

INFORMATION REQUIRED:

1. Manufacturer's drawings of bearings, connecting rods, crankpin journals
2. Cylinder firing pressure versus time for DSRV-16-4
3. Lubrication oil specifications
4. Connecting rod rotating and reciprocating weights

PISTONS

03-341

UNIT	PISTON TYPE	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:				
SHOREHAM	AE	Finite Element Analysis Thermo/Mechanical Analysis Fracture Mechanics Analysis on AE-type piston configuration	100 hrs at 100% Power and LOOP/LOCA simulation - 3 engines	NDT Inspection of pistons - sample basis
RIVER BEND	AN	Finite Element Analysis Thermo/Mechanical Analysis Fracture Mechanics Analysis on AN-type piston configuration	100 hrs - 1 engine	NDT Inspection Sample basis
RANCHO SECO	AN	Verify similarity to River Bend Evaluate differences if any	Normal Preop testing	NDT - Sample basis depending on River Bend results
V-16 ENGINES:				
GRAND GULF	AE	Verify Similarity of Operating Parameters to SNPS	100 hrs at 100% power - 2 engines	NDT - Sample basis depending on SNPS, RODIAR and TDI R-5 inspection results
CATAWBA	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
PERRY	AH	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
COMMANCHE PEAK	AH	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
HARRIS	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
VOGTLE	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
V-12 ENGINES:				
MIDLAND	AH/AN	Verify Similarity to River Bend Evaluate Differences if any	Normal Preop testing	NDT - Sample basis depending on SNPS or River Bend results
V-20 ENGINES:				
SAN ONOFRE	AN	Verify Similarity to River Bend Evaluate Differences if any	Normal operation	NDT - Sample basis depending on SNPS or River Bend results

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

Classification A
Completion 3/5/84

PISTONS
PART NO. 03-341

PRIMARY FUNCTION: The pistons react the cylinder firing pressure and provide a reciprocating mechanism for converting combined inertia and combustion pressure forces into mechanical torque through the wrist pin, connecting rod and crankshaft.

FUNCTIONAL ATTRIBUTES:

1. The piston crown must have sufficient strength to resist the high temperature and pressure firing loads.
2. The load transfer between the piston crown and skirt structure must not produce alternating stresses sufficient to cause failure of the skirt.
3. The wall structure of the skirt must be resistant to pressure induced deformation which could result in skirt fatigue in proximity to the stiffening ribs.
4. Preload in the crown studs must be sufficient to preclude failures of studs/nuts/washers.
5. The piston skirt must provide a suitable sliding surface against the cylinder liner.
6. The piston ring groove must be sufficiently wear resistant to provide sufficient ring life.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the historical evolution of the AF, AF modified, AH, AN, and AE piston designs, including casting, heat treatment, dimensional and material changes.
2. Determine maximum firing pressures and temperatures for DSR-48, DSRV-16-4, DSRV-12-4, and DSRV-20-4 designs.
3. Develop finite element models for AF modified and AE piston designs with pressure loading (static conditions).
4. Conduct thermo/mechanical analysis to determine thermally induced load transfer due to crown distortion.
5. Perform metallurgical examination of fractured AF piston skirts.
6. Perform eddy current examination of AE piston skirts from TDI DSR46 and R5 engines, and Alaska stationary diesel generator.

7. Conduct fracture mechanics analysis of possible crack propagation in AF modified and AE designs with differing stress conditions.
8. Conduct experimental static isothermal stress distribution test on AE skirt.
9. Evaluate the effect of piston side loading on wear.
10. Perform LP and eddy current inspection of SNPS AE pistons following 100 hrs at 100% load.
11. Assess the similarity of the AF modified, AH, and AN piston designs.
12. Complete report on AF modified, AH, AN and AE pistons.

REVIEW TDI ANALYSES:

1. Examine TDI strain gage testing (static) on skirt stud boss region.

INFORMATION REQUIRED:

1. TDI drawings for AN and AE designs including studs, Belleville washers, preload, material specifications
2. Historical information on casting changes, heat treatment changes
3. Maximum cylinder firing pressure and temperature for DSR-48, DSRV-16-4, DSRV-12-4 and DSRV-20-4

AIRSTART VALVE CAPSCREW

03-359

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Review 10CFR21 notification Evaluate capscrew length-tolerances vs. sylinder head tolerances. Worst case analysis of reaction air loading	100 starts - 1 engine 23 starts - 2 engines	Verification of proper torque and proper length (SIM360)
RIVER BEND	Review 10CFR21 response Verify similarity to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
RANCHO SECO	Review 10CFR21 response Verify similarity to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-16 ENGINES:			
GRAND GULF	Review 10CFR21 response Verify similarity of operating parameters to SNPS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
CATAWBA	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
PERRY	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
COMMANCHE PEAK	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
HARRIS	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
VOGTLE	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-12 ENGINES:			
MIDLAND	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)
V-20 ENGINES:			
SAN ONOFRE	Review 10CFR21 response Verify similarity to GGNS	69/N starts (Preop)	Verification of proper torque and proper length (SIM360)

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

AIR START VALVE CAPSCREWS
PART NO. 03-359

Classification A
Completion 3/1/84

PRIMARY FUNCTION: The air start valve capscrews provide clamping force to hold air start valves in place on cylinder heads.

FUNCTIONAL ATTRIBUTES:
1. The air start valve capscrews must have sufficient strength to withstand the necessary preload and reaction air loading without yielding and resulting in loss of clamping force on the air start valves.

SPECIFIED STANDARDS: None

EVALUATION:
1. Verify adequacy of new capscrew length to prevent bottoming out of the capscrew during installation. Review to include maximum tolerance of capscrew length coupled with cylinder head minimum hole depth.
2. Evaluate adequacy of specified torque value.
3. Perform worst case analysis of reaction air loading in capscrews.
4. Determine the total restart bolt stress.
5. Evaluate the TDI recommended retorquing requirements after operation due to use of copper gaskets.

REVIEW TDI ANALYSES: Review load and deflection analyses if any.

INFORMATION REQUIRED:
1. Capscrews and washer materials and dimensions
2. Cylinder head drawings
3. Specified torque value and lubrication requirements

CYLINDER HEAD

03-360A

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Evaluate evolution of cylinder head casting and fabrication; Evaluate possible fatigue crack growth of fire deck and adjacent valve port casting; Evaluate stellite valve seat fabrication technique and radial cracking	100 Hrs @ 100% power LOOP/LOCA Simulation - 3 engines	LP inspection of cylinder head fire deck and valve seats - Sample basis Engine barring (all) and check water in cylinder
RIVER BEND	Verify similarity to SNPS Evaluate differences	100 Hrs @ 100% power - 1 engine	LP inspection of cylinder head fire deck and valve seats, UT f deck thickness - Sample basis; Engine barring (all)
RANCHO SECO	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-16 ENGINES:			
GRAND GULF	Verify similarity to SNPS Evaluate differences	100 Hrs @ 100% power - 1 engine	LP inspection of cylinder head fire deck and valve seats, UT f deck thickness - Sample basis; Engine barring (all) and check water in cylinder
CATAWBA	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
PERRY	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
COMMANCHE PEAK	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
HARRIS	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
VOGTLE	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS Evaluate differences	Normal Preop testing	Same as above
V-20 ENGINES:			
SAN ONOFRE	Evaluate effect of lower firing pressure	Normal operational testing	Same as above

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

CYLINDER HEAD
PART NO. 03-360A

Classification B
Completion 3/12/84

PRIMARY FUNCTION: Provide pressure tight cap for engine cylinder and provide passages and sealing for cooling water, lube oil, starting air, intake and exhaust gasses.

FUNCTIONAL ATTRIBUTES:

1. The cylinder head must have sufficient structural stiffness to react the cylinder firing forces without seal leakage or deformation which would produce unacceptable bending loads on the cylinder head studs.
2. The fire deck must be sufficiently stiff with thickness necessary to maintain stresses below endurance limits, however, the firedeck must also be thin enough to provide adequate heat transfer for cooling purposes.
3. The cylinder head must also possess sufficient resistance to thermal and mechanical fatigue to prevent failure.
4. Residual stresses in the cylinder head must be adequately relieved to prevent casting fatigue and fracture.
5. Areas of high contact loading and high gas velocities, such as valve seats, must be resistant to impact and corrosion damage.

SPECIFIED STANDARDS: None

EVALUATION:

1. Review previous failure analyses of cylinder heads with jacket water passage flaws, fire deck flaws and valve seat cracking.
2. Evaluate possible causes of crack initiation.
3. Conduct physical/dimensional examination/comparison of early and current generations of cylinder heads.
4. Determine gas pressure loading and operating parameter differences between R-4B and RV engines.
5. Evaluate the improvements in manufacturing and casting techniques and the adequacy of the head cooling configuration. Identify possible crack propagation mechanisms if any.
6. Review NDT procedures for head castings.
7. Review results of hydrotesting.
8. Review the inspection of sampled SNPS cylinder heads following 4 hours at 112% power, 100 hours at 100% power.
9. Evaluate the adequacy of the engine barring procedure.

REVIEW TDI ANALYSES:

1. Review documents concerning cylinder head cracking including metallurgical examination of castings.
2. Review any stress or strain gage analyses.

INFORMATION REQUIRED:

1. Manufacturer's drawings of early and current heads including any changes in casting practices and process control.
2. Cylinder firing pressure curve for R-48, RV-16, RV-12, RV-20 engines
3. Thermocouple measurement of cylinder head transient and steady state temperatures
4. All documents and reports of cylinder head flaws and possibly cracking for the R48 and RV engines
5. Review information (depositions and affidavits) submitted to date in the cylinder head ASLB litigation.

FUEL OIL INJECTION TUBING

03-365C

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress/fatigue analysis; Fracture mechanics analysis	100 hrs @ 100% load LOOP/LOCA simulation - 3 engines	Visual inspection for signs of leakage
RIVER BEND	Review 10CFR21 response	100 hrs @ 100% load - 1 engine	Visual inspection for signs of leakage
RANCHO SECO	Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-16 ENGINES:			
GRAND GULF	Verify applicability of SNPS analysis Review 10CFR21 response	100 hrs @ 100% load - 1 engine	Visual inspection for signs of leakage
CATAWBA	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
PERRY	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
COMMANCHE PEAK	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
HARRIS	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
VOGTLE	Verify similarity to GGNS Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-12 ENGINES:			
MIDLAND	Verify applicability of SNPS analysis Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage
V-20 ENGINES:			
SAN ONOFRE	Verify applicability of SNPS analysis Review 10CFR21 response	Normal Preop testing	Visual inspection for signs of leakage

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

FUEL OIL INJECTION TUBING
PART NO. 03-365C

Classification B
Completion 3/23/84

PRIMARY FUNCTIONS: To transfer high pressure fuel from the fuel injection pump to the injection spray nozzle.

FUNCTIONAL ATTRIBUTES:
1. The fuel oil injection tube assembly must have adequate fatigue strength to withstand the cyclic high pressure and vibration stresses without fatigue cracking or failure by yielding.
2. The tube assembly must be resistant to corrosion and erosion on the inside diameter.
3. The connector must also withstand the service induced conditions.

SPECIFIED STANDARDS: None

EVALUATION:
1. Determine maximum stresses incurred in fuel injection tubing by calcualtion per ASME-Section III stress & fatigue analysis - R-48 & V engines.
2. Verify the tube assembly has sufficient strength and life by comparing actual stress levels to yield and endurance limits.
3. Perform fracture mechanics analysis to determine the maximum inner diameter flaw size that will not propagate to tube failure.
4. Evaluate the adequacy of the NDT procedure to guarantee subcritical flaws, if any.
5. Evaluate adequacy of mechanical joints and compression requirements for the Swegelock fittings.
6. Evaluate erosion/corrosion resistance of the tubing to the fuel used in nuclear standby service.

REVIEW TDI ANALYSES:
1. Review TDI R&D test summary report on F.O. injection tubes, RV-005-16.
2. Review any TDI test data on service pressures and flow rates.

INFORMATION REQUIRED:
1. Injection tube assembly drawings and material specifications
2. Manufacturing details; surface finish, required inspections
3. Applicable S/N data for tubing material
4. Service pressures and flow rates

PUSH RODS
03-390

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of plug and friction weld designs Metallurgical examination of friction weld pushrod	160 hrs. @ 100% LOOP/LOCA simulation - 3 engines Experimental endurance test of friction weld pushrod	LP inspection of plug weld - sample basis
RIVER BEND	Verify design type	100 hrs @ 100% 1 engine	LP inspection of plug weld - sample basis
RANCHO SECO	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
V-16 ENGINES:			
GRAND GULF	Verify design type Metallurgical examination of friction weld pushrod	Normal Preop testing Experimental endurance test of friction weld pushrod	LP inspection of plug weld - sample basis
CATAWBA	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
PERRY	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
COMMANCHE PEAK	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
HARRIS	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
VOGTLE	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
V-12 ENGINES:			
MIDLAND	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis
V-20 ENGINES:			
SAN ONOFRE	Verify design type	Normal Preop testing	LP inspection of plug weld - sample basis

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

MAIN AND CONNECTOR PUSHRODS
PART NO. 03-390

Classification B
Completion 2/27/84

PRIMARY FUNCTION: The pushrods form portions of a linkage that transmits camshaft lobe motion to the cylinder intake and exhaust valves, thereby controlling the valve opening and closing cycle by reacting against the valve spring and inertial forces.

FUNCTIONAL ATTRIBUTES:
1. The pushrod loading is compressive, so that the pushrods must have sufficient strength to withstand compressive buckling.
2. The pushrod ends must have acceptable wear resistance.
3. The design of the interface between the pushrod tube and end fitting must minimize the possibility of manufacturing defects and adequately react operational loads.

SPECIFIED STANDARDS: None

EVALUATION:
1. Review the historical evolution of pushrods, including dimensional, material and manufacturing changes.
2. Determine maximum compressive loads for DSR-48, DSRV-16-4, DSRV-12-4, and DSRV-20-4 designs.
3. Review metallurgical analysis performed by Middle South Service for Mississippi Power and Light (MP&L), entitled "Metallurgical Evaluation of Diesel Generator", dated October 1983.
4. Review relevant portions of "Grand Gulf Nuclear Station - Unit 1 Interim Report on Division I and II TDI Generators", dated January 1984.
5. Perform metallurgical examination of failed pushrods.
6. Review friction-welded pushrod end configuration from design, manufacturing, and metallurgical standpoints.
7. Complete report on pushrods on LILCO and MP&L engines (DSR-48 and DSRV-16-4).
8. Complete report on DSRV-12-4 and DSRV-20-4 engines.

REVIEW TDI ANALYSES:
1. Review any TDI analyses related to the evolution of the pushrod cap design from plug weld, to the hardened ball and ultimately to the inertial welded cap.

INFORMATION REQUIRED:
1. Manufacturer drawings and material specifications
2. Rocker arm spring and inertia loads
3. Metallurgical reports of previous plug and ball welded connecting rods which experienced fractures.

ROCKER ARM CAPSCREWS

03-390G

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis: preload and operational induced loads for reduced cross section capscrew design.	100 Hrs @ 100% power LOOP/LOCA simulation - 1 engines	Visual examination on 3 sets per engine, verification of proper torque and current design type
RIVER BEND	Verify similarity to SNPS/GGNS	100 Hrs @ 100% power - 1 engine	Verify proper torque and design type
RANCHO SECO	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-16 ENGINES:			
GRAND GULF	Stress analysis: preload and operational induced loads for uniform cross section capscrew design.	100 Hrs @ 100% power - 1 engine	Verify proper torque and design type
CATAWBA	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
PERRY	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
COMMANCHE PEAK	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
HARRIS	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
VOGTLE	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-12 ENGINES:			
MIDLAND	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to SNPS/GGNS Evaluate differences	Normal Preop testing	Verify proper torque and design type

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

ROCKER ARM CAPSCREWS
PART NO. 03-3906

Classification B
Completion 3/1/84

PRIMARY FUNCTION: The rocker arm capscrews transmit resultant loads from the valve springs, valve opening pressure pushrods, and rocker arm assemblies to the sub cover and cylinder heads.

FUNCTIONAL ATTRIBUTES:

1. The rocker arm capscrews must have sufficient strength to withstand the necessary preload and oscillation loads without fatigue cracking, unacceptable preload relaxation or thread distortion.

SPECIFIED STANDARDS: None

EVALUATION:

1. Determine the stud dimensions from existing design drawings and evaluate the stress at the minimum cross-sectional area resulting from the applied preloads assuming uniform thread lubrication and load distribution. Stress concentration factors for the thread root area will be included in the analysis for the previous TDI design.
2. Determine the stresses experienced at the minimum area resulting from push rod motion, valve spring deflection and valve opening pressure.
3. Determine the total resultant bolt stress and compare to yield and endurance limits.
4. Compare capscrew design and material specification to ASTM A-193.
5. Evaluate the thread specification for resistance to distortion and creep.
6. Perform similar analysis on the previous uniform cross section capscrew design.

REVIEW TDI ANALYSES:

1. Review any TDI stress analyses associated with design/material changes.

INFORMATION REQUIRED:

1. Capscrew preload (hold-down force)
2. Capscrew lubrication
3. Capscrew design drawings and material specifications
4. Rocker arm geometry and drawings
5. Valve spring constants, free length, compressed length
6. Operating loads on the capscrews
7. Valve pop-open pressure in cylinder

JACKET WATER PUMP

03-425

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Stress analysis of impeller/shaft connection, Evaluation of torsional oscillation effect Tapered ductile iron impeller	100 Hrs @ 100% power LOOP/LOCA simulation	Disassemble and LP inspection pump shaft, impeller and gear after 100 Hrs @ 100% power - 1 engine
RIVER BEND	Stress analysis of impeller/shaft/key connection, Evaluation of torsional oscillation effects Tapered bronze impeller with key	100 Hrs @ 100% power - 1 engine	Disassemble and LP inspection pump shaft, impeller and gear after 100 Hrs @ 100% power - 1 engine
RANCHO SECO	Verify similarity to River Bend Evaluate differences	Normal Preop testing	None if River Bend and SNPS inspections acceptable
V-16 ENGINES:			
GRAND GULF	Stress analysis of impeller/shaft/key connection (larger than R48) Evaluation of torsional oscillation effects Tapered bronze impeller with key	100 Hrs @ 100% power - 1 engine	None if analysis shows sufficient factors of safety compared to SNPS/River Bend and inspections are acceptable
CATAWBA	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
PERRY	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
COMMANCHE PEAK	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
HARRIS	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
VOGTLE	Verify similarity to GGNS Evaluate differences	Normal Preop testing	None if analysis shows sufficient factors of safety
V-12 ENGINES:			
MIDLAND	Verify similarity to GGNS Evaluate different torque oscill.	Normal Preop testing	None if analysis shows sufficient factors of safety
V-20 ENGINES:			
SAN ONOFRE	Verify similarity to GGNS Evaluate different torque oscill.	Normal Preop testing	None if analysis shows sufficient factors of safety

DR-03-425

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

JACKET WATER PUMP
PART NO. 03-425

Classification A
Completion 3/18/84

PRIMARY FUNCTION: This pump takes suction from the jacket water standpipe and delivers the required flow of treated jacket water at the required pressure to the engine jacket water header. The jacket water circulates through the engine cylinder jackets, exhaust manifold, the turbocharger intercooler, turbocharger lube oil and jacket water cooler. The Reactor Building Service Water System heat exchanger interfaces with the jacket water system for the ultimate heat removal.

FUNCTIONAL ATTRIBUTES:

1. The pressure boundary must maintain integrity to prevent unacceptable water leaks.
2. The jacket water pump must deliver required flow at normal operating pressure during engine operation.
3. The mechanical seal must be adequately designed for appropriate wear life.
4. The pump shaft must be able to deliver required torque to pump impeller with fluctuating torque input through gear train.
5. Pump drive gear must be adequate to transmit steady state and transient loads.

SPECIFIED STANDARDS: None

EVALUATION:

1. Evaluate design and hydrotest pressures for casing and impeller supplied by Berkeley Pump Co. for the R48 and Pacific Pump for the RV engines.
2. Verify that pumps have run to date with no unacceptable leaks in pressure boundary components.
3. Verify that jacket water pump has provided sufficient flow and pressure such that the cooling water temperature has not exceeded acceptable limits in the absence of other system problems, at rated load and speed.
4. Evaluate pump performance tests.
5. Verify that there have been no unacceptable mechanical seal conditions to date.
6. Analyze stresses in pump shaft due to bending, torque and nut tension on gear and impeller end (R-48 and RV engines).
7. Evaluate the effects of the fluctuating torque input from engine gear train.

REVIEW TDI ANALYSES:

1. Review any TDI analyses associated with changes in impeller attachment configurations.

INFORMATION REQUIRED:

1. Maintenance records associated with pump casing and mechanical seals
2. Start up and operational logs which identify cooling water system temperatures.
3. Design and hydrotest pressure for the casings provided by Berkeley & Pacific Pump Companies
4. Detailed drawings of pump rotors including fits and tolerances on impeller and gear and materials
5. Steady state and transient torque oscillations input to the jacket water pump from the drive gear assembly
6. Pump performance data including mechanical efficiency
7. Gear ratio on pump gear and crank gear
8. LP and visual inspection results of the SNPS jacket water pump assembly following 100 hours at full load and a LODP/LOCA simulation
9. TDI specified procedures for installing gear and impeller on shaft including percent contact required, torque on gear and impeller nut

WIRING & TERMINATION

03-688B

UNIT	ANALYSIS	TESTING	INSPECTION
R-48 ENGINES:			
SHOREHAM	Review test report or other approved qualification method for each cable type supplied by TDI; IAW IEEE 383	None required	Visual examination to identif adequate wiring/terminations industry standards
RIVER BEND	Review 10CFR21 response	None required	Visual examination to identify adequate wiring/terminations industry standards
RANCHO SECO	Review 10CFR21 response	None required	Visual examination to identify adequate wiring/terminations industry standards
V-16 ENGINES:			
GRAND GULF	Review 10CFR21 response	None required	Visual examination to identify adequate wiring/terminations industry standards
CATAWBA	Review 10CFR21 response	None required	Visual examination (etc.)
PERRY	Review 10CFR21 response	None required	Visual examination (etc.)
COMMANCHE PEAK	Review 10CFR21 response	None required	Visual examination (etc.)
HARRIS	Review 10CFR21 response	None required	Visual examination (etc.)
VOGTLE	Review 10CFR21 response	None required	Visual examination (etc.)
V-12 ENGINES:			
MIDLAND	Review 10CFR21 response	None required	Visual examination (etc.)
V-20 ENGINES:			
SAN ONOFRE	Review 10CFR21 response	None required	Visual examination (etc.)

COMPONENT DESIGN REVIEW
TASK DESCRIPTION

WIRING & TERMINATION
PART NO. 03-688B

Classification A
Completion 3/9/84

PRIMARY FUNCTION: The wiring and terminations interconnect instrument, control and power circuits on diesel generator itself and within the control panels.

FUNCTIONAL ATTRIBUTES:
1. Conductors, insulation, and termination must be suitable for specified amp rating.
2. Conductors and insulation must be flame retardant.
3. Material and insulation rating should be appropriate for engine and generator applications.

SPECIFIED STANDARDS: IEEE-383

EVALUATION:
1. Review wiring insulation for compatability with circuit requirements.
2. Flame retardant insulation:
   a. Determine whether insulation is qualified to IEEE-383, UL or some other industry standard.
   b. Determine whether insulation is a material known to have generic fire retardant characteristics.
   c. Determine whether wiring need be installed in individual conduit to minimize insulation damage.
3. Evaluate any special circuit requirements, such as shielded cable.
4. Compare termination type, material, size and insulation ratings with characteristics required for application.

REVIEW TDI ANALYSES: Review if available

INFORMATION REQUIRED:
1. Cable type test reports or other approved qualification method for each cable type supplied with the engine

APPENDIX 7

COMPONENT DATA BASE

This section contains the Owners Group Summary Data Base for the 16 Phase I (Known Problem) components on the lead R-48 diesel engine (Shoreham). The latest summary data bases for all Shoreham and Grand Gulf Components are being provided under separate cover.

E AGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DESIGN RVW. DEG RVW.	DESIGN RVW. NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
01-01A	A	02/16/84	02/10/84	X	X	X		D		F	

CRANKSHAFT AND BEARINGS - CRANKSHAFT & TURNING GEAR

SHOREHAM EXPERIENCE:
1) HOT ALIGNMENT DEFLECTION CHECK OF ENGINE CRANKSHAFT FOR ENGINE 3.
SOURCE: NOS:
RRR 409
2) HOT ALIGNMENT DEFLECTION CHECK OF ENGINE CRANKSHAFT FOR ENGINE 2.
SOURCE: NOS:
RRR 403
3) HOT ALIGNMENT DEFLECTION CHECK OF ENGINE CRANKSHAFT FOR ENGINE 1.
SOURCE: NOS:
RRR 412
4) ROUTINE ALIGNMENT CHECK ON ENGINE 2.
SOURCE: NOS:
RRR 804
5) HOT ALIGNMENT CHECK ON CRANKSHAFT ON ENGINE 4.
SOURCE: NOS:
RRR 894
6) PERFORM HOT WEB DEFLECTION CHECK ON ENG 2.
SOURCE: NOS:
RRR 1290
7) STONE CUT NICKS IN CRANKSHAFT ON ENG NO 2. 3.
SOURCE: NOS:
RRR 1307
LOR 1947
8) PERFORM WARM DEFLECTION CHECKS ON ENG 1.
SOURCE: NOS:
RRR 1316
9) INSTALL CRANKSHAFT GEAR & OIL PLUGS ON ENG 1.
SOURCE: NOS:
ESDER F-46109M
RRR 1092
10) PROVIDE SUPPORT LABOR TO SHOT PEEN CRANKSHAFT ON ENG 1.
SOURCE: NOS:
ESDER F-46109
RRR 1099
11) CRANKCASE INSPECT W/UT & LP EXAMS ON ENG 1.
SOURCE: NOS:
RRR 1017
LOR 1595
12) INSPECT #7 PISTON & BR & 2 MN BEARING CAPS ON ENG 2.
SOURCE: NOS:
RRR 1011

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EPGENCY DIESEL GENERATOR C PONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

NUCLEAR INDUSTRY EXPERIENCE:
1) WHILE FEEDING STEAM GENERATORS WITH THE DIESEL DRIVEN AUXILIARY FEED PUMP, THE DIESEL TRIPPED ON LOW LUBE OIL PRESSURE. STEAM GENERATOR LEVEL WAS MAINTAINED BY USING THE STEAM DRIVEN AUXILIARY FEED PUMP. THE DIESEL FAILURE WAS DUE TO A BROKEN CRANKSHAFT. INSPECTION OF THE ENGINE DID NOT REVEAL A CAUSE FOR THE FAILURE. A METALLURGICAL ANALYSIS OF THE CRANKSHFT IS BEING CONDUCTED.
SOURCE: NOS: MANUFACTURER:
LER TROJAN, 344-1700,770324 ELECTRO-MOTIVE DIV OF GM
2) DURING PERFORMANCE OF SURVEILLANCE PROCEDURES, 2303-M16 "EMERGENCY DIESEL GENERATOR AND COOLING WATER VALVE OPERABILITY TEST," THE "B" DIESEL GENERATOR FAILED TO START. THE REDUNDANT EMERGENCY DIESEL GENERATOR WAS OPERABLE. CAUSE WAS ATTRIBUTED TO IMPROPER MATERIAL IN VERICAL SHAFT BETWEEN UPPER AND LOWER CRANK SHAFT.
SOURCE: NOS: MANUFACTURER:
EPRI TMI 2, 052078, DG-2B FAIRBANKS-MORSE
3) AFTER INSTALLATION OF NEW CYLINDER HEADS, A DELAVAL DG AT SHOREHAM FRACTURED ITS CRANKSHAFT AT THE CRANKPIN AND CRANKARM. EXAMINATION OF 2 OTHER DIESELS SHOWED CRACKS ON THE CRANKSHAFT AND CRANKPIN BEARING FAILURE. PRESENTLY NOT CLEAR WHAT CAUSED THIS FAILURE.
SOURCE: NOS: MANUFACTURER:
IEE SHOREHAM NOTICE 83-98, 08/30/83 TDI
4) CYLINDER #4 HAD EXCESSIVE THREADING (GROOVED RADIALLY) ON THE CRANKSHAFT BEARING. THE CRANKPIN WAS DISCOLORED AND THE CYLINDER LINER WAS GROOVED IN 3 PLACES: 10 INCHES LONG BY 1/16 INCH DEEP.
SOURCE: NOS: MANUFACTURER:
LOCER80.59E PP&L, GRAND GULF 12/10/81, 04/15/82 TDI
5) INFO-PROCEDURE TO MEASURECRANKSHAFT THRUST CLEARANCE.
SOURCE: NOS:
TDI SIM 283

****

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) CRANKSHAFT OIL WAY PLUGS CRACKING DUE TO THE USE OF IMPROPER GAUGE OF MATERIAL ISSUED FOR PLUGS. (M/V "PRIDE OF TEXAS")
SOURCE: NOS:
OTHER TITAN NAVIGATION, INC. LETTER DATED JULY 22 1982; PG. 11
2) EXPERIENCED ENGINE VIBRATION AT CRANKSHAFT DUE TO VIBRATION DAMPER COUPLING FAILURE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN.
OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) TO D.MARTINI (TDI) DATED 03/19/79.
OTHER LETTER FROM M.ZBINDEN TO W.HUDSON DATED 02/02/79.
3) CURRENTLY CHECKING THE CAUSE OF EXCESSIVE MAIN ENGINE CRANKSHAFT DISTORTION. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO R.WARD DATED 12/10/82.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

****

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) ASSEMBLE EXISTING DOCUMENTATION ON REPLACEMENT CRANKSHAFT.

****

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE EXISTING DOCUMENTATION ON REPLACEMENT CRANKSHAFT.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
QR-2
1) PERFORM LP AND EDDY CURRENT INSPECTIONS OF CRANKPIN JOURNAL FILLETS NUMBERS 5, 7 & 8. (GOVERNOR AND GENERATOR ENDS) INSPECTION FOLLOWING 100 HOURS FULL POWER OPERATION. THIS TEST IS TO BE DONE IN EACH ENGINE.
QR-3
1) PERFORM VISUAL INSPECTION OF CRANKPIN JOURNAL SURFACE FOR SIGNS OF DISTRESS.
2) DOCUMENT WITH PHOTOGRAPHS.
3) INSPECTION FOLLOWING 100 HRS OF 100% OPERATION.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DESIGN RVW. DEG RVW.	DESIGN RVW. NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-1408		02/02/84	01/25/84	X	X	X		P		F	

CONNECTING RODS - BEARING SHELLS

SHOREHAM EXPERIENCE:
NONE

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NUCLEAR INDUSTRY EXPERIENCE:
1) DIESEL TRIPPED DUE TO CHANGES IN OIL AND COOLANT TEMP. AND CRANKCASE PRESSURE CAUSED BY INITIAL FAILURE OF CONNECTING ROD BEARING.
SOURCE: NOS: MANUFACTURER:
LER HATCH 2, 366-82079, 820727 FAIRBANKS-MORSE
OTHER SER 67-82, SOER 83-1

****

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) CONNECTING ROD SHELLS WERE FOUND BADLY WORN OR UNFIT FOR FURTHER USE. DELAVAL ADVISED THAT CONNECTING ROD SHELL CRACKING ON COLUMBIA COULD HAVE RESULTED FROM BAD ALLOY MAKEUP BY THEIR VENDORS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZRINDEN TO R.WARD DATED 11/06/80. (MEETING)
OTHER LETTER FROM M.ZRINDEN (STATE OF ALASKA) TO D.MARTINI (TPI) DATED 03/19/79.
OTHER LETTER FROM M.ZRINDEN TO W.HUDSON DATED 02/02/79.
2) LETTER CONTAINS DRAWINGS OUTLINING CONNECTING RODS THAT HAD CRACKED BEARING SHELLS, DAMAGED BOLTS AND/OR THREADS. NEW TORQUE VALUES: LINK ROD TO PIN 1050 FT-LBS; NEW 1.5 IN ROD BOLTS 1700 FT-LBS; OLD ROD BOLTS 2600 FT-LBS; NEW ROD BOX OUT OF ROUNDNESS SPEC: 0.004 IN MAX. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZRINDEN TO FILE DATED 07/05/80.

****

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) INVESTIGATE DESIGN ADEQUACY OF CONNECTING RODBEARINGS INCLUDING SHOREHAM & VALDEZ, ALASKA-COPPER VALLEY ELECTRIC.

****

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) VERIFY MATERIAL PROPERTIES. SUBMIT SAMPLE BEARING SHELLS FOR RADIOGRAPHIC EXAMINATION.

TASK DESCRIPTION:

E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

DR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) AFTER TORSIONAL TEST OF DG 103 SAMPLE BEARINGS FOR RADIOGRAPH & OTHER NDE, TO VERIFY MATERIAL PROPERTIES.
3) DEVELOP NDE PROCEDURE.

E R G E N C Y D I E S E L G E N E R A T O R [illegible] I P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY PVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY PVL. ACC.	QUALITY PVL. REC.
83-341A	A	02/09/84	02/08/84	X	X	X		L		F	

PISTONS - PISTON

SHOREHAM EXPERIENCE:
1) MODIFY PISTON SKIRT-TO-CROWN ATTACHMENT ON ENGINES 1, 2, 3.
SOURCE: NOS:
EEDCR E-38313
RRR 215, 216, 217
LDR 0573
2) DISASSEMBLE PISTONS & INSPECT. ON ENGINE 1, 2, 3. INSTALL NEW PISTON SKIRTS.
SOURCE: NOS:
EEDCR E-46324
RRR 1142, 1143, 1144
LDR 1811
3) PISTON CROWN PITTED @7 CYL ON ENGINE 3.
SOURCE: NOS:
LDR 1668
4) MIC READINGS - CROWN & PILOT SKIRTS 5 & 6 - OUT OF SPEC. ON ENGINE 2.
SOURCE: NOS:
LDR 1841
5) PISTON SKIRT SPOT FACE DEPTH - READINGS EXCESSIVE ON ENGINE 2.
SOURCE: NOS:
LDR 1838
6) L.P. EXAM - MACHINED AREA BOSS AROUND BOLT HOLES-LINEAR INDICATIONS ON PISTON SKIRTS ON ENGINES 1, 2 & 3.
SOURCE: NOS:
LDR 1811, 1818, 1822

****

NUCLEAR INDUSTRY EXPERIENCE:
1) CYLINDER FAILED. CAUSED BY FAILURE OF PISTON ROD PIN BOLTS. THEIR FAILURE WAS CAUSED BY ARTICULATING ROD PIN BOLTS AND PISTON PIN BOLTS BEING STRETCHED PROBABLY DURING PARTIAL PISTON SEIZURE.
SOURCE: NOS: MANUFACTURER:
LER COOPER 298-80027, 800508 COOPER-BESSMER
2) THE CROWN AND SKIRT OF ONE PISTON SEPARATED CAUSING A DISCERNABLE CHANGE IN ENGINE SOUND. EXAMINATION OF PISTON REVEALED FAILURE OF HOLD DOWN STUDS ADJACENT TO SPHEARICAL WASHERS USED UNDER THE BOTTOM STUD NUTS.
SOURCE: NOS: MANUFACTURER:
OTHER GRAND GULF REPORT NO. 83-024 9/22/83 TDI
OTHER IOCFR 50.55E, MPEL, GRAND GULF 12/10/81 AND 04/15/82
3) DURING D.G. INSPECTION, EROSION DAMAGE TO PISTONS AND CYLINDER LINERS WAS DISCOVERED, CAUSED BY WATER LEAKAGE INTO THE CYLINDER IN AND AROUNDTHE INJECTION NOZZLES.
SOURCE: NOS: MANUFACTURER:
SER ROBINSON 2, 56-80, 12/07/80 FAIRBANKS-MORSE

ERGENCY DIESEL GENERATOR MPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

OTHER AMERICAN BUREAU OF SHIPPING. REPORT NO. HAI-82-7600. AUG.19, 1982.
4) CYLINDER HEADS: ALL 32 CYLINDER HEADS HAVE BEEN REMOVED, REINSTALLED OR RENEWED AT LEAST THREE TIMES FOR REASONS OF LEAKING OR FRACTURED HEADS, UNDER SIZED PISTONS, CRACKED VALVE SEATS, FAULTY LINER SEALS, BROKEN OR STUCK VALVES, BROKEN VALVE GUIDES, ETC. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN.
OTHER LETTER-W.R.HUDSON TO D.H.MARTINI 12/14/76.
5) ALL 32 PISTONS HAVE BEEN REMOVED AND REINSTALLED AT LEAST ONCE FOR REASONS OF CYLINDER LINER SEAL RENEWAL, ONE RENEWED DUE TO IMPROPER RING GROOVE MACHINING AND ONE RENEWED FOR UNDERSIZED DIAMETER. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-W.R.HUDSON TO D.H.MARTINI-12/14/76.
6) VARIATIONS IN TORQUE OF PISTON CROWN NUTS. INITIALLY INSTALLED WITH 85 TO 100 FT LBS-FOUND LATER TO VARY FROM 75 TO 120 FT LBS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER LETTER TO B.DURIE (TDI) FROM M.ZBINDEN (STATE OF ALASKA) DATED 02/29/80.
OTHER LETTER TO D.MARTINI (TDI) FROM M.ZBINDEN (STATE OF ALASKA) DATED 03/19/79.
OTHER LETTER FROM M.ZBINDEN TO W.HUDSON DATED 02/02/79.
7) FRETTING BETWEEN PISTON CROWN AND SKIRTS AT 4500 HOURS SINCE PISTON MODIFICATIONS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
8) CHROME FAILURE ON PISTON RINGS (1978 SEASON) (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
9) PISTONS BEING REMACHINED TO REDUCE CROWN DIAMETERS WHICH MAY REDUCE LINER SCORING OR BROACHING CONDITIONS, CARBON BUILD UP IN AREA OF COMPRESSION RINGS-REWORK OF 4TH RING GROOVE AREA REQUIRED. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) TO C.MATHEWS (TDI) DATED 12/24/83.
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO P.WARD DATED 12/10/80.
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
10) ABNORMAL CARBON DEPOSITS AND FORMATIONS ON PISTONS AND CYLINDER HEAD ASSEMBLY. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA).
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA TO FILE DATED 02/05/80.
OTHER LETTER FROM M.ZBINDEN TO D.MARTINI DATED 03/10/79.
11) PISTONS REQUIRED REMACHINING BY TDI DUE TO MANUFACTURING DEFECT. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO FILE (04/09/81)
OTHER MEETING BETWEEN TDI (C.MATHEWS) & ALASKA (R.LINDI DATED 09/04/80.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

4) THE "2J" EDG TRIPPED ON HIGH JACKET COOLANT TEMPERATURE ON JUNE 13, 1983 DURING SURVEILLANCE TESTING. THE TRIP SETPOINT WAS FOUND TO BE LOWER THAN REQUIRED. THE SETPOINT WAS ADJUSTED SATISFACTORILY. INTERNAL COOLING WATER LEAKAGE RESULTED IN A HIGH CRANKCASE PRESSURE TRIP ON JUNE 14, AND CAUSED A CRACKED PISTON AND CYLINDER LINER. THE "2J" EDG WAS REPAIRED AND RETURNED TO SERVICE ON JUNE 20, 1983.
SOURCE: NOS: MANUFACTURER: FAIRBANKS-MORSE
LER NO ANNA 2, 339-83050, 830613

5) ENGINE WAS OVERHAULED TO REPLACE A CRACKED PISTON STEEL CROWN, ON A TDI 8 CYLINDER ENGINE AT KUOSHENG, TAIWAN.
SOURCE: NOS: MANUFACTURER: TDI
OTHER TELEX FROM PEI TO LILCO DATED 11/28/83

6) ENGINE PISTON SKIRT CASTINGS. POTENTIAL PROBLEM IS WITH PISTON SKIRT CASTINGS. RESIDUAL STRESS, CAUSED BY METHOD OF HEAT TREATING, IN COMBINATION WITH OPERATING STRESS COULD CAUSE CRACKING OF PISTON SKIRT DUPING OPERATION AND IF UNDETECTED COULD RESULT IN ENGINE FAILURE.
SOURCE: NOS: MANUFACTURER: TDI
10CFR50.55E CAROL POWER & LIGHT 01/14/83, TVA 01/24/83

7) MODIFIED CROWN DESIGNED TO REDUCE OIL CONSUMPTION.
SOURCE: NOS:
TDI SIM #350

7) INFO-PISTON CROWN STUDS CANNOT BE REVISED.
SOURCE: NOS:
TDI SIM-324A

8) PISTON MOD. REDUCE OIL CONSUMPTION & CONTAMINATION.
SOURCE: NOS:
TDI SIM-324 REV.3

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) PISTON SKIRT DISINTEGRATED DURING OPERATION. EXAMINATION SUGGESTS THAT BREAKAGE WAS CAUSED BY A STRESS RISER IN WAY OF THE BELLVILLE WASHER FASTENING DEVICE. OTHER INTERNAL PARTS DAMAGED AS A RESULT. (M/V "PRIDE OF TEXAS")
SOURCE: NOS:
OTHER TITAN NAVIGATION, INC. LETTER DATED JULY 22, 1992; PG 5.
OTHER NAUTILUS SURVEY INC. DAMAGES TO PORT MAIN ENGINE, MALTA, JUNE 1982, PERMANENT REPAIRS REPORT.
OTHER J.F. GOLLCHER & SONS LTD. REPORT NO. RS/MP. 708, JULY 5, 1992
OTHER THE SALVAGE ASSOC. DATED 07/16/82

2) PISTON PIN BORE DIAMETERS WERE NOTED TO BE INCONSISTANT. BORE DIAMETER VARIABLES FROM ONE SIDE OF PISTON TO OTHER SIDE OF PISTON. (M/V "PRIDE OF TEXAS")
OTHER TITAN NAVIGATION, INC. LETTER DATED JULY 22 1992; PG. 6.
OTHER NAUTILUS SURVEYS INC. DAMAGES TO PORT MAIN ENGINE, MALTA JUNE 1982 PERMANT REPAIRS REPORT SECTION A, P 2.
OTHER THE SALVAGE ASSOC. DATED 07/16/82

3) INSPECTION OF BOTH MAIN ENGINES AFTER 3400 HOURS OF OPERATION REVEALED THAT 6 PISTON SKIRTS (OUT OF 24 TOTAL) WERE CRACKED. ALL CRACKS APPEARED TO ORIGINATE AT THE SHARP NOTCH CREATED AT THE TERMINATION OF THE FILLET RADIUS MACHINED IN WAY OF PISTON SKIRTS STUDS NUTS LANDINGS. (M/V "STAR OF TEXAS")

E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

1*: PISTON FAILURES DUE TO FAILED LINERS AND CONNECTING RODS, CROWN TO SKIRT OIL SEAL FAILURES. PISTON MODIFIED-DECREASING CROWN DIAMETER, MODIFYING LUBE OIL PASSAGES AND SEALS, MACHINERY OF RING GROOVES AND PISTON SKIRTS. ALSO FRETTING UNDER BOLTED SURFACES AND BOLT WASHERS, BROKEN SKIRT BOLTS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SFS REPORT #123-01 DATED / / , PG 3-15, 6-3.

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) INVESTIGATE KODIAK, ALASKA EXPERIENCE.
2) PERFORM DETAILED FINATE ELEMENT MODEL DESIGN REVIEW OF AE PISTON CONFIGURATION.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE EXISTING NDE DOCUMENTATION & DEVELOP PLAN FOR POST-TEST NDE EXAMINATION.

TASK DESCRIPTION:
OR-1
1) ASSEMBLE & REVIEW EXISTING DOCUMENTATION.
2) PERFORM A LIQUID PENETRANT TEST UTILIZING APPROVED LILCO PROCEDURE OF THE PISTON SKIRT AT THE BOSSES FOR BOLT ATTACHMENT OF CROWN, ALSO L.P. TEST THE PISTON PIN BOSS AREA.
3) PERFORM A VISUAL INSPECTION OF THE SKIRT AND CROWN O.D. FOR SCUFFING, AND COMBUSTION BOWL IN CROWN FOR PITTING.
4) EAA TO DEVELOP AN EDDY CURRENT TEST PROCEDURE TO BE APPROVED BY LILCO, TO CONFIRM THAT ANY INITIATED CRACKS HAVE ARRESTED AT OR BELOW PREDICTED DEPTHS.
NOTE: SELECT A CONSERVATIVE AND REASONABLE NUMBER (3 PER ENGINE) FOR INSPECTION.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEC RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-369A	B	02/16/84	02/09/84	X	X	X		Q		F	

CYLINDER HEAD VALVES - CYLINDER HEAD.

SHOREHAM EXPERIENCE:
1) CHANGE CYLINDER HEADS WITH NEW PRODUCTION MODEL. PART 50.55 (e).
SOURCE: NOS:
EDDER E-45083
RRR 408, 636, 661, 670, 712, 714, 715, 717, 744, 863, 897, 951, 952, 998
LER 1060, 1065
2) REPLACE DEFECTIVE ENG. CYL. HEAD. CASTING DEFECTS ON ENGINE 1.
SOURCE: NOS:
RRR 408, 661, 744
LER 1065
3) INSPECT ENGINE CYLINDER HEAD FOR LUBE OIL LEAKS ON ENGINE 1.
SOURCE: NOS:
RRR 663
4) FABRICATE PLATES/RIG. FOR HYDRO TEST ON CYL. HEADS.
SOURCE: NOS:
RRR 1059

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NUCLEAR INDUSTRY EXPERIENCE:
1) DURING OPERATION, WATER WAS FOUND COMING FROM FUEL TUBE PASSAGE IN CYLINDER HEAD. POROSITY WAS FOUND IN CYLINDER HEAD. NEW HEAD WAS INSTALLED.
SOURCE: NOS: MANUFACTURER:
LER PILGRIM 1 293-76000, 760202 ALCO ENGINE DIV.
EPRI EPRI-NP-2433 6/82
2) ENGINE STARTED WITH PISTON FLOODED WITH WATER. DAMAGE WAS RENT CONNECTING ROD, RUPTURED CYLINDER WALL, AND BROKEN PISTON. EMD DIESEL HAD CRACK IN CYLINDER HEAD WHICH EXTENDED BETWEEN 2 EXHAUST VALVE SEATS AND INTO JACKET WATER WHICH IS HIGH HEAT STRESS AREA.
SOURCE: NOS: MANUFACTURER:
LER SURRY 1 280-76000, 760416 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433 6/82
3) DURING DIESEL TESTING, WATER WAS OBSERVED COMING OUT OF CYLINDER. ENGINE HAD HEAD AND GASKET REPLACED. ENGINE WAS FOUND TO HAVE A CRACK IN EMD CYLINDER HEAD WHICH EXTENDED BETWEEN 2 EXHAUST VALVE SEATS AND INTO WATER JACKET.
SOURCE: NOS: MANUFACTURER:
LER SURRY 1 280-76000, 760702 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433 6/82
4) PRIOR TO STARTING DIESEL, WATER WAS DETECTED IN CYLINDER. ENGINE SUSTAINED A CRACK IN CYLINDER HEAD BETWEEN 2 EXHAUST VALVE SEATS AND THROUGH JACKET WATER.
SOURCE: NOS: MANUFACTURER:
LER SURRY 1 280-76000, 760723 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433 6/82
5) WATER WAS OBSERVED DRIPPING OUT OF THE AIR BOX DRAIN. THIS WATER HAD ENTERED THE AIR BOX FROM

EPGIENCY DIESEL GENERATOR [IPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DES RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

61 CYLINDER VIA THE CYLINDER AIR INLET PORTS. THE PISTON IN THIS CYLINDER WAS NEAR THE BOTTOM OF THE STROKE WHICH OPENED THE AIR INTAKE PORTS. COMPONENT FAILURE: EMD-GM TURBO VEE 20, 3B10 BHP DIESEL ENGINE SUSTAINED A CRACK IN #1 CYLINDER HEAD WHICH EXTENDED FROM AN EXHAUST VALVE SEAT APPROX 3/4 OF DISTANCE TO INJECTOR WELL AND THROUGH TO WATER JACKET.
SOURCE: NOS: MANUFACTURER:
LER SURRY 1,280-76000,760508 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433, 06/82
61 CRACKED CYLINDER HEADS HAVE BEEN OBSERVED AT THE SHOREHAM NUCLEAR POWER STATION, AS WELL AS OTHER FACILITIES WHICH USE DIESEL GENERATORS MANUFACTURED BY TRANSAMERICA DELAVAL, INC.
DATE: 04/15/83
SOURCE: NOS: MANUFACTURER:
IEE SHOREHAM, NOTICE 83-51 TDI
71 CYLINDER HEAD WATER LEAKS WERE OBSERVED, ON A TDI 8 CYLINDER ENGINE AT KUOSHENG, TAIWAN.
SOURCE: NOS:
OTHER TELEX FROM PEI TO LILCO DATED 11/28/83
81 DURING INSPECTION OF TDI V-16 ENGINES CYLINDER HEADS, ONE WAS FOUND TO HAVE CRACKS. THE CRACKS WERE IN THE STELLITE SEAT FOR THE EXHAUST VALVES - ONE CRACK WAS APPARENTLY A THROUGH-WALL CRACK.
SOURCE: NOS: MANUFACTURER:
OTHER TELECON C.SEAMAN&LILCOTCH.ANGLE&MPLION 12/13/83.TDI
91 MOD OF VALVE GUIDES TO CONTROL OIL CONSUMPTION.
SOURCE: NOS:
TDI SIM-301, REV. 1
101 INFO-METHOD FOR MEASURING STEM TO GUIDE CLEARANCES.
SOURCE: NOS:
TDI SIM-235
111 INFO-CYL HEAD VALVE SEAT REPAIR PROCEDURE.
SOURCE: NOS:
TDI SIM-249, REV. 2
121 INFO-CYL HEAD OVERHAUL PROCEDURE.
SOURCE: NOS:
TDI SIM-250, REV. 1

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NON-NUCLEAR INDUSTRY EXPERIENCE:
11 FIVE HEADS HAVE FAILED-LOCKED UP. CASTING STRESSES IN HEADS, SEVERE AERATION PROBLEM IN STARBOARD ENGINE CONTRIBUTED TO HOT SPOTS IN HEAD. TDI STATED STANDPIPE CAUSED AERATION. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER MINUTES OF MEETING WITH TDI AT LAKE SHIPPING OFFICE (11/20/80) (M/V GOTT)
21 TWO HEADS STRESS RELIEVED PICKLED HEADS EXHIBITED VERTICAL CRACKS IN BACK WALL OF EXHAUST PORT. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER TDI MEMO FROM G.RUSSELL TO C.MATTHEWS DATED 02/17/81. (M/V GOTT)
31 FOUR QUANTITY HEADS FAILED WATER TEST. ONE QUANTITY WAS AN SR HEAD. EXPECT 3 MORE HEADS

EMERGENCY DIESEL GENERATOR MOVEMENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

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FAILED, BUT PASSED WATER TEST. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO G.KING 02/27/81. (M/V GOTT)
4) TDI TELEX-RECONDITIONED HEADS WILL BE ABS INSPECTED -SOME HEADS WILL BE CUT UP FOR EXAMINATION. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER TELEX FROM J.MOUNTIN (TDI) TO LINDA BLOCK (01/27/81) (M/V GOTT)
5) HEAD CRACKED THROUGH INTAKE SEAT.
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO FILE DATED 01/23/82 (M/V GOTT)
6) HEAD LEAKING JACKET WATER INTO EXHAUST CHAMBER -REPLACED HEAD & GASKETS. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER USS CORP MECHANICAL REPORT 81-232 (10/09/81) FROM R.HUTTON (M/V GOTT)
7) LIST OF CYLINDER HEADS (TDI) IN SERVICE ON 09/01/83 MANUFACTURED BY TDI SINCE 1978. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER USS GRANT LAKES FLEET SERVICE DATED 09/07/83 (M/V GOTT)
8) CYLINDER CRACKED IN WAY OF BRIDGE BETWEEN EXHAUST VALVE CAVITIES. INSTALL CYLINDER HEAD. (M/V "GOTT")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/30/83) TO C.SEAMAN
OTHER USS CORP. MECHANICAL REPORT NO. 80-96 (07/18/80) AND NO. 80-176 (11/13/80)
OTHER TELEX FROM B.LIBERTY (LAKE SHIPS) TO TO B.DURIE (11/18/80)
OTHER TELEX FROM S.SCHUMACHER TO B.LIBERTY (11/18/80)
OTHER USS CORP. MECHANICAL REPORT (11/01/79)
OTHER MEMO FROM TDI DATED 01/23/81. FROM SSCHUMACHER. TELEX 335304 TO LINDA BLOCK FROM JOHN MOUNTIN (01/17/81) (M/V GOTT).
9) ALL 32 CYLINDER HEADS HAVE BEEN REMOVED, REINSTALLED OR RENEWED AT LEAST THREE TIMES FOR REASONS OF LEAKING OR FRACTURED HEADS, UNDER SIZED PISTONS, CRACKED VALVE SEATS, FAULTY LINER SEALS, BROKEN OR STUCK VALVES, BROKEN VALVE GUIDES, ETC. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-W.R. HUDSON TO D.H.MARTIN- 12/14/76
10) EIGHT CYLINDER HEADS REMOVED AND RETURNED TO TDI AFTER EVIDENCE OF CRAKS FOUND. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-M.ZBINDEN TO J.BARICH-07/29/88
11) PRIOR TO THE START OF 1979 SEASON, #7 CYLINDER HEAD ON THE STARTBOARD ENGINE FOUND CRACKED THROUGH THE VALVE BRIDGE. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-M.F.ZBINDEN TO W.HUDSON-02/0279
12) SEVEN CYLINDER HEADS HAD CRACKS-ONE OF THE HEADS CRACKED IN THE EXHAUST PASSAGE AND PORT AREA JUST ABOVE A RENEWED VALVE SEAT, AND DEFECTS OR BLOWN RINGS. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEC RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) TO D.MCLDAVIDSON (FERGUSON & PURDELL) DATED 07/25/80.
OTHER LETTER FROM M.ZBINDEN TO D.MARTINI (TDI) DATED 06/14/79 AND 03/19/79
OTHER LETTER-M.F.ZBINDEN TO W.HUDSON-02/02/79
(3) ACTION TAKEN SINCE VESSEL DELIVERY-INSTALLED RELIEF PASSAGES IN CYLINDER HEADS TO PERMIT COMBUSTION GASES, LEAKING PAST FIRE RINGS, TO VENT INTO ENGINE ROOM. PRIOR TO THIS, GASES WOULD ENTER JACKET WATER SYSTEM AND CAUSE AIR BINDING OF CIRCULATING PUMPS. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
(4) ADDITION OF "POSTS" TO EXISTING CYLINDER HEADS SHOULD RESOLVE WARPAGE AT 3 & 9 O'CLOCK POSITIONS AND BURN OUT OF FIRE RINGS. DELAVAL NOW STRESS RELIEVES ALL HEADS AFTER VALVE SEAT REWORK-HEADS SO MARKED SR. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEETING BETWEEN TDI (C.MATHEWS) AND ALASKA (R.LIND) ON 09/04/80
OTHER LETTER-GE TRUSSEL TO M.ZBINDEN-11/29/78
OTHER LETTER FROM M.ZBINDEN TO W.HUDSON DATED 02/02/79
OTHER LETTER FROM M.ZBINDEN TO D.MARTINI DATED 03/19/79
(5) SUMMARY OF PROBLEMS-WARPAGE OF CYLINDER HEADS AND FIRE RING BURN OUT. CRACKING OF VALVE SEATS AND CYLINDER HEADS. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI)DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
OTHER LETTER FROM M.ZBINDEN TO M.MARTINI DATED 01/16/80
OTHER LETTER FRO M.ZBINDEN TO TDI DATED 07/10/79, 03/29/79 AND 03/19/79
OTHER LETTER FROM M.ZBINDEN TO W.HUDSON DATED 02/02/79
(6) DURING OVERHAUL, CYLINDER HEAD WAS REMOVED DUE TO INDICATIONS OF INTERNAL WATER LEAKAGE. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) TO B.DURIE (TDI) DATED 06/17/80
(7) LINERS RECEIVED HAD IMPROPER FINISH-REQUIRED REWORK. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO FILE (04/09/81)
(8) SIXTEEN NEW HEADS DEFECTIVE DUE TO CASTING CORE SHIFT WHICH BLOCKED OF COOLING WATER PASSAGE -REPAIRED BY GRINDING & WELDING. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZBINDEN TO R.LIND (STATE OF ALASKA) DATED 06/17/81 AND M.ZBINDEN TO FILE (STATE OF ALASKA)DATED 06/01/81 AND 04/29/81
OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) DATED 09/12/83
(9) ALLEGATIONS MADE THAT THE ENTIRE FORCE OF CYLINDER BOLTS IS BORNE BY THE LINER CAUSING THE HEAD TO SEPARATE FROM THE BLOCK. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER GROM G.TRUSSEL (TDI) TO D.THOMPSON (ALASKAN MARINE HIGHWAY)(10/27/81)
(10) TDI RECOMMENDS: REBUILD CYLINDER HEAD, NEW EXHAUST VALVE, SPRING ETC. REMOVE CYLINDER HEAD AFTER 5000 HRS OF OPERATION AND CHECK EFFECTS OF PISTON CROWN CUTBACK, WATER WASH SYSTEM, ENHANCED AIR FLOW. (M/V "COLUMBIA")
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO R.PRATT (07/09/82) PG 1,2.
(11) DISCUSSION CONCERNING HEAD-HEAD REMOVED, FIRESEALS IN GOOD CONDITION, EXHASUT VALVES LEAKING ,INTAKE VALVES GOOD-POSSIBLY DUE TO IMPROVEMENT OF COMBUSTION. (M/V "COLUMBIA")

E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO R.PRATT (07/09/82), PG 2,3
22) STATE OF ALASKA SENT TDI 6 JUNK HEADS (3 HAVE CRAKS BEYOND REPAIR POSSIBLY CAUSED BY EXHAUST VALVE SEAT RENEWAL). ONE HEAD FROM TDI DAMAGED IN TRANSIT. SOME HEADS RECEIVED HAD BEEN BUTCHERED-CRACKS, TAP BROKEN OFF IN THREADED HOLE, DAMAGED FLANGE FACES, SOME HEADS WELDING SLAY, PITS, BLOW HOLES, RUST. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FRIM MAX ZRINDEN (STATE OF ALASKA) TO HUGH MCDONALD (03/09/83)
OTHER LETTER FROM M.ZRINDEN (STATE OF ALASKA) TO R.BAILEY (TDI) (03/01/83 AND 03/07/83)
OTHER LETTER FROM M.ZRINDEN(STATE OF ALAS KA) TO B.BAILEY (TDI) 12/02/8_.
23) FIRE RING DISTRESS AND/OR FAILURE OF HEADS CAUSED BY UNSYMMETRICAL HEAD BOLTING PATTERN CAUSING MOMENTS WITHIN THE HEAD ASSEMBLY. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT NO. 123-01 DATED APRIL 1983, PG 3-10, 4-7
24) CYLINDER HEAD REMOVAL AND FAILURE RATE VERY HIGH DUE TO POOR CASTABILITY OF CAST STEEL AND CLOSER CONTROLLED FOUNDRY TECHNIQUES REQUIRED, THIN CROSS SECTIONS, MISALIGNED COOLING PASSAGES. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT NO. 123-01 DATED APRIL 1983, PGS 3-7, 3-8, 6-3
25) CYLINDER HEADS HAVE EXCESSIVELY HIGH FAILURE RATE-WARPAGE, CRACKING, LOSS OF FIRE RING SEAL, ETC. X-RAYS SHOWED GAS POCKETS FROM CASTING AND INADEQUATE WELD REPAIRS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS III, III-2, VI

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) ASSEMBLE & REVIEW EVALUATIONS COMPLETED TO DATE.

TASK DESCRIPTION:
1) TO EVALUATE RESISTANCE TO CRACKING OF ORIGINAL AND CURRENT CYLINDER HEAD DESIGNS AND DETERMINE COMPLIANCE WITH ABS STANDARDS.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE & REVIEW EVALUATIONS COMPLETED TO DATE.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) ASSEMBLE AND REVIEW EVALUATIONS COMPLETED TO DATE.
QR-2
1) PERFORM LP INSPECTION OF EXHAUST AND INTAKE VALVE SEATS AND FIRE DECK AREA BETWEEN EXHAUST VALVES.
2) INSPECTION FOLLOWING 100 HOURS FULL POWER OPERATION. THIS TEST IS TO BE PERFORMED ON 3 CYLINDERS OF EACH ENGINE.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

THORENAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	HD RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

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E A G I N E Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-3ESC	A	02/20/84	07/16/84	X	X	X		U		E	

CYLINDER BLOCK LINERS & WATER MANIFOLD - CYLINDER LINER

SHOREHAM EXPERIENCE
1) PITTINGS ON #7 CYL. LINER ON ENGINE 2.
SOURCE: NOS:
LER 1679
2) REMOVE #8 CYL LINER FOR INSPECTION ON ENG 1.
SOURCE: NOS:
RRR 1171
3) DG 101, #7 CYLINDER-REPLACED CRACKED LINER.
SOURCE: NOS:
RRR 1481

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NUCLEAR INDUSTRY EXPERIENCE:
1) DIESEL TRIPPED UNDER LOAD DUE TO HIGH CRANKCASE PRESSURE. 2 CYLINDER LINERS SCORED. SCORING OF LINERS CAUSED LOCALIZED HEATING AND EXHAUST LEAKAGE INTO OIL SUMP. THIS CAUSED HIGH CRANKCASE PRESSURE.
SOURCE: NOS: MANUFACTURER:
LER FARLEY 2 364-81043, R10910 COLT-PIELSTICK/FAIRBANKS-MORSE
2) DURING NORMAL OPERATION WHILE PERFORMING SURVEILLANCE TESTS ON THE NO. 2 DIESEL GENERATOR, FOUR CYLINDER SLEEVES WERE DAMAGED. THE COMPONENT MANUFACTURER IS PERFORMING AN INVESTIGATION AND AN UPDATED LICENSEE EVENT REPORT WILL BE SUBMITTED AS REQUIRED. ALL DAMAGED PARTS WERE REPLACED.
SOURCE: NOS: MANUFACTURER:
LER COOPER,298-79036,791110 COOPER-BESSMER
3) IAD 75-19) DIESEL GENERATOR 1A FAILED TO START WHILE ATTEMPTING TO PERFORM A LOAD TEST. WHILE THE ENGINE COASTED TO A STOP, AN UNUSUAL HIGH PITCH NOISE EMANATED FROM THE ENGINE. WATER IN OIL FROM LEAK IN CYLINDER OR LINER BELLOWS. LUBE OIL FILTERS REPLACED. OIL CHANGED AND SENSING LINES PURGED. NOISE CAUSED BY CARBON BUILDUP ON TURBINE CASING. TURBOCHARGER REPLACED.
SOURCE: NOS: MANUFACTURER:
LER ZION 1,295-75000,750811 COOPER-BESSMER
EPRI EPRI-NP-2433, 06/82
4) DURING D.G. INSPECTION, EROSION DAMAGE TO PISTONS AND CYLINDER LINERS WAS DISCOVERED. CAUSED BY WATER LEAKAGE INTO THE CYLINDER IN AND AROUND THE INJECTION NOZZLES.
SOURCE: NOS: MANUFACTURER:
SER ROBINSON 2, 56-80, 12/02/80 FAIRBANKS-MORSE
5) CYLINDER #4 HAD EXCESSIVE THREADING (GROOVED RADIALLY) ON THE CRANKSHAFT BEARING. THE CRANKPIN WAS DISCOLORED AND THE CYLINDER LINER WAS GROOVED IN 3 PLACES: 10 INCHES LONG BY 1/16 INCH DEEP.
SOURCE: NOS: MANUFACTURER:
INCERSO.55E MPEL, GRAND GULF 12/10/81, 04/15/82 TDI

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E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) ONE CYLINDER LINER FOUND TO BE SCUFFED AFTER 3000 OPERATING HRS AND WAS CONSEQUENTLY CHANGED OUT. CAUSE UNKNOWN (COULD BE ISOLATED CASE SINCE NO OTHER LINES WERE SCUFFED).
(M/V "PRIDE OF TEXAS")
OTHER TITAN NAVIGATION, INC. LETTER DATED JULY 22, 1982; PG. 12
2) ALL 32 CYLINDER LINES HAVE BEEN REMOVED AND REINSTALLED AT LEAST ONCE FOR REPLACEMENT AT LEAS T ONCE FOR REPLACEMENT OF LINER SEALS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-W.R.HUDSON TO D.H.MARTINI-12/14/76
3) APPROX 21 OF 32 LINERS HAVE LOST THEIR CRUSH-REPAIR ACTION WOULD REQUIRE MACHINING ENGINE BLOCK AND INSERTION OF A SHIM TO RESTORE THE CRUSH WHICH RESTRAINS THE LINER IN POSITION VERTICALLY. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZRINDEN (STATE OF ALASKA) TO R.WARD DATED 12/10/80.
OTHER LETTER FROM M.ZRINDEN TO D.MARTINI (TDI) DATED 07/10/79 AND 03/19/79.
4) STATE OF ALASKA WILL INSTALL A CYLINDER WATER-WASH SYSTEM WHICH MAY POSSIBLY REDUCE CARBON BU ILD UP IN THE COMBUSTION AREA. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZRINDEN (STATE OF ALASKA) TO R.WARD DATED 12/10/80.
5) LINERS NOT MAINTAINING THEIR DIMENSIONS, REQUIRING REMACHINING-DUE TO EXCESSIVE PISTON SIDE THRUST. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZRINDEN TO R.LIND (STATE OF ALASKA) DATED 06/17/81.
OTHER LETTER FROM M.ZRINDEN (STATE OF ALASKA) TO C.MATHEWS (TDI) DATED 12/24/80.
OTHER MEMO FROM ZRINDEN TO R.WARD DATED 12/10/80.
6) CYLINDER LINER INSPECTED-SCUFFING AND SCRATCHES FOUND. VERY LITTLE CARBON BUILDUP ABOVE TOP RING TRAVEL (WAS NON-EXISTENT ON MOST OF THE CIRCUMFERENCE). PISTON CROWN IN EXCELLENT SHAPE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO R.PRATT (07/09/82), PG 2.
7) CYLINDER LINER FRACTURE CAUSED BY HIGH COMPRESSIVE STRESSES ON THE COUNTERBORE LIP, LOCALIZED STRESS CONDITION FROM THE COMBINATIONS OF SHARP INTERNAL CORNER FOR LIP (1/32 INCH RADIUS), NEARBY DRILLING FOR WATERJACKET OR STUD, TERMINATION OF STUD THREADING AT THE SAME LEVEL, CREEP DEFORMATION, AND FATIGUE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS IV.
8) CYLINDER LINERS DEFORMED DUE TO ENGINE BLOCK DEFORMATION AND CRUSH (ENTIRE FORCE OF HEAD BOLTS IS BORNE BY THE LINER AND THE HEAD IS SEPARATED FROM THE BLOCK SURFACE. CYLINDER LINERS SHOWED HEAVY GROOVING. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS II, II-6, II-9, VIII-PG 1, 2, 8, 12, 16, 25, 27.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	D&G RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

9) CYLINDER LINERS OUT OF ROUNDNESS DUE TO METAL CREEP. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS 1-9.
10) HIGH CYLINDER LINER FAILURE RATE-REQUIRES HONING TO RESTORE ROUNDNESS/SURFACE QUALITY. ALSO, LINERS REPLACED DUE TO LINER SEAL FAILURE. GALLING OF LINERS DUE TO FOREIGN MATTER OR CHROME FROM RING SURFACES FLAKING OFF. WEAR DUE TO INCOMPLETE COMBUSTION, RAW FUEL IMPINGEMENT. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT 8123-01 DATED APRIL 1983, PG 3-11 THRU 3-14, 4-3, 6-3
11) VALVE GUIDES BREAKING OFF AND DAMAGING HEADS DUE TO CARBON BUILD UP. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT 8123-01 DATED APRIL 1983, PG 3-8

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW UNIVERSITY OF TEXAS 8-CYL. IN-LINE TDI (DSR-4P) ENGINE CYLINDER LINER ABNORMALITY FAILURES.
2) PERFORM PRESSURE AND THERMAL GROWTH ANALYSIS INCLUDING INTERACTION WITH CYLINDER BLOCK.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) DOCUMENT VERIFICATION. PERFORM DIMENSIONAL VERIFICATION ON BORE, LENGTH, HEIGHT & O.D. INCLUDING SHOULDER HEIGHT.
2) ASSEMBLE EXISTING TDI MATERIAL SPECIFICATION DOCUMENTATION AND DEVELOP INSPECTION PLAN FOR VERIFYING LINER MATERIAL PROPERTIES.

TASK DESCRIPTION:
OP-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION
2) VERIFY DIMENSIONS INCLUDING BORE, LENGTH, HEIGHT, O.D., AND SHOULDER HEIGHT.
3) DEVELOP INSPECTION PLAN TO VERIFY MATERIAL PROPERTIES BY USE OF COMPARITER.
OP-2
1) PERFORM VISUAL INSPECTION OF OUTSIDE PILOT DIAMETER AS TO WHERE IT CONTACTS CYLINDER BLOCK. LOOK FOR INDICATIONS OF CONTACT, SPALLIN VISUALLY INSPECT PISTON LINER OVER ZONE OF PISTON TRAVEL. LOOK FOR INDICATIONS OF SCUFFING, SCORING . DOCUMENT ALL INSPECTIONS WITH PHOTOGRAPHS (FOLLOWING 100 HRS. AT FULL LOAD)

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-315A	A	02/20/84	02/16/84	X	X	X		C		F	

CYLINDER BLOCK LINERS & WATER MANIFOLD - CYLINDER BLOCK.

SHOREHAM EXPERIENCE:
1) INSPECT CAM GALLERY FOR CASTING INDICATIONS ON ENGINE 1,2, & 3.
SOURCE: NOS:
RRR 867, 868, 869, 870, 871, 872, 874, 880
LOR 1224
2) CLEAN ENGINE CRANKCASE ON ENGINE 2.
SOURCE: NOS:
RRR 32
3) CLEAN ENGINE LIFTER OIL PASSAGES #1 CYL. FORENGINE 3.
SOURCE: NOS:
RRR 547
4) DISASSEMBLE, INSPECT & REASSEMBLE #7 CYLINDER ON ENG 1. DISASSEMBLE, INSPECT & REASSEMBLE #3 CYLINDER ON ENG 3.
SOURCE: NOS:
RRR 1480, 1482, 1483

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NUCLEAR INDUSTRY EXPERIENCE:
1) INFO-CYLINDER BLOCK REPAIR OF CORROSION.
SOURCE: NOS:
TDI SIM 247

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NON-NUCLEAR INDUSTRY EXPERIENCE:
1) THE FORWARD OUTBOARD CYLINDER BLOCK OF THE STARBOARD MAIN ENGINE OF THE VESSEL CRACKED DUE TO THE ENTRY OF WATER FROM THE COOLING SYSTEM INTO THE AIR INTAKE SYSTEM OF THE ENGINE, PERMITTING THE ENTRY OF WATER INTO A CYLINDER DURING THE COMPRESSION CYCLE. THE SOURCE OF THE COOLANT WATER WAS LEAKAGE FROM THE JACKET WATER COOLING SYSTEM INTO THE COMBUSTION AIR INTAKE SYSTEM AS A RESULT OF LEAKING TUBES IN THE STARBOARD OUTBANK INTERCOOLER. (M/V "PRIDE OF TEXAS")
SOURCE: NOS:
OTHER LETTER TO W.BUSCH FROM J.BLAIN DATEDAPRIL 21, 1983/COMPLAINT C.A. NO. H-83-2470 FILED IN U.S. DISTRICT CT.T NO. 52, PG. 4.
OTHER U.S. SALVAGE ASSOC., INC., CASE REPORT NO. 52-15573, 07/01/82
OTHER AMERICAN BUREAU OF SHIPPING, REPORT NO. HA-81-2539, 12/16/81
OTHER THE SALVAGE ASSOC, SURVEY REPORT NO.CHO830, 04/01/82
2) BLOCK CYLINDER BORES WERE FOUND EGG SHAPED. MANY OF THE LINERS ARE EGG SHAPED ON THE O.D. AND SEVERAL HAVE UNDERSIZE FLANGES. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZINDEN (STATE OF ALASKA) TO P.WARD (01/16/81).
3) EXTENSIVE CRACKING OF CYLINDER BLOCK. MAIN BLOCKS CHECKED FOR ALIGNMENT BY LASERS-DISTORTION

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

WAS EVIDENT. ALSO, MAIN BLOCK THROUGH BOLTS WERE NOT TORQUED ACCORDING TO SPECS.
(M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO P.WARD DATED 03/13/81.
4) FINAL CAM TAPPET COULD NOT BE PLACED INTO POSITION DUE TO DEFICIENT CYLINDER BLOCK
TOLERANCES. TAPPET ASSEMBLIES REQUIRED MILLING PRIOR TO INSTALLATION. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZBINDEN TO FILE (04/29/81).
5) CYLINDER BLOCKS ORDERED DUE TO PREVIOUS ONES FRETTING, DISTORTING, CRACKING, HEAD STUD HOLES
NOT MACHINED PROPERLY PER TDI'S SPEC. SO THE HEAD STUDS WERE MACHINED TO CORRECT SITUATION
(ELIMINATES CYLINDER BLOCK CRACKING NEAR STUD HOLES). NEW BLOCKS HAD MODIFICATIONS TO CORRECT
PREVIOUS PROBLEMS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO FILE (04/07/81).
OTHER MEMO FROM M.ZBINDEN TO R.WARD DATED 03/13/81.
6) TDI BLOCKS ON MALASPINER CLASS VESSELS ARE STRUCTURALLY STRONGER ALTHOUGH RATED LESS THAN 1/2
OF COLUMBIA'S HP. FACTORS COMPOUNDING THE SITUATION-COOLING OR HEAT TRANSFER PROBLEMS AT
CYLINDER LINER. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZBINDEN TO R.LIND (STATE OF ALASKA) DATED 06/17/81
7) ALLEGATIONS MADE THAT CYLINDER BLOCK HAS EXPERIENCED CREEP AND CYLINDER BLOCK IS HEATED
DURING OPERATION IN THE CENTER AND ROOM TEMPERATURE AT THE ENDS. ALSO, THE COMBINED STRESSES
OF THE BLOCK EXCEED THE DESIGN LIMITS OF CAST IRON. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM G.TRUSSEL (TDI) TO D.THOMPSON (ALASKAN MARINE HIGHWAY) (10/27/81)
8) ENGINE DERATING WILL LESSEN, THERMAL STRESSES OF CYLINDER BLOCK, HOWEVER, BLOCK LIP CRACKING
SHOULD STILL OCCUR. BASE TIE RODS TORQUED ON A SCHEDULE MAY MINIMIZE CYLINDER BLOCK FRETTING.
(M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT 8123-01 DATED APRIL 1983, PG 4-6, 4-7
9) OBSERVED DEFORMATION OF THE CYLINDER LINER BLOCK, COUNTERBORE LIP OF THE CYLINDER BLOCK WITH
SOME CRACKING. THIS CAUSES CYLINDER LINER DEFORMATION. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT 8123-01 DATED APRIL 1983, PG 3-14, 3-28, 6-3
10) DEFORMATION OF COUNTERBORE LIP OF CYLINDER LINER BLOCK CAUSED BY METALLIC FATIGUE.
(M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS 1, 1-10
11) BLOCK DEFORMATION DUE TO CRACKS, METALLIC FATIGUE, CREEP, OVERLOAD OF COUNTERBORE LIP, CLOSE
PROXIMITY OF COOLING WATER HOLES WHICH PRODUCE STRESS, CLOSE PROXIMITY OF HEAD RETAINING STUDS
AND THREAD TERMINATION FOR STUDS COUNTERBORE DEPTH CAUSING HIGH STRESS CONCENTRATION AREA.
(M/V "COLUMBIA")
SOURCE: NOS:

E R G E N C Y D I E S E L G E N E R A T O R [illegible] P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS I-9, V, V-10, VI, VIII-SUMMARY PG 25, 27.
12) ENGINE CRANKSHAFT OUT OF ALIGNMENT-POSSIBLY DUE TO ENGINE BLOCK MISALIGNMENT.
(M/V COLUMBIA)
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS V-10, V-12, VI.

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) EVALUATE CYLINDER LINER LANDING STRUCTURAL DISCONTINUITY AND STUD HOLES. INVESTIGATE DIESEL VESSELS T. JEFFER & TRAVER FAILURES.
2) REVIEW FOR ANALYSIS REGARDING COMPRESSION ZONES IN CAM GALLERY AREA.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE EXISTING DOCUMENTATION INCLUDING ISLEIB REPORT.
2) DEVELOP INSPECTION PLAN FOR AREA OF CONCERN AROUND CYLINDER LINER, INCLUDING LINER LANDING DIMENSIONAL CHECK.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION, INCLUDING ISLEIB REPORT.
2) DEVELOP INSPECTION PLAN FOR AREA OF CONCERN AROUND CYLINDER LINER, INCLUDING LINER LANDING DIMENSIONAL CHECK.
QR-2
1) PERFORM LP INSPECTION OF CYLINDER BLOCK LINER LANDING ALONG TOP LANDING SURFACE, FILLET RADIUS, AND VERTICAL FACE ADJACENT TO LANDING SURFACE, FOLLOWING 100 HRS. AT FULL LOAD. THIS TEST IS TO BE PERFORMED ON 3 CYLINDERS PER ENGINE
QR-3
1) PERFORM VISUAL INSPECTION OF CYLINDER BLOCK LINER LANDING #5, 7 AND 8 FOR SIGNS OF DISTRESS.
2) INSPECTION TO FOLLOW 100 HOUR FULL POWER RUN.
3) PERFORM LP NDE ENGINE ON CYLINDER #5, 7, 8 CYLINDER BLOCK LINER LANDINGS. REF QR-2 FOR LP.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-305A	A	01/25/84	01/16/84	X	X	X		0		F	

BASE AND BEARING CAPS - BASE ASSEMBLY

SHOREHAM EXPERIENCE:
1) NUMEROUS LINEAR INDICATORS/PITTING BEARING BASE JOURNAL ARE ON ENGINE 3.
SOURCE: NOS:
LOR 1649, 1657, 1744

NUCLEAR INDUSTRY EXPERIENCE:
NONE

NON-NUCLEAR INDUSTRY EXPERIENCE:
NONE

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) INVESTIGATE SHOREHAM INDICATIONS.
2) INVESTIGATE THE FAILURES ON USCG ICEBREAKERS WEST WIND & NORTH WIND VESSELS.
3) INVESTIGATE DYNAMICALLY INDUCED LOADS, INCLUDING EFFECTS OF COUNTERBALANCED CRANKSHAFT.

TASK DESCRIPTION:
1) REVIEW FAA REPORT ON BRG SADDLE INDICATIONS.
2) REVIEW INFO FROM JSEG BRG SADDLE FAILURES.
3) STRUCTURAL ANALYUSIS OF BRG SADDLE LOADING.
4) EXAMINE NUT POCKET LOADING. [illegible] SADDLE
5) EXAMINE THRU BOLT NUT POCKET [illegible]G.

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) PACKAGE ALL SITE INSPECTIONS & NDE TESTS.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) ALL SITE INSPECTIONS & NDE TESTS.
QR-2
1) AFTER 100 HOURS OF OPERATION AT FULL LOAD, PERFORM AN LP INSPECTION OF ENGINE 103 ON MAIN BEARING SADDLE #5 AND COMPARE THE RESULTS TO THOSE FOUND ON LOR (09/14/83), AND ENGINE 102 ON MAIN BEARING SADDLE #8 , AND COMPARE THE RESULTS TO THOSE FOUND ON THE TDI CERTIFICATE OF COMPLIANCE P.O. #310552-29 (09/18/83).

E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. AGC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY RVW.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVW. ACC.	QUALITY RVW. REC.
03-31SE	B	02/11/84	02/06/84	X	X	X		D		F	

CYLINDER BLOCK LINERS & WATER MANIFOLD-STUDS

SHOREHAM EXPERIENCE:
1) CHANGED CYLINDER HEAD STUDS WITH NEW DESIGN, PRODUCT IMPROVEMENT.
SOURCE: NOS:
FEDER F-45848A
RRR 1000, 1001, 1002

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NUCLEAR INDUSTRY EXPERIENCE:
1) D.G. START ATTEMPTED FOR TEST; ENGINE TRIPPEDDURING STARTING CYCLE. LEAKING CYLINDER LINEAR EXPANSION BELLOWS GASKET CAUSED WATER TO ENTER LUBE OIL.
SOURCE: NOS: MANUFACTURER:
NPRDS ZION 1, 740701, HIT 38 COOPER-BESSMER

****

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) ENGINE TIE BOLT BROKE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/93) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZRINDEN TO R.LIND (STATE OF ALASKA) DATED 06/17/81.
2) TIE BOLTS HOLDING BLOCK TO BASE BROKE. BOLTS NOT PROPERLY TORQUED ON ONE ENGINE AND ON ONE OCCASION, CYLINDER BANK WAS CLOSE TO SEPARATING FROM THE BASE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS I, V-12, VIII-PG21, 25
3) ENGINE BLOCK BOLT BROKE-MAY BE DUE TO FIRING PRESSURE AND MOVEMENT FROM PISTON SIDE THRUST & LIFTING BLOCKS (ALSO CAUSING BLOCK FRETTING) -PROPER TORQUING BOLTS WILL REDUCE THIS PROBLEM. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER ENGINE REBUILD REPORT FOR STATE OF ALASKA DATED 03/31/81, PGS I-14, I-16.

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW DESIGN OF NEW CYLINDER HEAD STUDS.

TASK DESCRIPTION:
1) REVIEW CYLINDER STUD FAILURES ON M.V.GOTT.
2) CONDUCT STRENGTH/FATIGUE ANALYSIS OF STUDS UNDER PRELOAD AND CYLINDER FIRING LOADS.
3) CONSIDER NEED FOR EXPERIMENTAL STRESS ANALYSIS ANALYSIS. (STRAIN GAGE)

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE DOCUMENTATION TO CONFIRM THAT ALL CYLINDER HEAD STUDS HAVE BEEN REPLACED & PROPERLY INSTALLED WITH NEW DESIGN.
2) PERFORM HARDNESS TESTS ON INSTALLED STUDS.
3) VERIFY THREAD DIMENSIONS CHECK & ENGAGEMENT LENGTH

TASK DESCRIPTION:
OR-1 REV-1
1) PERFORM HARDNESS TESTS ON SPARE PARTS PO 8379433.
2) PROVIDE AS-BUILT DRAWING FOR PROGRAM FILE.
3) REVIEW INSTALLATION DATA AND VERIFY STUD PART # IDENTIFIED ON SEDCR E-4596RA HAS BEEN INSTALLED IN DG 101, 102 & 103.
4) PERFORM SUPERFICIAL HARDNESS TEST ON ONE STUD PER ENGINE - #5 - 101, #7 - 102, #8 - 103.
5) VERIFY INSTALLATION TORQUE WITH EXISTING DOCUMENTATION.
6) FORWARD DATA TO THE DESIGN GROUP FOR FINAL REVIEW VERIFICATION/ACCEPTANCE.
OR-2
1) PERFORM VISUAL INSPECTION OF HEAD STUDS FOR SIGNS OF DISTRESS, CYLINDERS #5, 7, AND 8.
2) RECORD RESULTS. RECORD AND IDENTIFICATION NUMBERS VISIBLE.
3) PERFORM MATERIAL COMPARITOR TEST ON ONE STUD PER ENGINE: 101 #5, 102 #7, 103 #8. (SEE TDI DRAWING #03-315-01-0A FOR DIMENSIONS AND MATERIALS. MATERIALS AND HARDNESS A151, A-41401, A-4142 H.R.S.)

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DSG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-399A	B	02/11/94	07/06/84	X	X	X		D		F	

ROCKER ARMS AND PUSHRODS - INTAKE & INTERMEDIATE ROCKER SHAFT ASSEMBLY INCLUDING CAPSCREWS

SHOREHAM EXPERIENCE:
1) REPLACE PUSHROD SOCKETS ON ENGINE 1,2. REPAIR PUSHROD CUPS CYL #7 ON ENG 3.
SOURCE: NOS:
RRR 885,887
LER 1235,1245
2) ADJUST ENGINE LIFTER ROCKER ARMS, CLEAN OIL PASSAGES FOR ENGINE 3.
SOURCE: NOS:
RRR 374
3) REPLACE CRACKED ENGINE ROCKER ARM PUSHROD SOCKET ON ENGINE 3.
SOURCE: NOS:
RRR 637
LER 0991, 1051
4) REPLACE DAMAGED SUBCOVER & ROCKER ARM ASSY FOR CYL #3 ON ENG 1.
SOURCE: NOS:
RRR 1329
LER 1954, 1955, 1956

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NUCLEAR INDUSTRY EXPERIENCE:
1) WHILE PERFORMING SURVEILLANCE TEST (PT-11) ON "1A" DIESEL, AN ABNORMAL AMOUNT OF LUBE OIL WAS SEEN LEAKING FROM #8 RIGHT CYLINDER HEAD COVER AS WELL A AN UNUSUAL NOISE FROM SAME CYLINDER. INTAKE ROCKER ARM BROKE DUE TO BINDING BETWEEN IT & ROCKER STAND. BINDING WAS DUE TO INADEQUATE END CLEARANCE BETWEEN ROCKER ARM & STAND.
SOURCE: NOS: MANUFACTUPER:
LER ZION 1, 295-81036,810106 COOPER-BESSMER

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NON-NUCLEAR INDUSTRY EXPERIENCE:
1) ACTION TAKEN SINCE VESSEL DELIVERY - PLUG WELDED ROCKER ARM ASSEMBLY DRILLED OIL PASSAGES TO REDUCE OIL FLOODING OF ROCKER BOXES. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/22/80 FROM M.ZPINDEN (STATE OF ALASKA)

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW LOADS IN ROCKER ARM ASSEMBLY & PUSHROD CUPS
2) REVIEW FATIGUE RESISTANCE OF CAPSCREWS DESIGN

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) REVIEW PUSHROD CUP INSTALLATION DOCUMENTATION (INSURE OVERHANG PROPERLY GROUND FLUSH)

TASK DESCRIPTION:
OR-1 REV-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) REVIEW PUSHROD CUP INSTALLATION DOCUMENTATION(INSURE OVERHANG PROPERLY GROUND FLUSH, TDI P/N
08-390-01-DFI
OR-2
1) PERFORM VISUAL INSPECTION OF INTAKE AND INTERMEDIATE ROCKER ARM ASSEMBLES FOR SIGNS OF
DISTRESS. 2) PERFORM MATERIAL COMPARITOR AND SUPERFICIAL H
ARDNESS TESTS ON ONE ROCKER ARM ASSEMBLY PER ENGINE. 101 - 05, 102 - 07, 103 - 08.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-19?G	9	01/24/84	01/19/84	X	X	X		F		F	

ROCKER ARMS AND PUSHRODS - MISCELLANEOUS BOLTS & DRIVE STUDS

SHOREHAM EXPERIENCE:
1) ROCKER ARM L.O. TUBE DRIVE STUDS REPLACED WITH THREADED PLUGS.
SOURCE: NOS:
ESDER E-45416
RRR 812, 813, 814, 820, 823, 876, 877, 878
LOR 1170
2) FAILED ROCKERS ARM SHAFT BOLT CYL # 1 IN ENGINE 3 PART 50.55 (e); REPLACED ALL BOLTS, NEW DESIGN.
SOURCE: NOS:
RRR 860, 862
LOR 1201
3) SHOREHAM - 5/4/83, DURING PREOPERATIONAL TESTING, THE ROCKER ARM BOLT FAILED.
SOURCE: NOS:
ISE NOTICE 83-51
4) VERIFY ALL ROCKER ARM HOLD DOWN BOLTS TORQUED TO 365 FT/LBS ON ENG 2.
SOURCE: NOS:
RRR 1335
5) VERIFY ROCKER ARM HOLD DOWN BOLTS TORQUED TO 365 FT/LBS ON CYL #7 ON ENG 3.
SOURCE: NOS:
RRR 1334

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NUCLEAR INDUSTRY EXPERIENCE:
NONE

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NON-NUCLEAR INDUSTRY EXPERIENCE:
NONE

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW SHOREHAM EXPERIENCE WITH THREADED PLUGS.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE NDE DOCUMENTATION ON BOLTING & CONFIRM INSTALLATION OF PROPER BOLTING.

TASK DESCRIPTION:
QR-1 REV-1

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) ASSEMBLE NDE DOCUMENTATION ON BOLTING.
3) CONFIRM INSTALLATION OF PROPER BOLTING.

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E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-349A	A	07/11/84	02/29/84	X	X	X		D		F	

CONNECTING RODS - CONNECTING RODS & BUSHING.

SHOREHAM EXPERIENCE:
1) PERFORM MICROMETER MEASUREMENT ON OLD CONN RODS AS PART OF INSPECTION ON ENGINES 2 & 3.
SOURCE: NOS:
RPR 1043, 1044
2) PERFORM INFORMATIONAL CHK ON PISTON WRIST PIN CLEARANCES. CHECKS SAT.
SOURCE: NOS:
RPR 997

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NUCLEAR INDUSTRY EXPERIENCE:
1) NORMAL SURVEILLANCE BEING PERFORMED. INVESTIGATION REVEALED ONE OF THE TWO ROD CAP RETAINING BOLTS HAD COME OUT ALLOWING ENGINE TORQUE TO BREAK SECOND RETAINER BOLT WHICH ALLOWED ROD TO SEPARATE FROM CRANKSHAFT.
SOURCE: NOS: MANUFACTURER:
LER HATCH 2, 366-81127-1, 811216 FAIRBANKS-MORSE
2) SURVEILLANCE PERFORMED ON DIESEL GENERATOR. INVESTIGATION REVEALED COTTER PINS THAT LOCK CONNECTING RODS IN PLACE IN ONE CYLINDER WERE BROKEN ALLOWING CONNECTING ROD TO SEPERATE FROM CRANKSHAFT RESULTING IN ENGINE FAILURE.
SOURCE: NOS: MANUFACTURER:
LER HATCH 2, 366-80159-1, 801126 FAIRBANKS-MORSE
3) DURING OPERATION, UPPER PISTON CONNECTING ROD BEARING CAP CAPSCREWS SHEARED. THIS RESULTED IN EJECTION OF ROD THROUGH CRANKCASE COVER. THIS WAS PROBABLY CAUSED BY A SERIES OF UNLUBRICATED DRY STARTS.
SOURCE: NOS: MANUFACTURER:
LER MILLSTONE 2,336-76000,761219 FAIRBANKS-MORSE
4) INSPECTION FOUND BOLT HEAD CRACKED ON CONNECTING ROD - #3 D.G. CAUSE UNKNOWN. REPLACED ALL CONNECTING ROD BOLTS.
SOURCE: NOS: MANUFACTURER:
NPRDS BRUNSWICK 2, 820416, HIT 252 NORBERG
5) DIVISION I DIESEL ENGINE, CYLINDER #7, LEFT BANK, THE CYLINDER LINK ROD WRIST PIN WAS GROOVED AND PITTED APPROXIMATELY 1/16 INCH DEEP. WRIST PIN DISCOLORED.
SOURCE: NOS: MANUFACTURER:
IOCFR50.55E MP&L, GRAND GULF, 12/10/81, 04/15/82 TDI
6) INFO-CONN ROD WRIST PIN BUSHINGS LOCKED IN PLACE IF NO OIL GROOVE.
SOURCE: NOS:
TDI SIM 312

****

NON-NUCLEAR INDUSTRY EXPERIENCE:
1) DELAVAL INSPECTED DEFECTIVE CONNECTING ROD BOLTS AND HEAVY FRETTING NOTED IN THE LINK ROD BUSHING BORES. DAMAGED ROD BOLT RECEIVED FROM TDI. M/V "COLUMBIA"

E R G E N C Y D I E S E L G E N E R A T O R M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY PVL.	SELECTION COMMITTEE DEC RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY PVL. ACC.	QUALITY PVL. REC.

SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM L.BLOCK (TDI) TO M.ZBINDEN (STATE OF ALASKA) 06/02/80
OTHER LETTER FROM M/ZBINDEN (STATE OF ALASKA) TO M.MARTINI (TDI) DATED 01/16/80
OTHER M/V COLUMBIA-REPAIR PART STATUS (STARTING DATE 07/27/79)
2) DELAVAL ADVISED THAT FORGINGS REQUIRED TO FABRICATE REPLACEMENTS FOR THE CRACKED CONNECTING ROD LINK BOXES WILL BE SHIPPED SHORTLY. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM L.BLOCK (TDI) TO M.ZBINDEN (STATE OF ALASKA) DATED 06/02/80.
3) COLUMBIA TAKEN OUT OF SERVICE PREMATURELY DUE TO CRACKING OF CONNECTING RODS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM L.BLOCK (TDI) TO M.ZBINDEN (STATE OF ALASKA) DATED 06/02/80.
OTHER LETTER FROM A.MCDONALD (STATE OF ALASKA) TO J.EIDE (DIV OF MARINE HWY SYSTEMS) DATED 12/26/79.
4) ACTION TAKEN SINCE VESSEL DELIVERY-CHANGED ORIGINAL ROD BOLTS TO THOSE WITH ROLLED AIRCRAFT TYPE THREADS-PROBLEM OF CRACKING CONTINUES. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
5) CONNECTING ROD CAPSCREWS INSTALLED TO REPLACED CRACKED ONES-INCREASED TORQUE CAUSED MATING SURFACES TO BECOME GALLED. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO P.LE 04/09/81.
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO R.WARD DATED 12/10/80.
6) TDI FEELS DAMAGE TO LINK ROD BUSHING BAIL AREA CAUSED BY FOREIGN (DIRTY) MATERIAL IN LUBE OIL. STATE OF ALASKA FEELS THAT THE DRILLED OIL PASSAGES WERE NOT PROPERLY MACHINED-THE REMAINED RAISED AREA OR BURR AROUND OIL HOLE IS THE CAUSE OF THE DAMAGE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER LETTER R.ZURIE (TDI) FROM M.ZBINDEN (STATE OF ALASKA) DATED 02/29/80.
7) DAMAGE TO PDT BOLTS INCLUDING CRACKING. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TDI (D.MARTINI) DATED 03/24/80 & 03/19/79 FROM M.ZBINDEN (STATE OF ALASKA)
OTHER LETTER FROM M.ZBINDEN TO W.HUDSON DATED 07/02/79.
8) CRACKING OF CONNECTING ROD BOXES AND BEARING SHELLS. FRETTING OF LINK ROD AND LINK ROD PINS AT THEIR ATTACHMENT TOGETHER. INSUFFICIENT CONNECTING ROD BEARING WEAR/CONTACT AREA TO JOURNAL WHEREIN IT IS LESS THAN 15% OF THE TOTAL BEARING AREA. (1979 SEASON) (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
9) CRACKING ON CONNECTING RODS USUALLY IN THE LINK PIN AREA BETWEEN THE LINK PIN BUSHING AND SERRATED BUSHING. MODIFICATIONS MADE. ROD BOX HAS DISTRESS IN LINK PIN BUSHING. HIGH LOADING FORCES AT THE SERRATED JOINT BETWEEN MATER CONNECTING ROD AND CONNECTING ROD BOX. CAUSED BY UNEVEN FIRING. SURFACE FINISHES. CONNECTING RODS SHOULD BE MORE RELIABLE IF ENGINE IS DERATED.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY REQ RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

(M/V "COLUMBIA")
SOURCE: NRS:
OTHER SES REPORT #123-01 DATED APRIL 1983, PG 3-16 THRU 3-17, 4-4.

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) INVESTIGATE FAILURE AT GLEN ALLEN, ALASKA (COPPER VALLEY ELECTRIC) LONGITUDINALLY SPLIT CONNE
CTING ROD.
2) PERFORM STRESS ANALYSIS DESIGN REVIEW OF CONNECTING ROD & BUSHING.

TASK DESCRIPTION:
1) REVIEW REPORT OF FAILURE OF CONNECTING ROD AT COPPER VALLEY ELECTRIC.
2) JOURNAL ORBIT ANALYSIS FOR WRIST PIN BUSHING.
3) STRUCTURAL ANALYSIS OF BUSHING AND UPPER CONNECTING ROD.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE DOCUMENTATION VERIFICATION & PERFORM ADDITIONAL CHECKS AS REQUIRED BY DESIGN.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
QR-2
1) PERFORM VISUAL INSPECTION OF CONNECTING RODS & BUSHINGS FOR SIGNS OF DISTRESS, CYLINDERS #5,
7 AND 8.
2) PERFORM MATERIAL COMPARITOR TEST ON CONNECTING ROD AND BUSHING, CYLINDERS #5, 7 AND 8.
3) PERFORM SUPERFICIAL HARDNESS TEST ON CONNECTING RODS AND BUSHINGS #5, 7 AND 8.
4) PERFORM MATERIAL COMPARITOR AND SUPERFICIAL HARDNESS TESTS ON SPARES IF AVAILABLE.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DCG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
01-6898	A	01/25/84	01/24/84	X	X	X		F		F	

ENGINE & AUX. MODULE WIRING MATERIAL: WIRING & TERMINATIONS

SHOREHAM EXPERIENCE:
1) REPLACE CONTROL CABLES (IDCER211) ON ENGINES 1, 2 & 3. USE OF UNDIAL. CABLE.
SOURCE: NOS:
ESDCP F-46291
RRR 1137, 1140, 1141
2) THERMOCOUPLE WIRING DETERIORATED (OXIDIZED) ON ENGINE 1.
SOURCE: NOS:
LDR 1881
3) REPAIR DAMAGE CABLE AT T-207A ON ENG 1.
SOURCE: NOS:
RRR 1310

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NUCLEAR INDUSTRY EXPERIENCE:
1) THE CONDUIT CONTAINING NEUTRAL LEADS TO THE TRANSFORMER WERE CUT. THE ELECTRICAL LEADS IN THE CONDUIT WERE GROUNDED BUT NOT SEVERED. THE CABLE WAS REPAIRED AND TESTED IN ACCORDANCE WITH A REPAIR PROCEDURE. THE CABLE WILL BE REPLACED. SEVERAL PROCEDURES HAVE BEEN PUT INTO EFFECT TO PREVENT RECURRENCE.
SOURCE: NOS: MANUFACTURER:
LER CONN YANKEE 213-10002, 791224 ELECTRO-MOTIVE DIV OF GM
2) EMERGENCY DIESEL GENERATOR FAILED TO CARRY THE FULL TEST LOAD. THE CAUSE WAS DETERMINED AND CORRECTED AND A SATISFACTORY TEST PERFORMED. LETTER DATED OCTOBER 15, 1976. THE MANUAL FUEL SHUTOFF WAS NOT RESET COMPLETELY DUE TO PAINT ON THE CONTROL CABLE RESTRICTING ITS MOVEMENT. THE CABLE WAS CLEANED AND NORMAL ACTION RESTORED.
SOURCE: NOS: MANUFACTURER:
LER LA CROSSE, 409-76900, 760915 ALLIS CHALMERS

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NON-NUCLEAR INDUSTRY EXPERIENCE:
NONE

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW DESIGN.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) REVIEW DOCUMENTATION TO SHI-15B.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY RVL.	D&G RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

TASK DESCRIPTION:
OP-1 REV-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-365C	B	01/19/84	01/17/84	X				B			

FUEL INJECTION EQUIPMENT - TUBE ASSEMBLY.

SHOREHAM EXPERIENCE:
1) REPL ALL FUEL INJECT LINES W/SHROUDED TYPE ON ENG 1, 2, 3. INSPECTION REQUIREMENTS PER EGDCR.
SOURCE: NOS:
EGDCR F-45709
RRR 969
2) REPLACE DAMAGED INJECTION LINE #6 CYL ON ENGINE 1 AND #6 CYL. LINE ON ENGINE 3.
SOURCE: NOS:
RRR 801, 837
LDR 1140, 1148
3) ADJUST FUEL RACK STOPS AT FUEL OIL INJECTOR PUMPS ON ENGINE 2.
SOURCE: NOS:
RRR 25
4) REPLACE FITTING ON FUEL INJECTION LINE FOR ENGINE 3.
SOURCE: NOS:
RRR 332
5) GREASE FUEL OIL INJECTOR RACK LINKAGE ON ENGINES 1, 2, 3.
SOURCE: NOS:
RRR 666, 657
6) BENDS IN FUEL EJECTOR LINES - EXCEED LIMITS ON ALL ENGINES.
SOURCE: NOS:
LDR 1766, 1767, 1768
7) REPLACE FUEL OIL INJECTION LINE CYL. # 8 ON ENGINE 2 & CYL. # 4 ON ENGINE 3.
SOURCE: NOS:
RRR 373, 691, 726, 796
8) REPLACED FUEL OIL INJECTION LINE AT CYL. # 5 FOR ENGINE 1.
SOURCE: NOS:
RRR 377
9) REPLACE LEAKING SHROUDED F.O. LINE TO CYL #2 ON ENG 1.
SOURCE: NOS:
RRR 1318
10) REPLACED FUEL OIL INJECTION LINE AT CYL #5 FOR ENGINE 1.
SOURCE: NOS:
RRR 377

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NUCLEAR INDUSTRY EXPERIENCE:
1) #11 D.G. WAS SHUT DOWN TO REPAIR A FUEL OIL LINE LEAK. THE 18" .625" INJECTOR SUPPLY LINE WAS REPLACED.
SOURCE: NOS: MANUFACTURER:
LER CAL CLIFFS 1 317-79069-1, 791127   FAIRBANKS-MORSE
2) DURING TESTING A FUEL OIL SUPPLY HOSE ON THE #1 D.G. DEVELOPED A LEAK. THE LEAK WAS CAUSED BY LOCALIZED FLEXURE AND VIBRATION. THE HOSE WAS REPLACED AND REPORTED.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

SOURCE: NOS: MANUFACTURER:
LER COOPER 298-81019, 810729 COOPER-BESSMER
3) A HP FUEL INJECTION LINE FOR THE #2 LB. CYLINDER DEVELOPED A SMALL THRU THE WALL LEAK. THE CAUSE WAS ATTRIBUTED TO MANDREL DRAW SEAM ON THE ID OF THE TUBING. A POTENTAIL DEFECT IN THIS TUBING WAS REPORTED BY THE MFG. ON 07/27/83. THE LINE WAS REPLACED.
SOURCE: NOS: MANUFACTURER:
LER GRAND GULF 416-83114, 830802 TDI
OTHER GRAND GULF REPORT 83-024, 09 /22/83.
4) THE FUEL LINE TO AN INJECTOR OF D.G. #1 BURST. EVENT WAS NOT REPETITIVE. THE FUEL LINE WAS REPAIRED.
SOURCE: NOS: MANUFACTURER:
LER COOPER 298-76000, 760823 COOPER-BESSMER
5) #12 D.G. WAS SHUTDOWN TO REPAIR 2 MINOR FUEL OIL LEAKS. TWO FERULED TYPE FITTINGS AT THE INLET TO CYLINDERS #2 AND #6 APPARENTLY VIBRATED LOOSE AND REQUIRED TIGHTENING.
SOURCE: NOS: MANUFACTURER:
LER CAL CLIFFS 1, 317-77000,770603 FAIRBANKS-MORSE
6) #12 D.G. WAS SHUTDOWN TO REPAIR VARIOUS FUEL OIL LEAKS. VARIOUS FLARE AND FERRULE FITTINGS LOOSE FROM VIBRATION WERE TIGHTENED AND ONE 4" PIECE OF TUBING WAS REPLACED DUE TO A CRACK.
SOURCE: NOS: MANUFACTURER:
LER CAL CLIFFS 1, 317-79074,791204 FAIRBANKS-MORSE
7) #2 DG INJECTOR LINE FAILED AND WAS SHUTDOWN. CAUSE OF FAILURE IS BELIEVED TO BE METAL FATIGUE & VIBRATION. LINE WAS REPLACE.
SOURCE: NOS: MANUFACTURER:
LER COOPER 298-81021,810728 COOPER-BESSMER
8) #12 DG DEVELOPED A FUEL OIL LEAK AND WAS SHUTDOWN. LEAK WAS AT A FLARED-TYPE BRASS COMPRESSION FITTING WHICH WAS REPLACED.
SOURCE: NOS: MANUFACTURER:
LER CAL CLIFFS 2, 318-80055,801209 FAIRBANKS-MORSE
9) SHOREHAM-04/20/83-DURING PREOPERATIONAL TESTING, THR FUEL INJECTION LINE FAILED.
SOURCE: NOS: MANUFACTURER:
IEE NOTICE 83-51 TDI
10) A SMALL FUEL OIL LEAK WAS DETECTED ADJACENT TO INJECTION PUMP FOR NO. 12 CYLINDER. CAUSE-CAUSE-THREADED NIPPLE ON SUCTION SIDE OF INJECTOR HAD SMALL CRACK IN THREAD LINE WHERE IT CONNECTS TO THE INJECTOR.
SOURCE: NOS: MANUFACTURER:
NPRDS MILLSTONE 1, 770701, HIT 174 FAIRBANKS-MORSE
11) OIL LEAK FOUND IN LINE TO INJECTION PUMP DUE TO CRACK IN FLANGE NIPPLE.
SOURCE: NOS: MANUFACTURER:
NPRDS MILLSTONE 1, 770927, HIT 175 FAIRBANKS-MORSE
12) A FUEL LINE RUPTURE RESULTING IN A FIRE NEAR THE LEFT BANK TURBO CHARGER. THE FUEL LINE RUPTURE OCCURRED IN THE JOINT OF A BRANCH TEE AT THE MAIN FUEL OIL HEADER CONNECTION. THE CAUSE IS BEING INVESTIGATED.
SOURCE: NOS: MANUFACTURER:
LER GRAND GULF - 416-83126,830904 TDI
13) DG-21 WAS REMOVED FROM SERVICE 4 HOURS TO REPAIR SEVERAL FITTINGS ON FUEL OIL TO INJECTOR LINES, WHICH WERE LEAKING. OTHER DG'S AND EPS-OFF VERIFIED OPERABLE.
SOURCE: NOS:
EPRI CALVERT CLIFFS 2, 110277, DG-21

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

NON-NUCLEAR INDUSTRY EXPERIENCE:
NONE

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW EXISTING REPORTS ON SHOREHAM FAILURES & REPORTS FOR RESOLUTION.

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
NONE

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

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MP-01?	P	02/20/84	02/13/84	X	X	X		N		F	

TURBOCHARGER

SHOREHAM EXPERIENCE:
1) VERIFY THRUST CLEARANCE OF TURBOCHARGER ON ENGINE 3.
SOURCE: NOS:
RRR 924
2) INSPECT TURBOCHARGER BEARINGS ON ENGINE 2
SOURCE: NOS:
RRR 805
3) REBUILD TURBOCHARGER DUE TO BEARING FAILURE FOR ENGINE 3.
SOURCE: NOS:
RRR 590,596,597,592
LDR 926,960
4) INSPECT TURBOCHARGER BEARINGS ON ENGINE 1
SOURCE: NOS:
RRR 808
5) REMOVAL/REPAIR AS NECESSARY ALL TURBOCHARGER DAMAGED PARTS ON ENGS 1 & 3.
SOURCE: NOS:
RRR 1423,1431
6) PERFORM TURBOCHARGER DISASSEMBLY PER ELLIOT MANUAL ON ENGINE 2
SOURCE: NOS:
RRR 1479
7) REMOVE TURBOCHARGER & REINSTALL UPON COMPLETION OF INSPECTION ON ENG.2
SOURCE: NOS:
RRR 1471
8) STAKE NOZZLE RING HUB NUT ON TURBOCHARGER ON ENGINES 1,2 & 3
SOURCE: NOS:
RRR 1465, 1466, 1467
LDR 2040

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NUCLEAR INDUSTRY EXPERIENCE:
1) LOUD NOISE IN VICINITY OF TURBOCHARGER. DIESEL GENERATOR IMMEDIATELY SHUT DOWN. TURBOCHARGER REPLACED & DEFECTIVE UNIT SENT TO EMD FOR INSPECTION & REPAIR.
SOURCE: NOS: MANUFACTURER:
LER SURRY1 280-79044, 791230 ELECTRO-MOTIVE DIV. OF GM
2) DURING OPERATION, EXCESSIVE NOISE & VIBRATION WAS OBSERVED. DIESEL GENERATOR SHUTDOWN. INVESTIGATION REVEALED SCAVENGING AIR BLOWER WAS CAUSING PROBLEM. AIR BLOWER REPLACED.
SOURCE: NOS: MANUFACTURER:
LER HATCH2 366-80146, 801029 FAIRBANKS-MORSE
3) DIESEL ENGINE'S TURBOCHARGER FAILED WHICH RESULTED IN FIRE WITHIN ENGINE'S EXHAUST SYSTEM.
SOURCE: NOS: MANUFACTURER:
LER MAINE YANKEE 309-79026-1, 791015 ELECTRO-MOTIVE DIV. OF GM
4) DIESEL GENERATOR TRIPPED CAUSED BY FAILURE OF TURBOCHARGER CLUTCH & SHAFT BEARING. EXCESSIVE

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

EPRI EPRI-NP-2433, 6/82

(6) EXCESSIVE EXHAUST MANIFOLD TEMPERATURES AND FIRE EXITING EXHAUST DUE TO FUEL ACCUMULATION IN DIESEL EXHAUST MANIFOLD CAUSED BY AIR LEAK ONTURBOCHARGER DISCHARGE.
SOURCE: NOS: MANUFACTURER:
LER CRYSTAL RIVER 3 302-79069, 790724 FAIRBANKS-MORSE

(7) FIRE INSIDE TURBOCHARGER DUE TO FAILURE OF BEARING BETWEEN AIR INLET BLADING AND EXHAUST TURBINE BLADING.
SOURCE: NOS: MANUFACTURER:
LER ARKANSAS NUCLEAR 1 313-78008, 780120 ELECTRO-MOTIVE DIV OF GM
NPRDS HIT 117, HIT 271

(8) DIESEL GENERATOR FAILED TO START DUE TO TURBOCHARGER FAILURE. TURBOCHARGER SENT TO MANUFACTURER FOR EVALUATION.
SOURCE: NOS: MANUFACTURER:
LER ARKANSAS NUCLEAR 1 313-82005, 820227 ELECTRO-MOTIVE DIV OF GM

(9) TURBOCHARGER AND EXHAUST GAS EXPANSION JOINT FAILED. CAUSE DETERMINED TO BE TURBINE BLADE FAILURE. MODIFICATION MADE TO TURBINE UNIT TO IMPROVE BLADE RELIABILITY. DESIGN CHANGE BEING INVESTIGATED FOR REMAINING TURBOCHARGERS.
SOURCE: NOS: MANUFACTURER:
LER SALEM 1, 272-77080-1, 771202 ALCO ENGINE DIV.
EPRI EPRI-NP-2433, 6/82
NPRDS HIT 18,84

(10) DURING LOSS OF POWER TEST FOR UNIT 3, E-2 DIESEL GENERATOR FAILED TO ATTAIN RATED SPEED AND VOLTAGE. THE SCAVENGING AIR BLOWER SEIZED CAUSING DAMAGE TO BLOWER DRIVE GEARS. CLEANED AIR INTAKE PASSAGE. INSTALLED NEW FILTERS AND REPLACED DEFECTIVE BLOWER AND DRIVE GEARS. SMALL WELD BEADS ENTERED BLOWER AND CAUSED IT TO SEIZE.
SOURCE: NOS: MANUFACTURER:
LER PEACH BOTTOM 2, 277-74000, 740615 FAIRBANKS-MORSE
EPRI EPRI-NP-2433, 6/82

(11) FINAL REPORT DURING PREOPERATIONAL TEST, DIESEL GENERATOR D-2 BLOWER FAILED DUE TO INGESTION OF FOREIGN MATERIAL TOO LARGE TO PASS THRU BLOWER LOBE CLEARANCES. CAUSED BY INGESTION OF FOREIGN MATERIAL TOO LARGE TO PASS THRU BLOWER LOBE CLEARNACES. BLOWER BOUND UP AND OVERHEATED.
SOURCE: NOS: MANUFACTURER:
LER PRAIRIE ISLAND 1, 282-73000, 730130 FAIRBANKS-MORSE
EPRI EPRI-NP-2433, 6/82

(12) (80-25-01) DURING SURVEILLANCE, #2 DIESEL GENERATOR START TIME WAS 11 SECONDS INSTEAD OF THE REQUIRED 10. THE TURBO ASSIST VALVES MALFUNCTIONED. THE VALVES WERE CLEANED AND RETURNED TO SERVICE. ASCO SOLENOID OPERATED, EXPLOSION PROOF NEMA TYPE, CAT. NO. LBX-8210-B-83
SOURCE: NOS: MANUFACTURER:
LER PILGRIM 1, 293-75000, 751217 ALCO ENGINE DIV.
EPRI EPRI-NP-2433, 6/82
NPRDS HIT 6

(13) WHEN THE DIESEL GENERATORS HAVE OPERATED LONG ENOUGH FOR THE LUBE OIL TO REACH OPERATING TEMPERATURE, THEN SHUT DOWN AND THEN RESTARTED BETWEEN 15 MINUTES AND 3 HOURS LATER, DAMAGE COULD OCCUR TO THE DIESEL ENGINE TURBO CHARGER THRUST BEARING. OPERATING INSTRUCTIONS HAVE BEEN CHANGED SO THAT THE ENGINES WILL NOT BE RUN BETWEEN 15 MINUTES AND THREE HOURS AFTER A SHUTDOWN. THE TURBO CHARGERS HAVE BEEN INSPECTED AND NO DAMAGE HAS BEEN FOUND. END IS DEVELOPING A LUBE OIL SYSTEM WHICH WILL PRECLUDE THE TEST RESULT.
SOURCE: NOS: MANUFACTURER:

E ERGENCY DIESEL GENERATOR C PONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

OPERATION OF DIESEL AT LOW LOADS IS PROBABLE CAUSE OF FAILURE.
SOURCE: NOS: MANUFACTURER:
LER DRESDEN 2 237-77051, 771030 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433 6/82
5) DIESEL GENERATOR TRIPPED DUE TO MALFUNCTIONING TURBOCHARGER CLUTCH.
SOURCE: NOS: MANUFACTURER:
LER FITZPATRICK 333-74000, 741018 ELECTRO-MOTIVE DIV. OF GM
6) DIESEL GENERATOR FAILED TO MEET STARTING TIME REQUIREMENTS CAUSED BY FAILURE OF THE DIESEL TURBO BOOST SYSTEM DUE TO IMPROPER WIRING ON ONE AIR SUPPLY SOLENOID.
SOURCE: NOS: MANUFACTURER:
LER SALEM 2 311-81050, 810625 ALCO ENGINE DIV.
7) DURING DIESEL GENERATOR OPERATION, AN EXHAUST LEAK WAS IDENTIFIED ON EXPANSION JOINT ON TURBO CHARGER EXHAUST. EXPANSION JOINT WAS REPLACED.
SOURCE: NOS: MANUFACTURER:
LER COOK 2 316-83012, 830126 WORTHINGTON CORP.
8) DURING TEST, DIESEL GENERATOR LEAKED ETHYLENE GLYCOL FROM CAST STEEL INLET CASING OF THE TURBO CHARGER. CAUSE WAS FOUND TO BE INCOMPLETE FUSION OF WELD AT A PLUG IN CASING.
SOURCE: NOS: MANUFACTURER:
LER PILGRIM 1 293-73000, 730822 ALCO ENGINE DIV.
EPRI EPRI-NP-2433, 6/82
9) DIESEL GENERATOR FAILED TO ACCEPT LOADS GREATER THAN 5%. CAUSE WAS SEIZED TURBOCHARGER.
SOURCE: NOS: MANUFACTURER:
LER ZION 2 304-83007, 830131 COOPER-BESSMER
10) DEFECTIVE TURBOCHARGERS DISCOVERED ON DIESEL GENERATORS. TURBOCHARGERS REMOVED AND RETURNED TO END TO DETERMINE CAUSE OF DEFECTS.
SOURCE: NOS: MANUFACTURER:
LER ZIMMER 358-78000, 781220 ELECTRO-MOTIVE DIV. OF GM
11) DURING DIESEL GENERATOR OPERATION, UNIT TRIPPED. INVESTIGATION REVEALED TURBOCHARGER SHAFT AND OIL SEAL HAD BEEN DAMAGED.
SOURCE: NOS: MANUFACTURER:
LER ST. LUCIE 335-77000, 770118 ELECTRO-MOTIVE DIV. OF GM
EPRI EPRI-NP-2433, 6/82
12) DIESEL GENERATOR TRIPPED DUE TO TURBOCHARGER SEIZING, CAUSING LOSS OF COMBUSTION AIR TO DIESEL.
SOURCE: NOS: MANUFACTURER:
LER QUAD CITIES 2-265-73000, 730520 ELECTRO-MOTIVE DIV. OF GM
13) TURBOCHARGER FAILED DURING DIESEL GENERATOR OPERATION. CAUSE UNDETERMINED. HOWEVER, IN THE WEEK PRIOR TO FAILURE, THERE WERE APPROXIMATELY 60 ENGINE STARTS AND A GREAT DEAL OF LIGHT LOADING.
SOURCE: NOS: MANUFACTURER:
LER ST. LUCIE 1 335-81047, 811010 ELECTRO-MOTIVE DIV. OF GM
14) EXCESSIVE SMOKE FROM TURBOCHARGER EXHAUST FLANGE DUE TO LOOSE EXHAUST FLANGE BOLTS AND BROKEN EXHAUST FLANGE GASKET.
SOURCE: NOS: MANUFACTURER:
LER ARKANSAS NUCLEAR 1 313-80031, 800927 ELECTRO-MOTIVE DIV OF GM
15) ENGINE SPEED AND LOAD INSUFFICIENT TO DISENGAGE MECHANICAL DRIVE OF TURBO-BLOWER.
SOURCE: NOS: MANUFACTURER:
LER SURRY 1 280-75000, 750430 ELECTRO-MOTIVE DIV. OF GM

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

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LER SEQUOYAH 1, 327-79000-1, 790621 ELECTRO-MOTIVE DIV. OF GM
24) WHILE PERFORMING SWITCHING FOR A LOSS OF POWER TEST, THE E-4 DIESEL GENERATOR FAILED TO START. INVESTIGATION REVEALED COOLING WATER FROM THE TURBOCHARGER HAD LEAKED INTO THE EXHAUST & INTAKE MANIFOLDS PREVENTING PROPER STARTING. THE TURBOCHARGER GASKETS FAILED BECAUSE THE COOLING WATER OUTLET VALVE HAD BEEN LEFT CLOSED FROM A PREVIOUS REPAIR. THE TURBOCHARGER AND VARIOUS ENGINE PARTS WERE REPLACED. THE DIESEL SATISFACTORILY TESTED AND RETURNED TO SERVICE. THE VALVES WERE ADDED TO THE TEST CHECKOFF LIST AND CONTROLS ADDED FOR TURBOCHARGER WATER DETECTION.
SOURCE: NOS: MANUFACTURER:
LER PEACH BOTTOM 2,277-81026, 810921 FAIRBANKS-MORSE
NPRDS HIT 186
25) E-3 DIESEL START TIME TO REACH RATED VOLTAGE AND FREQUENCY DID NOT MEET SURVEILLANCE TEST REQUIREMENT. THE MOST PROBABLE CAUSE WAS A LEAKING CHECK VALVE IN THE HYDRAULIC SYSTEM ASSOCIATED WITH THE AIR BOOSTER RELAY (FAIRBANKS MORSE PART NO 16-105-9741). A NEW AIR BOOSTER RELAY WAS INSTALLED. THE DIESEL TESTED SATISFACTORILY (7.4 SEC). THE DEFECTIVE AIR BOOSTER RELAY WILL BE ANALYZED BY MANUFACTURER TO DETERMINE CAUSE OF FAILURE.
SOURCE: NOS: MANUFACTURER:
LER PEACH BOTTOM 2, 277-78033, 780830 FAIRBANKS-MORSE
NPRDS HIT 184
EPRI EPRI-NP-2433, 6/82
26) DURING SURVEILLANCE TEST, DG-1A WAS STARTED AND SUCCESSFULLY LOADED TO CARRY FULL EMERGENCY LOAD. DURING LOADING IT TO FULL DESIGN LOAD, SMOKE BEGAN ISSUING FROM THE 1A2 DIESEL TURBOCHARGER. THE DIESEL WAS IMMEDIATELY STOPPED. THE DAMAGED UNIT WAS BEING ANALYZED BY THE VENDOR TO DETERMINE THE EXACT CAUSE OF FAILURE.
SOURCE: NOS: MANUFACTURER:
EPRI ST. LUCIE 1, 092677, DG 1A ELECTRO-MOTIVE DIV. OF GM
27) DURING PT, THE DG WOULD NOT LOAD OVER 2000KW. TURBOCHARGER SEIZED, REDUCING CAPACITY.
SOURCE: NOS: MANUFACTURER:
NPRDS ZION 1, 930131, HIT 62 COOPER-BESSMER
28) INTERNAL OIL FIRE IN TURBOCHARGER OF DG1-2 CAUSED IT TO OVERHEAT AFTER 23 HRS. OIL WAS COMING THRU LOWER CASING JOINT ON TURBO CAUSING A FIRE INTERNALLY.
SOURCE: NOS: MANUFACTURER:
NPRDS DAVIS BESSE 1, 800923, HIT 33 ELECTRO-MOTIVE DIV. OF GM
29) REMOVE TURBOCHARGE TO CHECK FOR DAMAGE MADE BY LOOSE BOLT FRAGMENT FOUND IN CRANKCASE. - SHEARED OFF 5/8 BOLT FOUND.
SOURCE: NOS: MANUFACTURER:
NPRDS DAVIS BESSE 1, 800904, HIT 23 ELECTRO-MOTIVE DIV. OF GM
30) TURBOCHARGER REMOVED FROM DG1-1 BECAUSE OF NOISE; INSTALLED NEW TURBOCHARGER.
SOURCE: NOS: MANUFACTURER:
NPRDS DAVIS BESSE 1, 810414, HIT 25 ELECTRO-MOTIVE DIV. OF GM
31) OVER A PERIOD OF TIME, DIESEL SUBJECT TO BROKEN STAY RODS AND CRACKED BASE METAL IN INTERCOOLER, CRACKED WELDS ON TURBOCHARGER JACKET WATER PIPE, CRACKED METAL ON AIR HEADER FLANGE. PROBLEMS POSSIBLY DUE TO FAULTY TURBOCHARGER CAUSING EXCESSIVE VIBRATION, EVEN THOUGH NO INDICATION OF HIGH VIBRATIONS FROM VIBRATION SENSORS.
SOURCE: NOS: MANUFACTURER:
OTHER GRAND GULF REPORT NO. 83-024, 09/22/83. TDI
32) OIL LEAK UNDER AIR INLET TO TURBOCHARGER, CAUSE - DEFECTIVE TURBOCHARGER.
SOURCE: NOS: MANUFACTURER:

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

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NPRDS ARK NUC ONE-1, 780715, HIT 119 ELECTRO-MOTIVE DIV OF GM
3) TWO TURBOCHARGERS WERE REPLACED DUE TO BROKEN STATIONARY NOZZLE RING VANES ON TDI 8 CYLINDER ENGINES AT KUOSHENG, TAIWAN.
SOURCE: NOS: MANUFACTURER:
OTHER TELEX FROM PET TO LILCO 11/28/83 TDI

34) OPERATORS NOTED THAT AFTER 15 MIN OF OPERATION THE OUTPUT POWER BECAME ERRATIC AND EXHAUST TEMPS WERE INDICATING HIGH. CAUSE - TURBOCHARGER HAD CAME IN CONTACT WITH THE TURBINE SEVERLY DAMAGING BOTH.
SOURCE: NOS: MANUFACTURER:
NPRDS PEACH BOTTOM 2, 830907, HIT 180 FAIRBANKS-MORSE

35) DURING TEST, DG 1-1 WAS MAKING UNUSUAL NOISES. DG 1-1 WAS DECLARED INOPERABLE AT 1245 HOURS. TURBOCHARGER WAS REPLACED AND DG 1-1 DECLARED OPERABLE FROM 121978 AT 1420 HOURS. DG 1-2 AND AC-DFF AVAILABLE AT ALL TIMES.
SOURCE: NOS: MANUFACTURER:
NPRDS HIT 22, 411 89 ELECTRO-MOTIVE DIV OF GM
EPRI DAVIS-BESSE, 020878, DG 1-1
36) CLAVERT CLIFFS - 4/7/83 - DURING A ROUTINE INSPECTION OF INTAKE AIR CHECK VALVE ON DG, A SHEARED CHECK VALVE HOLDING PIN WAS FOUND AND THE CHECK VALVE WAS LOOSE. SIMILIAR CRACKS ON OTHER DIESEL CHECK VALVES WERE DISCOVERED IN 1982. CHECK VALVE DIVERTS AIR BETWEEN TURBOCHARGER AND INTERNAL AIR BLOWER. INTERNAL BAFFLES BETWEEN CHECK VALVES AND TURBOCHARGER MADE IT UNLIKELY TO HAVE PIECE OF CHECK VALVE ENTER TURBOCHARGER. FAIRBANKS MORSE MODEL 38TD91/8.
SOURCE: NOS: MANUFACTURER:
IEE NOTICE 83-51 FAIRBANKS-MORSE
37) GM IDENTIFIED POTENTIAL FAILURE MODE OF TURBOCHARGERS USED ON EMD DIESELS. PBS OCCURS IF ENGINE RECEIVES A REPEAT RAPID START WITHIN A MIN. OF 15 MIN. AND MAX. OF 3 HRS AFTER A SHUTDOWN, FROM A PREVIOUS RUN IN WHICH ENGINE REACHED FULL OP. TEMP. THIS CAUSES LACK OF PRIME LUBE OIL SYSTEM PRESSURE WHICH MAY RESULT IN ENGINE DAMAGE.
SOURCE: NOS: MANUFACTURER:
IEE CIRCULAR 79-12, 06/28/79 ELECTRO-MOTIVE DIV OF GM
38) WELD CORE PLUGS TO TURBOCHARGER CASING & INCREASE NUMBER OF BOLTS.
SOURCE: NOS:
TDI SIM 309
39) INFO-PROCEDURE FOR TURBOCHARGER BEARING REPLACEMENT.
SOURCE: NOS:
TDI SIM 249

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NON-NUCLEAR INDUSTRY EXPERIENCE:
1) THESE UNITS HAVE BEEN REMOVED, REPAIRED AND REINSTALLED OR RENEWED A TOTAL OF 16 TIMES FOR REASONS INCLUDING LEAKING OIL SEALS, VIBRATION, ABNORMAL NOISE, ACCUMULATION OF FOREIGN MATTER, ROTOR DAMAGE AND A DEFECTIVE BEARING SEAL HOUSING. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS 12/29/831 TO C.SEAMAN
OTHER LETTER-MR HUDSON TO D.H.MARYIMI-12/14/76
2) A HOT SIDE BEARING AND SEALS ON ONE TURBOCHARGER REPLACED DUE TO EXCESSIVE WEAR. (M/V "COLUMBIA")

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

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SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER-M.F.ZBINDEN TO W.HUDSON-02/02/79
OTHER LETTER-M.F.ZBINDEN TO D.MARTINI-03/19/79
3) ACTION TAKEN SINCE VESSEL DELIVERY-MODIFIED TURBOCHARGER NOZZLE RING DESIGN AND BOLTING CONFIGURATION-NO TURBOCHARGER DAMAGE SINCE. CHANGED ORIGINAL TURBO WITH DEFECTIVE BEARING SUPPORT HOUSING-NO PROBLEMS SINCE. ADDED EXTERNAL TURBO AIR SEAL SYSTEM-NO PROBLEMS SINCE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN.
OTHER LETTER TO TDI (D.MARTINI) DATED 03/24/80 FROM M.ZBINDEN (STATE OF ALASKA)
4) TURBOCHARGERS HAVE OPERATED IN EXCESS OF 4000 HOURS WITHOUT BREAKAGE OF NOZZLE RING SINCE REVISING NOZZLE RING BOLTING CONFIGURATION. ALSO, NO ABNORMAL BUILDUP OF DEPOSITS OR NO OIL SEAL LEAKAGE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER LETTER FROM M.ZBINDEN (STATE OF ALASKA) TO D.MCDAVIDSON (FERGUSON & BUNDELL) DATED 07/25/80
5) A VOLUTE SECTION OF ONE TURBOCHARGER WAS FOUND CRACKED AND WAS REPLACED USING A SPARE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM M.ZBINDEN (STATE OF ALASKA) TO R.WARD DATED 03/13/81.
6) TDI SUGGESTS REPLACING ELLIOT TURBOS WITH DELAVAL C-17'S. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMO FROM S.SCHUMACHER (TDI) TO R.PRATT (07/09/82), PG. 2.
7) MODIFICATIONS MADE TO TURBOS-CHANGED NOZZLE RING OPENINGS-DID NOT CORRECT DEFICIENT MANIFOLD AIR PRESSURE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER HUNT & WILLIAMS (12/29/83) TO C.SEAMAN
OTHER MEMORANDUM FROM M.ZBINDEN (STATE OF ALASKA) TO R.LIND (DEPUTY COMMISSIONER), 07/09/82, PG. 2
8) TURBOS GOING INTO SURGE-MAY BE DUE TO IMPROPERLY SIZED TURBOS IN RELATION TO THE ENGINE. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT NO. 123-01 DATED APRIL 1983, PG 2-23, 4-10
9) TURBOCHARGERS-LEAKING OIL/AIR SEALS, BEARINGS, NOZZLES, ROTORS/CRACKED CASINGS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT NO. 123-01 DATED APRIL 1983, PG. 3-29
10) DESIGN DEFICIENCY-IF TURBOS FAIL, ENGINE MUST BE SHUTDOWN-OTHER ENGINES CAN BE RUN UNDER NORMAL ASPIRATED CONDITIONS. (M/V "COLUMBIA")
SOURCE: NOS:
OTHER SES REPORT NO. 123-01 DATED APRIL 1983, PG 4-8

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW THRUST BEARING PERFORMANCE.
2) REVIEW SITE FAILURE OF D.G. 103 TURBOCHARGER NOZZLE RING VANE.
3) REVIEW SIMILAR TIAWAN POWER FAILURES AS IN #2 & PROVIDE INPUT TO QUALITY.

RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) ASSEMBLE/REVIEW EXISTING DOCUMENTATION OF VENDOR MANUFACTURER.

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVM.	SELECTION COMMITTEE QUALITY RVL.	DEG RVM.	NO RVM.	DESIGN RVM. ACC.	DESIGN RVM. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
03-42SA	A	02/16/84	02/13/84	X	X	X		C		F	

JACKET WATER PUMP - JACKET WATER PUMP.

SHOREHAM EXPERIENCE:
1) REPLACE DEFECTIVE SUCTION FLANGE ON JACKET WATER PUMP #P-802A.
SOURCE: NOS:
RRR 292
LER 0594
2) INSPECT JACKET WATER PUMP DUE TO LOW PRESSURE #P-803B.
SOURCE: NOS:
RRR 394
3) INSPECT JACKET WATER PUMP DUE TO LOW PRESSURE #P-803B.
SOURCE: NOS:
RRR 423
4) MODIFIED JW PUMP SHAFT AND IMPELLERS DUE TO PART 50.55 (E).
SOURCE: NOS:
ESDCR F-41289
RRR 566, 554, 442, 751, 444, 575, 576, 577, 546, 551
LER 0832, 0855, 0726, 0830
ESDCR F-43525
5) JACKET WATER PUMP MOUNTING HOLES DO NOT MATCH #P-803B.
SOURCE: NOS:
RRR 564
6) PERFORM INSPECTION OF JACKET WTR PUMP #P-803A, B & C. B PUMP DAMAGED DUE TO ENG 102 FAILURE.
REPLACED WITH SPARE AFTER MACHINING.
SOURCE: NOS:
RRR 1086, 1092, 1093, 1103, 1084, 1111, 1117
7) INSTALL IOCR21 MODIFIED JW PUMP #P-903A, B & C.
SOURCE: NOS:
RRR 12, 138, 139
8) JW PUMPS #P803A,B CASTING POROSITY FLANGE.
SOURCE: NOS:
LER 955
9) REPLACE WIRING ON LS-053A & TS-070A.
SOURCE: NOS:
RRR 443
10) REPLACE MECH. SEAL OF JW PUMP ON ENG 2.
SOURCE: NOS:
RRR 1238
11) REPLACE SEAL OF JW PUMP #P-803B.
SOURCE: NOS:
RRR 1247
12) MODIFIED JW PUMP SHAFT AND IMPELLERS DUE TO PART 50.55 (E)
SOURCE: NOS:
ESDCR F-41289, F-43525
RRR 566, 554, 442, 751, 444, 575, 576, 577, 546, 551

E R G E N C Y D I E S E L G E N E R A T O R C O M P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

NPRDS DAVIS BESSEL, 820401, HIT 35 ELECTRO-MOTIVE DIV. OF GM
01 DIESEL TRIPPED FROM HIGH TEMPERATURE BOLT SHEARED OFF, DAMAGING IMPELLER OF COOLING PUMP. REPLACED PUMP.
SOURCE: VOS: MANUFACTURER:
NPRDS SAN ONOFRE 1, 740913, HIT 194 FAIRBANKS-MORSE
10) ENGINE TRIPPED DUE TO HIGH COOLING WATER TEMP. WATER PUMP SUCTION SCREEN BECAME PLUGGED BY MARINE GROWTH AND FOREIGN MATERIAL.
SOURCE: VOS: MANUFACTURER:
LER BIG ROCK PT., 155-76000, 760324 CATERPILLAR
11) WATER PUMP SEAL LEAKING DUE TO OLD AGE. INSTALLED NEW PUMP.
SOURCE: NOS:
NPRDS CONN. YANKEE, 790222, HIT 219
12) D.G. TRIPPED DUE TO LOW JACKET WATER PRESSURE. PINS AND CAP SCREWS FOR THE JACKET WATER PUMP DRIVE COUPLING SHEARED. NEW DRIVEPLATE, PINS, AND CAP SCREWS INSTALLED.
SOURCE: VOS: MANUFACTURER:
NPRDS BRUNSWICK 1, 820701, HIT 249 NORBERG
13) DURING TESTING OF UNIT 3 FIRE PROTECTION SYSTEM, DG-2/3 COOLING WATER PUMP TRIPPED. THE DIESEL SUBSEQUENTLY TRIPPED ON HIGH TEMPERATURE. DG-2 WAS OPERABLE. NO DEFINITE CAUSE ESTABLISHED. NORMAL BUS AND BACKUP BUS FOUND TRIPPED. PROBLEM RECURRED ON 020575.
SOURCE: VOS: MANUFACTURER:
EPRI DRESDEN 2, 082975, DG-2/3 ELECTRO-MOTIVE DIV OF GM
14) WHILE PERFORMING DG-2/3 OPERABILITY SURVEILLANCE, COOLING WATER PUMP TRIPPED 10 MINUTES AFTER THE DIESEL HAD BEEN LOADED. THE DIESEL WAS MANUALLY SHUT DOWN. PUMP WAS RESTARTED BUT TRIPPED AGAIN. SURVEILLANCE TEST ON DG-3 ALSO FAILED. CONDUIT LOADING TO THE DIESEL WATER PUMP WAS FILLED WITH MIXTURE OF WATER AND OIL. HOLE WAS FOUND AT STATOR WINDING ENCLOSURE.
SOURCE: VOS: MANUFACTURER:
EPRI DRESDEN 2, 112977, DG-2/3 ELECTRO-MOTIVE DIV OF GM
15) WHILE TESTING DG-2/3, ITS COOLING WATER PUMP TRIPPED. REDUNDANT DG-2, DG-3 WERE AVAILABLE. HIGH AMPERAGE OF COOLING PUMP TRIPPED OVERLOAD FOR BREAKER. HEAT LOADS REQUIRING EXCESSIVE PUMP SERVICE HAVE BEEN REDUCED.
SOURCE: VOS: MANUFACTURER:
EPRI DRESDEN 2, 063078, DG-2/3 ELECTRO-MOTIVE DIV OF GM
16) DG COOLING WATER PUMP TRIPPED REPEATEDLY. PUMP BEARINGS WERE FOUND TO BE EXCESSIVELY WORN. MANUFACTURER:
SOURCE: VOS: ELECTRO-MOTIVE DIV OF GM
NPRDS DRESDEN 3, 760713, HIT 155
17) SHOREHAM - 10/15/82. DURING PREOPERATIONAL TESTING, JACKET WATER PUMP SHAFT FAILED. MANUFACTURER:
SOURCE: VOS: TDI
IEE NOTICE 83-51

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NON-NUCLEAR INDUSTRY EXPERIENCE:
1) DESIGN DEFICIENCY - FAILURE OF STAND-BY JACKET WATER COOLING PUMP WOULD REQUIRE ENGINE SHUT DOWN. (M/V "COLUMBIA")
SOURCE: VOS:
OTHER SES REPORT 2123-01 DATED APRIL 1983, PG 4-10

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NG RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.
LER		0832, 0855, 0726, 0830									

3) DISCHARGE PIPING & DISCHARGE OF P-803B MIS-ALIGNED ON ENG 2.
SOURCE: NOS:
LER 1919
4) OUTAGE J.M. PUMP INSPECTION GUIDELINES ON ENGINE 2.
SOURCE: NOS:
RRR 1436

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NUCLEAR INDUSTRY EXPERIENCE:
1) DURING DIESEL GENERATOR LOADING, COMPONENTS OF ENGINE COOLING PUMP COUPLING OVERHEATED CAUSING SMOKE UNIT SHUTDOWN. LOOSE SET SCREW ALLOWED COUPLING SLEEVE TO MOVE AND CAUSE WEAR ON REDUCTION GEAR.
SOURCE: NOS: MANUFACTURER:
LER BIG ROCK PT. 155-80037 801118 CATERPILLAR
2) BEARING FAILURE OF STANDBY COOLING PUMP. PUMP REPAIRED. DIESEL BROUGHT BACK TO SERVICE.
SOURCE: NOS: MANUFACTURER:
LER CRYSTAL RIVER 3, 302-80108, 791203 FAIRBANKS-MORSE
3) DIESEL EXPERIENCED HIGH JACKET WATER TEMPERATURE. JACKET WATER COOLANT RECIRCULATION PUMP OVERLOAD DEVICE TRIPPED. NO CAUSE FOUND FOR TRIPPING. PUMP RESTARTED, DIESEL OPERATED SATISFACTORY.
SOURCE: NOS: MANUFACTURER:
LER CALVERT CLIFFS 2, 318-21038, 810730 FAIRBANKS-MORSE
4) THE MAIN BREAKER OF THE UNIT 2/3 DIESEL GENERATOR COOLING WATER PUMP WAS FOUND TRIPPED. EXCESSIVE HEAT BUILDUP WITHIN THE BREAKER HOUSING DUE TO INSUFFICIENT VENTILATION. HIGH AMBIENT TEMP IN BREAKER LOCATION INTENSIFIED HEAT TRANSFER PROBLEMS.
SOURCE: NOS: MANUFACTURER:
LER DRESDEN 2, 237-75080, 750911 ELECTRO-MOTIVE DIV OF GM
ERR LER-NP-2433, 6/82
5) THE 1/2 EMERGENCY DIESEL GENERATOR TRIPPED FROM HIGH ENGINE TEMPERATURE AFTER 1 HOUR AND 50 MINUTES OF RUNNING BECAUSE THE 1/2 DIESEL COOLING WATER PUMP TRIPPED. THE MOTOR FOR THE 1/2 DIESEL GENERATOR COOLING WATER PUMP WAS FOUND TO HAVE A SHORT. THE MOTOR WAS REPLACED WITH A SHOP TESTED USED MOTOR. THE SHORTED MOTOR WILL BE REPAIRED AND REINSTALLED.
SOURCE: NOS: MANUFACTURER:
LER QUAD CITIES 1, 254-80026, 801011 ELECTRO-MOTIVE DIV OF GM
6) UNIT TRIPPED ON HIGH WATER TEMP. INVESTIGATION REVEALED AIR-IN LEAKAGE AT COOLING WATER PUMP SHAFT PACKING CAUSED LOSS OF SUCTION FOR ENGINE WATER COOLING SYSTEM. PACKING ADJUSTED.
SOURCE: NOS: MANUFACTURER:
LER BIG ROCK PT., 155-78007, 780209 CATERPILLAR
7) AT 1000 ON 10/20/82, UNIT 2 IN MODE 1, COOLING JACKET CIRCULATING WATER PUMP ON DIESEL GENERATOR (D/G) 2B-2 WAS FOUND INOPERABLE DURING THE PERFORMANCE. THE PUMP FAILURE WAS CAUSED BY BALL BEARING FAILURE.
SOURCE: NOS: MANUFACTUPER:
LER SEQUOYAH 2, 328-82127, 821020 ELECTRO-MOTIVE DIV. OF GM
IEE NOTICE 83-51
8) D/G-2 RIGHT HAND PUMP SEALS ARE BAD. NAT'L END OF LIFE ON SEALS.
SOURCE: NOS: MANUFACTURER:

DATE : -84

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY PVL.	DSG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY PVL. ACC.	QUALITY PVL. REC.

RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) REVIEW DESIGN MODIFICATIONS TO PUMP SHAFT ASSEMBLY (INCLUDING LOCK NUTS).
2) EVALUATE TORSIONAL VIBRATIONS
3) REVIEW FAILURE ANALYSIS REPORT ON D.G. 102 JACKET WATER PUMP FAILURE.

TASK DESCRIPTION:
1) VERIFY DESIGN PRESSURE, PERFORMANCE AND MATERIAL COMPATABILITY.
2) STRESS ANALYSIS ON PUMP ROTOR AND IMPELLER AND GEAR ATTACHMENT.
3) DETERMINE PRESSURE BOUNDARY INTEGRITY.
4) REVIEW DESIGN MODIFICATIONS TO PUMP SHAFT ASSEMBLY (INCLUDING LOCK NUTS).

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) VERIFY BEARING SURFACE CONTACT BETWEEN IMPELLAR & SHAFT TO INSURE RE-BUILT PUMPS MEET SHOP SPECIFICATIONS.
2) VERIFY SHAFT MATERIAL PROPERTIES. REVIEW EXISTING DOCUMENTATION AND, IF NECESSARY, DEVELOP TEST PLAN FOR FIELD DETERMINATION.

TASK DESCRIPTION:
OR-1 REV-1
1) ASSEMPLE AND REVIEW EXISTING DOCUMENTATION.
2) VERIFY BEARING SURFACE CONTACT BETWEEN IMPELLER AND SHAFT TO INSURE RE-BUILT PUMPS MEET SHOP SPECIFICATIONS.
3) REVIEW EXISTING DOCUMENTATION AND, IF NECESSARY, DEVELOP TEST PLAN FOR FIELD DETERMINATION.
4) VERIFY SHAFT MATERIAL PROPERTIES BY A MATERIAL COMPARITOR TEST & A SUPERFICIAL HARDNESS TEST.
ONE ENGINE ONLY AS NOTED ON TSR 28 ATTACHED DOC.
OR-2
1) DISASSEMBLE JACKET WATER PUMP AND PERFORM LP INSPECTION OF GEAR/SHAFT CONTACT AND INSPECTION OF SHAFT TAPER AND IMPELLER. LOOK FOR EVIDENCE OF RELATIVE MOTION.
2) VISUALLY INSPECT CLEARNACE RING FOR EVIDENCE OF GALLING OR WEAR.
3) DOCUMENT ALL VISUAL INSPECTIONS WITH PHOTOGRAPHS.
4) INSPECTIONS TO BE PERFORMED FOLLOWING 100 HRSAT FULL LOAD.
OR-3
1) VERIFY MATERIAL PROPERTIES OF IMPELLER WITH SUPERFICIAL HARDNESS AND MATERIAL COMPARITOR TEST

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EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	CODE CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	QUALITY REL.	DRG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVW. ACC.	QUALITY RVW. REC.
01-159	S	07/20/84	02/09/84	X	X	X		A		F	

AIR START VALVES - AIR START VALVE

SHOREHAM EXPERIENCE:
1) REPLACE DEFECTIVE STARTING AIR VALVE FOR CYL #5 FOR ENGINE 2.
SOURCE: NOS:
RRR 452
2) REPLACE AIR START PIPING SOLENOID VALVES #SOV-46A-47A.
SOURCE: NOS:
RRR 507
3) REPLACED AIR STARTING VALVE BOLTING (LOCTITE) FOR ENGINES 1, 2, 3.
SOURCE: NOS:
ECDCR E-42362
RRR 538, 539, 580
4) VERIFY TORQUE OF ASSEMBLY BOLTS OF AIR START VALVES ON ENGINES 1, 2, 3.
SOURCE: NOS:
ECDCR E-42362
RRR 615, 616, 617, 619
LER 84-08
5) INSPECT & CLEAN AIR START SOLENOID VALVE #SV-046C.
SOURCE: NOS:
RRR 680
6) REPLACE STEEL WITH COPPER GASKET ON AIR START VALVE.
SOURCE: NOS:
RRR 705
7) RETORQUE AIR START PIPING VALVES AFTER 12 HRS. OPERATION @ 1 & 84 CYL. 1 86 & 87 CYL. 121, 86 & 87 CYL. 131 FOR ENGINES 1, 2, 3.
SOURCE: NOS:
RRR 745
8) REPLACE LEAKY GASKET ON AIR START SOV-47C.
SOURCE: NOS:
RRR 776
9) INSTL. CAPSCREWS IN AIR START DISTRIB. MANIF. AT CYL. HEADS ON ENG. 1.
SOURCE: NOS:
RRR 930
10) REPAIR/REPL. #SOV-466
SOURCE: NOS:
RRR 950
11) REPLACE AIR START SOLENOID - VALVES STICKING #SV-046C.
SOURCE: NOS:
RRR 626
12) RE-TORQUE AIR START VALVE CAPSCREWS ON ENG 3.
SOURCE: NOS:
RRR 1209
13) RE-TORQUE AIR START VALVE CAPSCREWS ON ENG 2.
SOURCE: NOS:

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

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RPR 1236
14) CLEAN INTERNALS & LUBRICATE SEALS OF AIR START CONTROL VALVE ON ENG. 1.
SOURCE: NOS:
RPR 1345
15) #6 & #7 CYL #21, #6 & #7 CYL #31 ON ENG 1, 2 & 3.
SOURCE: NOS:
RPR 745
16) VERIFY TORQUE OF ASSEMBLY BOLTS OF AIR START VALVES ON ENGINES 1, 2 & 3.
SOURCE: NOS:
ESOCR F-42362
RPR 615, 616, 617, 618
LOR 0946
17) REPAIR LEAKING AIR START SLENOID VALVES #02V-0219 ON ENGINE 2.
SOURCE: NOS:
RPR 112

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NUCLEAR INDUSTRY EXPERIENCE:
1) AIR START MOTOR FAILED (PARTIALLY DISABLING D.G.1-1) DUE TO FAILURE OF SOLENOID VALVE.
SOURCE: NOS: MANUFACTURER: ELECTRO-MOTIVE DIV OF GM
NPRDS DAVIS BESSE 1, 810520, HIT 26
2) EACH AIR START VALVE ASSEMBLY (16 PER ENGINE) IS MOUNTED TO CYLINDER HEAD WITH STEEL BOLTS. A TDI LETTER 06/11/82 NOTIFIED NPCL THAT MOUNTING CAPSCREWS MAY BE BOTTOMING OUT IN THE CYLINDER HEAD TAPPER HOLES. THIS COULD RESULT IN INSUFFICIENT OR UNEQUAL FORCES BEING APPLIED TO, AND EVENTUAL FAILURE OF THE AIR START VALVES AND HENSE THE ENGINE ITSELF. CONDITION WAS REPORTABLE U UNDER (10 CFR 21 & 10 CFR 50.55(E)).
SOURCE: NOS: MANUFACTURER: TDI
OTHER GRAND GULF REPORT NO. 83-024 9/22/83
3) DURING A SURVEILLANCE TESTING, DG-1A FAILED TO START BECAUSE THE IV FOR THE AIR SUPPLY TO THE STARTER MOTOR WAS LEFT SHUT. DG-1A WAS OUT OF SERVICE FOR PREVENTIVE MAINTENANCE. DG-1B WAS RETURNED TO SERVICE AND TESTED.
SOURCE: NOS: MANUFACTURER: ELECTRO-MOTIVE DIV OF GM
EPRI ST. LUCIE 1, 810279 DG-1A, 1B
4) DG-3 FAILED TO START ON THREE OCCASIONS. RUST PARTICLES HAD PLUGGED THE PARTS OF AN AIR RELAY VALVE PREVENTING AIR FROM PASSING INTO THE STARTING MOTORS.
SOURCE: NOS: MANUFACTURER: ELECTRO-MOTIVE DIV OF GM
EPRI SURRY 1, 040473 DG-3
6) STARTING AIR SYSTEM LEAK BLED DOWN THE STARTING AIR RECEIVERS. STARTING AIR VALVE WAS LEAKING THRU BECAUSE OF LOOSE CAP SCREWS HOLDING VALVE SEAT TO SEAT RETAINER.
SOURCE: NOS: MANUFACTURER: COOPER-BESSMER
NPRDS ZION 1, 790511, HIT 55
6) REPAIR LEAKING AIR START SOLENOID VALVES #02V-0219 ON ENGINE 2.
SOURCE: NOS: MANUFACTURER: COLT-PIELSTICK/FAIRBANKS-MORSE
RPR 112
LER FARLEY 1 348-79016, 780302
7) DIESEL FAILED TO START IN 10 SECONDS. AN AIR STARTING VALVE FOUND TO HAVE BEEN STUCK SHUT PREVENTING CYLINDER FROM RECEIVING STARTING AIR PRESSURE AND CAUSING DIESEL TO TAKE LONGER TIME

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DEG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

TO START.
SOURCE: NOS: MANUFACTURER:
LER BRUNSWICK 1 325-77115, 771209 NORBERG
EPRI EPRI-NP-2433 6/82
8) AT 1709 03/13/78 DIESEL GENERATOR 1A FAILED TO COME UP TO RATED SPEED. MAIN AIR START VALVE PUSHER ASSEMBLY USED FOR NORMAL ENGINE STARTS REMOVED DURING PREVIOUS MAINTAINANCE. THIS PROVIDED AIR LEAKAGE PATH THROUGH VALVE TOP AND RESULTED IN INSUFFICIENT AIR TO OPEN VALVE TO ATTAIN RATED SPEED IN LESS THAN 10 SECONDS.
SOURCE: NOS: MANUFACTURER:
LER FARLEY 1,348-78023, 780329 COLT-PIELSTICK/FAIRBANKS-MORSE
9) DIESEL GENERATOR TRIPPED ON OVERSPEED DUE TO MAIN AIR START VALVE FAILED TO FULLY SHUT, AIR LEAKING BY VALVE MAINTAINED MECHANICAL BOOSTER IN HIGH RACK POSITION WHICH OVERRODE GOVERNOR. AIR START INLET STRAINERS, MAIN START VALVES CLEANED. DESIGN EVALUATION IN PROGRESS.
SOURCE: NOS: MANUFACTURER:
LER FARLEY 1, 348-77027,770916 COLT-PIELSTICK/FAIRBANKS-MORSE
10) DIESEL GENERATOR TRIPPED ON OVERSPEED DUE TO MAIN AIR START VALVE FAILED TO FULLY SHUT, AIR LEAKING BY VALVE MAINTAINED MECHANICAL BOOSTER IN HIGH RACK POSITION WHICH OVERRODE GOVERNOR. AIR START INLET STRAINERS, MAIN START VALVES CLEANED. DESIGN EVALUATION IN PROGRESS.
SOURCE: NOS: MANUFACTURER:
LER FARLEY 1, 348-77026,770913 COLT-PIELSTICK/FAIRBANKS-MORSE
11) DIESEL GENERATOR WAS STARTED WHEN AIR START LINE WAS OBSERVED TO BE HOT AND BURNING OFF PAINT. ENGINE SHUTDOWN. PISTON BOLT FOR AIR START CHECK VALVE HAD BECOME LOOSE ENOUGH TO ALLOW COMBUSTION VAPORS TO ENTER AIR STARTING LINE. CHECK VALVE REPLACED.
SOURCE: NOS: MANUFACTURER:
LER COOK 2, 316-78070,780911 WORTHINGTON
12) DURING DIESEL GENERATOR TESTING, THE AIR STARTING CHECK VALVE BROKE IN TWO. THIS CAUSED THE GASKETS ON AIR START LINE TO BE BLOWN OUT. CHECK VALVE AND GASKETS REPLACED. DIESEL GENERATOR OPERATED SATISFACTORY.
SOURCE: NOS: MANUFACTURER:
LER COOK 2, 316-78013,780319 WORTHINGTON
EPRI COOK2, 031978,DG-CD
13) DURING STARTING OF DIESEL GENERATORS, AIR STARTERS FAILED TO REACH MINIMUM RPM. BOLT FOUND LOOSE ON RIGHT BANK AIR START VALVE ALLOWING LOSS OF PILOT AIR PRESSURE NECESSARY FOR OPENING MAIN AIR SUPPLY TO AIR STARTERS.
SOURCE: NOS: MANUFACTURER:
LER BROWNS FERRY 3, 296-82062, 820831 ELECTRO-MOTIVE DIV OF GM
14) DURING PREOPERATIONAL TESTING, THE "A" DIESEL GENERATOR WAS BEING TESTED TO VERIFY OPERABILITY WHEN ONE OF THE AIR START SYSTEM SOLENOID VALVES AND ITS ASSOCIATED AIR LINE WERE FOUND CLOGGED WITH DIRT. DEFECTIVE PROCEDURES.
SOURCE: NOS: MANUFACTURER:
LER ST LUCIE 1, 335-76000, 760518 ELECTRO-MOTIVE DIV OF GM
EPRI ST LUCIE1, 051876, DG-1A
15) POTENTIAL DEFECT IS RELATED TO LENGTH OF CAPSCREW WHICH HOLDS STARTING AIR ASSEMBLY TO THE CYLINDER HEAD. THIS PROBLEM WAS INVESTIGATED BY THE SEO AND FOUND TO BE A PROBLEM AT RIVER BEND UNIT 1.
SOURCE: NOS: MANUFACTURER:
10CFR50.55E SWEC NOTIF TO GSU,RIVERBEND1-9/20/83 TDI
OTHER GSU 50.55E NOTIF TO NRC 09/21/82

E R S E N C Y D I E S E L G E N E R A T O R C [illegible] P O N E N T T R A C K I N G S Y S T E M

S H O R E H A M N U C L E A R P O W E R S T A T I O N U N I T N U M B E R 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	DEG RVW.	NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

16] INFO-MOD TO EASE REMOVAL OF AIR START VALVE.
SOURCE: NOS: MANUFACTURER:
TDI SIM 8310 TDI
17] DURING A TEST, DG-2 FAILED TO START. IMMEDIATELY FOLLOWING INITIAL ATTEMPT, THE UNIT STARTED SUCCESSFULLY THREE TIMES. THE APPARENT CAUSE WAS THE FAILURE TO FOLLOW THE MONTHLY DG INSPECTION PROCEDURE. IMPROPER SEAL RING IN THE MAIN AIR RELAY VALVE WAS INSTALLED IN LAST INSPECTION PROCEDURE. THE IMPROPER SEAL RING WAS RESPONSIBLE FOR THE SLUGGISH OPERATION OF THE VALVE. VALVE WAS DISASSEMBLED AND REPAIRED.
SOURCE: NOS: MANUFACTURER:
EPRI DRESDEN 2, 092375, DG-2 ELECTRO-MOTIVE DIV OF GM
19] DG FAILED TO START DUE TO FAILURE OF AIR START VALVES.
SOURCE: NOS: MANUFACTURER:
NPRDS ROBINSON 2, 781009, HIT 167 FAIRBANKS-MORSE
19] STARTING AIR VALVE HOLDDOWN CAPSCREW POTENTIAL DEFECT IS RELATED TO LENGTH OF CAPSCREW WHICH HOLDS STARTING AIR VALVE ASSEMBLY IN CYLINDER HEAD. IF THIS CAPSCREW BOTTOMS IN THE TAPPED HOLE IN THE CYLINDER HEAD DURING INSTALLATION BEFORE VALVE ASSEMBLY IS PROPERLY SEATED, THE TORQUE WRENCH READING WOULD BE MISLEADING AND ASSEMBLY WILL FAIL.
SOURCE: NOS: MANUFACTURER:
10CFR50.55E GULF STATE UTILITIES CO., 09/07/82 - RBT 13390 TDI
10CFR50.55E CLEVELAND ELEC ILLUMINATING CO., 06/28/82
OTHER 50.55E NOTIF TO NRC,DUKE POWER CO., 07/22/83
OTHER 50.55E NOTIF TO NRC,GSU, 09/02/82
OTHER SWEC NOTIF TO GSU (PBT) 09/20/83
20] DURING A TEST, DG-2 FAILED TO START. IMMEDIATELY FOLLOWING INITIAL ATTEMPT, THE UNIT STARTED SUCCESSFULLY THREE TIMES. THE APPARENT CAUSE WAS THE FAILURE TO FOLLOW THE MONTHLY DG INSPECTION PROCEDURE. IMPROPER SEAL RING IN THE MAIN AIR RELAY VALVE WAS INSTALLED IN LAST INSPECTION PROCEDURE. THE IMPROPER SEAL RING WAS RESPONSIBLE FOR THE SLUGGISH OPERATION OF THE VALVE. VALVE WAS DISASSEMBLED AND REPAIRED.
SOURCE: NOS: MANUFACTURER:
EPRI DRESDEN 2, 092375, DG-2 ELECTRO-MOTIVE DIV OF GM
21] THE STARTING AIR VALVE FOR THE NO. 9 RIGHT CYLINDER FAILED. THE VALVE FAILED APPROXIMATELY 14 HOURS INTO THE TEST. ON 830724 APPROXIMATELY 6 HOURS INTO A DIESEL TEST RUN, THE NO. 1 LEFT BANK CYLINDER AIR START VALVE ON THE DIVISION I DIESEL ALSO FAILED. THE CAUSE OF THE VALVE FAILURES IS ATTRIBUTED TO THE CONTAMINATION OF ATMOSPHERIC VENT LINES AND MALFUNCTIONS OF THE STARTING AIR DISTRIBUTOR. DAMAGED VALVES AND THESTARTING AIR DISTRIBUTOR WERE REPLACED.
SOURCE: NOS: MANUFACTURER:
LER G.GULF, 416-83082-1, 830717 TDI
OTHER GRAND GULF REPORT 83-024, 09/22/83
23] DIESEL FAILED TO START. SYSTEM AIR RELAY VALVE STUCK PREVENTING AIR SUPPLY TO START MOTORS. VALVES DISASSEMBLED, CLEANED AND RELUBRICATED.
SOURCE: NOS: MANUFACTURER:
LER MONTICELLO 263-73000, 731217 ELECTRO-MOTIVE DIV OF GM
23] AIR START VALVE CAPSCREWS BOTTOMING IN CYL. HEAD.
SOURCE: NOS:
TDI SIM-360
24] AIR START VALVE CAGE TO CYL. HEAD GASKET CHANGED TO COPPER.
SOURCE: NOS:
TDI SIM-329

EMERGENCY DIESEL GENERATOR COMPONENT TRACKING SYSTEM

SHOREHAM NUCLEAR POWER STATION UNIT NUMBER 1

COMP. NO.	COMP. CLASS	CURRENT DATE	PRIOR DATE	SELECTION COMMITTEE DESIGN RVW.	SELECTION COMMITTEE QUALITY RVL.	SELECTION COMMITTEE DSG RVW.	SELECTION COMMITTEE NO RVW.	DESIGN RVW. ACC.	DESIGN RVW. REC.	QUALITY RVL. ACC.	QUALITY RVL. REC.

25) MFD-MOD. TO STARTING AIR VALVES TO PREVENT BINDING.
SOURCE: NOS:
TDI SIM-292

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NON-NUCLEAR INDUSTRY EXPERIENCE:
1) SEVERAL AIR START VALVES HAVE CEASED TO FUNCTION. REASON UNKNOWN. TDI HAS PUBLISHED INCREASED TORQUE VALVES IN AN ATTEMPT TO ALLEVIATE THE PROBLEM. (M/V "PRIDE OF TEXAS")
OTHER TITAN NAVIGATION, INC. LETTER DATED JULY 22, 1982; PG 9.

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RECOMMENDED DESIGN REVIEW ATTRIBUTES:
1) RESEARCH OPERATING HISTORY WITH TDI & LSU ON SHOREHAM DESEGN INCLUDING MODIFICATION TO VALVE DSIGN.
2) REVIEW DESIGN OF VALVES WITH RESPECT TO CORROSION PROBLEMS IDENTIFIED IN INDUSTRY OPERATING EXPERIENCE.

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RECOMMENDED QUALITY REVALIDATION ATTRIBUTES:
1) INVESTIGATE GASKET MATERIAL USED IN UNION AT VALVE TO CYLINDER HEAD.
2) CHECK TO INSURE AIR START VALVE ASSEMBLY IN ACCORDANCE WITH TDI PARTS MANUAL COMPONENT DRAWING (SHOWING LATEST TDI MODIFICATIONS)

TASK DESCRIPTION:
QR-1
1) ASSEMBLE AND REVIEW EXISTING DOCUMENTATION.
2) VERIFY THAT MOUNTING BOLTS ARE OF CORRECT LENGTH AND BOLT HOLES ARE CLEAN AND LURRICATED.
3) VERIFY GASKET SEAL TO CYLINDER HEAD IS OF PROPER MATERIAL.
4) VERIFY THAT LOCKING PIN IS IN VALVE ARM LOCK NUT.
5) VERIFY CONDITION OF OUTER "O" RING GROOVE AND "O" RING. USE LATEST TDI DRAWING FOR DIMENSIONS AND MATERIALS.
QR-2
1) PERFORM VISUAL INSPECTION FOR INDICATIONS OF CORROSION ON 02-359-01-AK, 02-359-01-AL, 02-359-01-AH AND DOCUMENT INSPECTION WITH PHOTOGRAPHS.
2) ONE SPARE VALVE TO HEAD METAL SEAL (PART 803-359-01-06) IS TO BE DESTRUCTIVELY TESTED FOR DETERMINATION OF CHEMICAL PROPERTIES FOR MATERIALS CONFIRMATION. PERFORM VISUAL INSPECTION OF VALVE BODY AND VALVE.
3) VISUAL INSPECTIONS TO BE PERFORMED AFTER 100 HRS. AT FULL LOAD.

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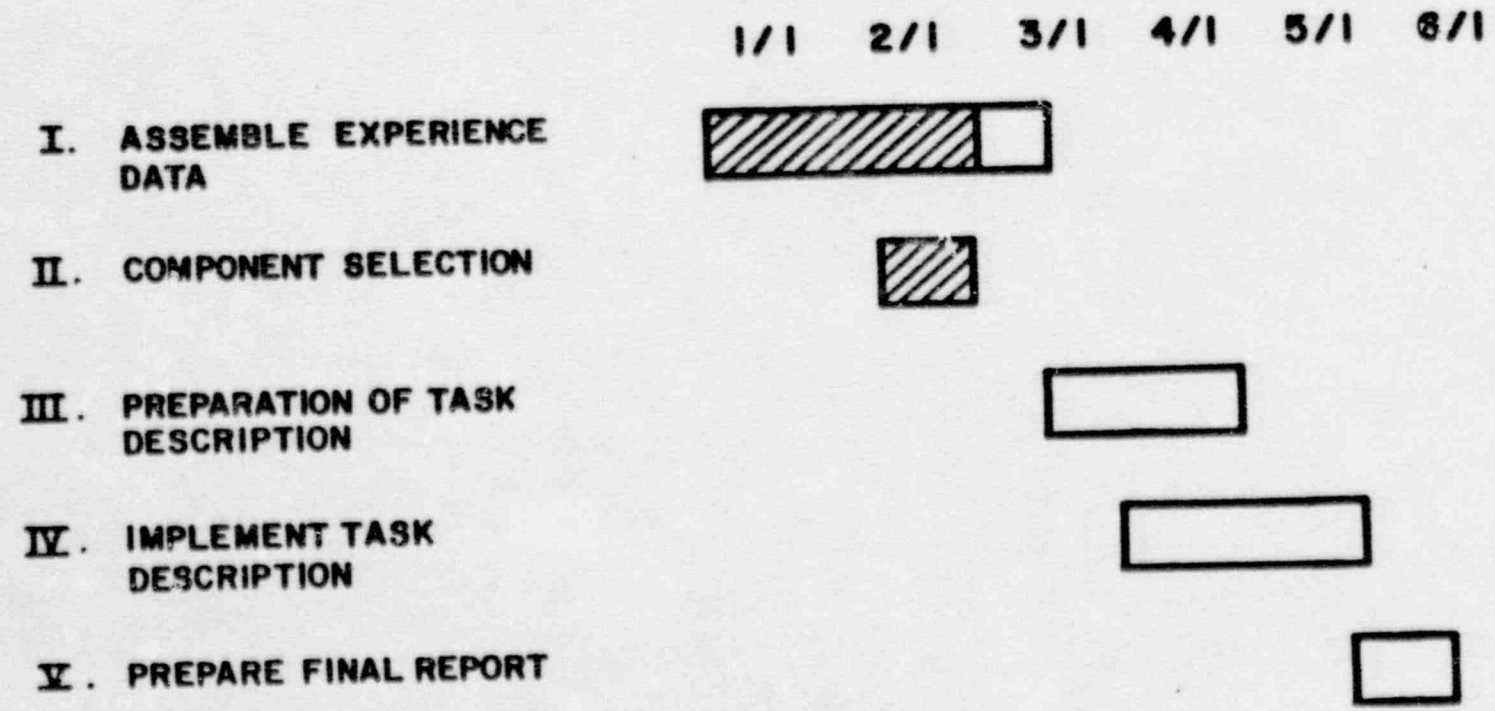
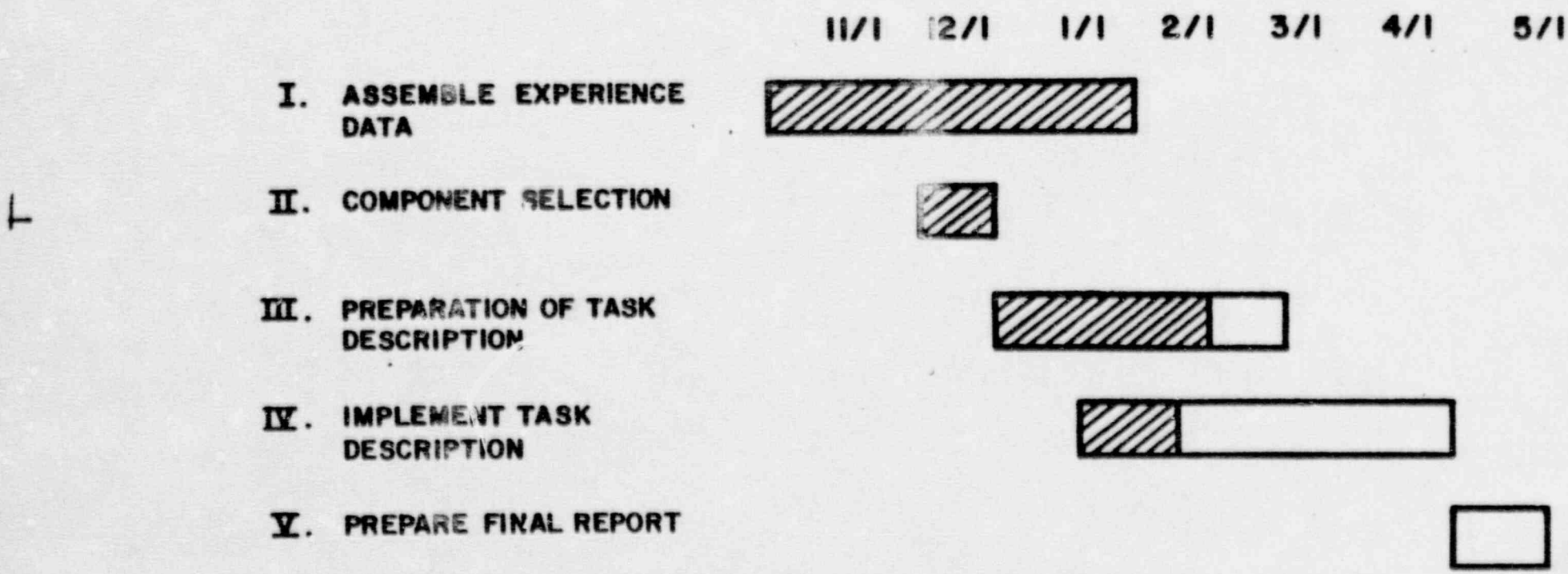
SCHEDULE / STATUS
LEAD V-ENGINE (GRAND GULF, V-16)



SCHEDULE / STATUS
R48 LEAD ENGINE (SHOREHAM)



TDI OWNERS GROUP SUMMARY SCHEDULE

(PRELIMINARY)