

Title BLN DESIGN REVIEW AND QUALITY EVALUATION REPORT		Project BLN	MEB	Meds No. 85 0227 651
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Manufacturer/Subvendor		Document Number DRQR REP. VOL I	Revision Level 0	
Vendor Letter Number		Project Authorization	Work Order Number	
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(Response) action to TVA? YES NO		(Circle response) Subject to changepaper? YES NO		
Changepaper? YES NO		STATUS Date Approved Accepted for Use Information Only Branch/Project		
		MEDS. W5B63 C-K		

TDI DIESEL GENERATOR

**DESIGN REVIEW
AND
QUALITY REVALIDATION
REPORT**

Prepared For

TENNESSEE VALLEY AUTHORITY

BELLEFONTE NUCLEAR PLANT

By

TDI DIESEL GENERATOR OWNERS GROUP

3805040142 380428
PDR ADUCK 05000438
AQ DGD

VOLUME 1

TDI DIESEL GENERATOR
DESIGN REVIEW
AND QUALITY REVALIDATION
REPORT

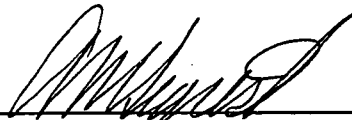
Prepared For

TENNESSEE VALLEY AUTHORITY
BELLEFONTE NUCLEAR PLANT

By

TDI DIESEL GENERATOR OWNERS GROUP

Revision 2
April 1986

A handwritten signature in dark ink, appearing to read 'A. M. Segrest', is written over a horizontal line.

A M Segrest
Program Manager
TDI Diesel Generator Owners Group

CHANGE LOG

Reply Ltr #

DG-23

Accession #

B44 '86 0514 701

Component # DRQR REP VOL IV

Rev. 0

Change # 1

Vendor DUKE POWER

Contract # TV-65137A

Date 5-14-86

Description of Revision

ITEM

APPENDIX 2

DELETE

ENTIRE APPENDIX 2

INSERT

ENTIRE APPENDIX 2 REV. 2

Preparer

William R. Kistler

CHANGE LOG

Reply Ltr #

DG-23

Accession #

B44 '86 0514 700

Element #

DRQR REP. VOL I

Rev. 0

Change # 2

Vendor

DUKE POWER

Contract #

TV-65137 A

Date

5-14-86

Description of Revision

REPLACE THE VOLUME I SIGNED COVER SHEET
DATED FEBRUARY 1985 WITH THE ATTACHED
SIGNED COVER SHEET, REV. 2, DATED APRIL 1986.

Preparer

William R. Kistler

P. O. BOX 33189

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B44 '86 0514 703

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April 29, 1986

TDI Diesel Generator Owners Group,
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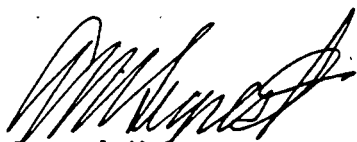
Re: Management and Technical Services
TDI Diesel Generator Owners Group
Revision 2 of the Final DR/QR Report
File: MTS-4086

Enclosed is one copy of Revision 2 to the final DR/QR Report for your station and a document providing justification for all changes. Additional copies of Revision 2 to the final DR/QR Report for your station have been mailed and should arrive by May 5, 1986.

If you have any questions or require additional information, please contact S E Eckert at 704-373-3818.

Very truly yours,

A P Cobb, Jr., Manager
Project Management Division


By: A M Segrest
Senior Engineer

AMS/SEE/kfb/E4-16/2

Enclosures

cc: Central Records

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B44 '86 0514 704

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373-4011

April 30, 1986

Mr. T A Hogan
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: Management and Technical Services
TDI Diesel Generator Owners Group
Revision 2 of the Final DR/QR Report for
the Transamerica Delaval Diesel Generators
at Bellefonte Nuclear Station
File: MTS-4086

Dear Mr. Hogan:

Enclosed are thirty-five (35) copies of Revision 2 of the Final DR/QR Report for the TDI diesel generators installed at Bellefonte Nuclear Station. This revision has been approved by the TDI Diesel Generator Owners Group Executive Committee and Transamerica Delaval, Inc.

Very truly yours,

A P Cobb, Jr., Manager
Project Management Division



By: A M Segrest
Senior Engineer

AMS/SEE/kfb/E4-15/2

Attachments

cc: w/attachments
Central Records

REVISION 2 TO DR/QR REPORT

Enclosed is Revision 2 to the DR/QR Report. Please revise your copy(ies) of the report per the instructions below.

<u>Item</u>	<u>Delete</u>	<u>Insert</u>
Appendix 2	Entire Appendix	Entire Appendix

TDI DIESEL GENERATOR

DESIGN REVIEW

AND

QUALITY REVALIDATION

REPORT

prepared for

TENNESSEE VALLEY AUTHORITY
BELLEFONTE NUCLEAR PLANT

by

TDI DIESEL GENERATOR OWNERS GROUP

February, 1985

Reviewed by:

R J Deese

R. J. Deese Licensing Coordinator
TDI Diesel Generator Owners Group

Approved by:

C. L. Ray, Jr.

C. L. Ray Technical Program Director TDI
Diesel Generator Owners Group

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

2.0 PROGRAM PLAN OVERVIEW

2.1 GENERIC PROBLEM RESOLUTION - PHASE I

2.2 COMPONENT SELECTION

2.3 TASK DESCRIPTION PREPARATION

2.4 DESIGN REVIEW

2.5 QUALITY REVALIDATION

2.6 FINAL DOCUMENTATION

3.0 RESULTS OF DESIGN REVIEW AND QUALITY REVALIDATION

3.1 SUMMARY RESOLUTION OF SIXTEEN GENERIC COMPONENTS (PHASE I)

3.2 SUMMARY RESOLUTION OF PHASE II COMPONENTS

4.0 SUMMARY/CONCLUSIONS

5.0 RECOMMENDATIONS

6.0 REFERENCES

APPENDICES

I. DR/QR SUMMARY REPORTS

II. MAINTENANCE & SURVEILLANCE RECOMMENDATIONS

III. INCLUDED REFERENCES

EXECUTIVE SUMMARY

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

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

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

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

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

This final report for Tennessee Valley Authority (TVA) provides the results of this extensive investigation of 169 components of the TDI DSRV-16 diesel generators at Bellefonte Nuclear Plant Unit 1. It forms the basis for the conclusion that the TDI diesel generators presently installed are fully capable of reliably performing their intended safety function.

1.0 INTRODUCTION

This report has been prepared for Tennessee Valley Authority by the TDI Diesel Generator Owners Group. The results of the Design Review and Quality Revalidation Program are specifically applicable to Bellefonte and are based on the generic program methodology briefly discussed in Section 2.0.

The purpose of this report is to provide the results of an extensive investigation of the design and manufacture of 169 components of the TDI DSRV-16 diesel generators at Bellefonte. This report forms the basis for the conclusion that the TDI diesel generators presently installed are fully capable of performing their safety function as described in the Bellefonte Final Safety Analysis Report.

2.0 PROGRAM PLAN OVERVIEW

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

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

Phase I

Generic Problem Resolution

Phase II

Component Selection

Task Description Preparation

Design Review

Quality Revalidation

Final Documentation

Each element is briefly discussed in the following sections.

2.1 GENERIC PROBLEM RESOLUTION - PHASE I

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

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

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

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

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

2.2 COMPONENT SELECTION

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

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

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

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

2.3 TASK DESCRIPTION PREPARATION

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

A. DR Task Descriptions

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

B. QR Task Descriptions (Component Revalidation Checklist)

1. Component to be validated
2. Attributes to be verified
3. Methodology to be used (documentation review, NDE techniques, etc.)
4. Acceptance criteria
5. Final documentation requirements

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

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

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

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

2.4 DESIGN REVIEW

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

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

2.5 QUALITY REVALIDATION

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

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

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

2.6 FINAL DOCUMENTATION

The DR/QR program has been completed for Tennessee Valley Authority. A summary of the results of this effort are contained in Section 3.0.

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

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

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

TABLE 2-1

PHASE I COMPONENTS (GENERIC PHASE I)

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

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
BL-101A	Emergency Diesel Generator	X	X		Generator
BL-101B	Generator Controls	X	X		Generator
BL-101C	Generator: Shaft & Bearings	X	X		Generator
F-068	Intercooler	X	X		Turbo, Intake Intrclr. & Exhaust
F-139	Tools Turbo			X	
F-161	Pyrometer Wire			X	
MP022/23	Turbocharger	X	X		Turbo, Intake, Intrclr. & Exhaust
00-420	Lube Oil Pressure Regulating Valve	X	X		Lube Oil
00-442A	Starting Air Distributor: Distributor Assembly	X	X		Air Start & Barring Device
00-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	X	X		Air Start & Barring Device
00-491A	Turbocharger - Air Inlet Adapter: Adapter			X	
00-491B	Turbocharger - Air Inlet Adapter: Mounting Hardware W/Flexible Connector			X	
00-495A	Turbocharger - Air Outlet Adapter			X	
00-495B	Turbocharger Air Outlet Adapter: Mounting Hardware			X	
00-520	Instruction Plate - Warning Plate			X	
00-620A	Fuel Oil Day Tank	X	X		Fuel Oil Injection
00-621A	Fuel Oil Drip Tank Assy	X	X		Fuel Oil Injection
00-621B	Fuel Oil Drip Tank Assy: Misc. Hardware, Gasket, Switch			X	

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-CFR	Turbocharger Thrust Bearing Drip Lube System	X	X		Turbo, Intake Intercooler & Exhaust
02-305A	Base and Bearing Caps: Base Assembly	X	X		Engine Base & Bearing Caps
02-305B	Base and Bearing Caps: Dowels			X	
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	X	X		Engine Base & Bearing Caps
02-305D	Base and Bearing Caps: Main Bearing Caps	X	X		Engine Base & Bearing Caps
02-305E	Base and Bearing Caps: Seals, Gaskets & Covers			X	
02-307A	Lube Oil Fittings: Internal - Headers	X	X		Lube Oil
02-307B	Lube Oil Fittings: Internal - Tubing & Fittings	X	X		Lube Oil
02-307C	Lube Oil Fittings Internal: Seals			X	
02-307D	Lube Oil Fittings Internal: Supports	X	X		Lube Oil
02-310A	Crankshaft	X	X		Crankshaft & Bearings
02-310B	Main Bearings	X	X		Crankshaft & Bearing
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	X	X		Crankshaft & Bearing
02-311A	Crankcase: Crankcase Assy	X	X		Crankshaft & Bearing
02-311C	Crankcase: Crankcase Seal			X	
02-311D	Crankcase: Crankcase Mounting Hardware	X	X		Crankshaft & Bearings

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-315A	Cylinder Block	X	X		Cyl. Block & Liners & Water Manifold
02-315B	Cylinder Block: Block To Crankcase Dowel			X	
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	X	X		Cyl. Block & Liners & Water Manifold
02-315D	Jacket Water Manifold Piping	X	X		Cyl. Block & Liners & Water Manifold
02-315E	Cylinder Block Liners & Water Manifold: Studs	X	X		Cyl. Block & Liners & Water Manifold
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	X	X		Cyl. Block & Liner & Water Manifold
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	X	X		Cyl. Block & Liners & Water Manifold
02-315H	Cylinder Block-Block to Crankcase Dowel			X	
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	X	X		Jacket Water
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	X	X		Jacket Water
02-316C	Jacket Water Inlet Manifold: Vent Line to Discharge Manifold	X	X		Jacket Water
02-317A	Jacket Water Discharge Manifold, Coupling and Seals	X	X		Jacket Water
02-317B	Water Discharge Manifold: Coupling & Seals	X	X		Jacket Water

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-317C	Water Discharge Manifold: Supports	X	X		Jacket Water
02-330A	Flywheel	X			Flywheel
02-330B	Flywheel Bolting	X	X		Flywheel
02-331A	Guards: Flywheel Guard Assembly			X	
02-335A	Front Gear Case: Gear Case			X	
02-335B	Front Gearcase - Bolting	X	X		Idler Gear Assembly & Front Gear Case
02-340A	Connecting Rods: Rods & Bushings	X	X		Connecting Rods
02-340B	Connecting Rod Bearing Shells	X	X		Connecting Rods
02-341A	Pistons	X	X		Pistons
02-341B	Pistons: Rings	X	X		Pistons
02-341C	Piston Pin Assembly	X	X		Pistons
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	X	X		Camshaft & Valve Train
02-345B	Tappets and Guides: Fuel Tappet Assembly	X	X		Camshaft & Valve Train
02-345C	Tappets and Guides: Fuel Pump Base Assembly	X	X		Camshaft & Valve Train
02-350A	Camshaft: Camshaft Assembly	X	X		Camshaft & Valve Train
02-350B	Camshaft: Camshaft Bearing	X			Camshaft & Valve Train

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-350C	Camshaft: Supports, Bolting and Gear	X	X		Camshaft & Valve Train
02-355A	Idler Gear Assembly: Crank To Pump Gear	X	X		Idler Gear Assembly & Front Gear Case
02-355B	Idler Gear Assembly	X	X		Idler Gear Assembly & Front Gear Case
02-355C	Idler Gear Assembly: Gaskets & Bolting			X	
02-359	Air Start Valves	X	X		Air Start & Barring Device
02-360A	Cylinder Heads	X	X		Cylinder Heads & Valves
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	X	X		Cylinder Heads & Valves
02-360C	Cylinder Head and Valves: Bolting and Gaskets	X	X		Cylinder Heads & Valves
02-360D	Cylinder Head & Valves: Springs and Retainers	X	X		Cylinder Heads & Valves
02-361	Indicating Cocks			X	
02-362A	Subcover	X	X		Camshaft & Valve Train
02-362B	Cylinder Head Covers: Gaskets and Bolting			X	
02-365A	Fuel Injection Equipment: Fuel Injection Pump	X			Fuel Oil Injection
02-365B	Fuel Injection Equipment - Fuel Injection Tips	X			Fuel Oil Injection

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-365C	Fuel Injection Equipment - Tube Assembly	X	X		Fuel Oil Injection
02-365D	Fuel Injection Equipment: Supports	X	X		Fuel Oil Injection
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	X	X		Fuel Oil Injection
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	X	X		Fuel Oil Injection
02-373A	Gear Case Opening - Cover			X	
02-373B	Gear Case Opening Cover - Gaskets & Bolting			X	
02-375	Intake Manifold and Piping	X	X		Turbo, Intake, Intrclr. & Exhaust
02-380A	Exhaust Manifold	X	X		Turbo, Intake, Intrclr. & Exhaust
02-380B	Exhaust Manifold: Gasket and Bolting	X	X		Turbo, Intake, Intrclr. & Exhaust
02-385A	Cylinder Block Covers: Covers and Relief Valves			X	
02-385B	Cylinder Block Covers: Gaskets and Bolting	X	X		Cyl. Block & Liners & Water Manifold
02-386A	Crankcase: Crankcase Cover Assy			X	
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	X	X		Crankshaft & Bearings

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-387A	Crankcase Ventilator: Crankcase Vacuum Fan			X	
02-387B	Crankcase Ventilator - Oil Separator			X	
02-387C	Crankcase Ventilator- Crankcase Vacuum Fan			X	
02-387D	Crankcase Ventilator- Crankcase & Fluid Manometer			X	
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	X	X		Camshaft & Valve Train
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	X	X		Camshaft & Valve Train
02-390C	Main and Connector Pushrods	X	X		Camshaft & Valve Train
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	X	X		Camshaft & Valve Train
02-390E	Rocker Arms and Pushrods: Bushings	X			Camshaft & Valve Train
02-390F	Rocker Arms and Pushrods: Lifters	X	X		Camshaft & Valve Train
02-390G	Rocker Arms and Pushrods Misc. Bolts & Drive Studs	X	X		Camshaft & Valve Train
02-395A	Gear Case Covers: Cover			X	
02-395B	Gear Case Covers: Gaskets and Bolting			X	
02-410A	Overspeed Trip Governor	X	X		Overspeed Trip & Governor

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	X	X		Overspeed Trip & Governor
02-410C	Overspeed Trip: Couplings (Flexible and Spider)	X	X		Overspeed Trip & Governor
02-410D	Overspeed Trip Vent Valve	X	X		Overspeed Trip & Governor
02-411A	Governor Drive: Governor & Tachometer Drive Gear & Shaft	X	X		Overspeed Trip & Governor
02-411B	Governor Drive: Couplings, Pins & Keys	X	X		Overspeed Trip & Governor
02-413A	Governor Linkage & Cross Shaft Assembly	X	X		Overspeed Trip & Governor
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	X			Fuel Oil Injection
02-415A	Governor Assembly: Woodward Governor	X	X		Overspeed Trip & Governor
02-415B	Governor Assembly - Booster Servomotor	X			Overspeed Trip & Governor
02-415C	Governor Assembly - Heat Exchangers	X	X		Overspeed Trip & Governor
02-420	Engine Driven Lube Oil Pump	X	X		Lube Oil
02-425A	Engine Driven Jacket Water Pump	X	X		Jacket Water
02-425B	Jacket Water Pump			X	
02-435A	Jacket Water Fittings: Pipe & Fittings	X	X		Jacket Water
02-436A	Intercooler Piping - Pipe	X	X		Turbo, Intake Intercooler & Exhaust

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	X	X		Turbo, Intake Intercooler & Exhaust
02-437	Turbo Water Piping: Pipe & Fittings	X	X		Jacket Water
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	X	X		Air Start & Barring Device
02-441B	Starting Air Manifold Valves, Filters & Strainer	X	X		Air Start & Barring Device
02-441C	Starting Air Manifold: Supports	X	X		Air Start & Barring Device
02-445	Fuel Oil Booster Pump	X	X		Fuel Oil In- jection
02-450B	Fuel Oil Header: Piping/Tubing	X	X		Fuel Oil In- jection
02-450D	Fuel Oil Header: Fuel Oil Supports	X	X		Fuel Oil Injection
02-455A	Fuel Oil Filters & Strainers: Filters	X			Fuel Oil In- jection
02-455B	Fuel Oil Filters & Strainers: Strainers	X			Fuel Oil In- jection
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	X	X		Fuel Oil In- jection
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	X	X		Lube Oil
02-465B	Lube Oil Lines External - Supports	X	X		Lube Oil
02-467A	Turbocharger: Lube Oil Fitting - Piping	X	X		Lube Oil

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-467B	Turbocharger: Lube Oil Fittings - Supports	X	X		Lube Oil
02-475A	Turbocharger: Bracket	X	X		Turbo, Intake, Intrclr. & Exhaust
02-475B	Air Butterfly Valve Assembly	X	X		Turbo, Intake, Intrclr. & Exhaust
02-475C	Turbocharger: Bracket - Bolting & Gaskets	X	X		Turbo, Intake, Intrclr. & Exhaust
02-500A	Control Panel Assembly Cabinet/System	X	X		Control Panel Assembly
02-500B	Control Panel Assembly: Annunciators			X	
02-500C	Control Panel Assembly: Circuit Breaker/Contact Blocks			X	
02-500D	Control Panel Assembly: Pressure Gauges			X	
02-500E	Control Panel Assembly: Hourmeter			X	
02-500F	Control Panel Assembly Accumulator	X	X		Control Panel Assembly
02-500G	Control Panel Valves	X	X		Control Panel Assembly
02-500H	Control Panel Assembly Pressure Switch	X	X		Control Panel Assembly
02-500I	Control Panel Assembly: Pyrometers			X	

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-500J	Control Panel Assembly: Control Relays	X	X		Control Panel Assembly
02-500K	Control Panel Assembly: Solenoid Valves	X	X		Control Panel Assembly
02-500L	Control Panel Assembly: Tachometer			X	
02-500M	Control Panel Assembly - Piping, Tubing, Fittings		X		Control Panel Assembly
02-500N	Control Panel Assembly: Terminal Boards/Switches/ Wiring		X		Control Panel Assembly
02-520	Instruction Plate: Nameplate			X	
02-525A	Barring Device - Pneumatic: Barring Device Assembly			X	
02-525B	Barring Device - Pneumatic: Regulator Valve/Shutoff Valve	X	X		Air Start & Barring Device
02-525C	Barring Device - Pneumatic: Misc. Fitting, Hose, Filters Tubing			X	
02-525D	Barring Device - Pneumatic: Mounting Bracket/Supports			X	
02-530A	Platform - Front & Side: Side Platform Assembly			X	
02-530B	Platform - Front & Side: Front Platform Assembly			X	
02-530E	Platform - Rear & Side Platform Bracing			X	

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-531A	Platform Ladder - Rear Assembly - Handrail			X	
02-531B	Platform Ladder - Rear - Bracing			X	
02-540A	Lube Oil Sump Tank and Mounting Hardware		X		Lube Oil
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	X	X		Lube Oil
02-540C	Lube Oil Sump Tank: Mounting Hardware	X	X		Lube Oil
02-550	Foundation Bolts: Anchor Bolts, Misc. Hardware	X	X		Engine & Aux. Sub Base & Foundation Bolts
02-590	Special Tools: Asst. Engine Assembly Tools			X	
02-595	Spares			X	
02-630A	Pyrometer Conduit Assembly: Conduit	X	X		Engine Instrumentation & Wiring
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	X	X		Engine Instrumentation & Wiring
02-630C	Pyrometer Conduit Assembly: Support	X	X		Engine Instrumentation & Wiring
02-630D	Pyrometer Conduit Assembly: Thermocouples	X			Engine Instrumentation & Wiring

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-630E	Pyrometer Conduit Assembly: Gaskets			X	
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	X	X		Engine Instrumentation & Wiring
02-688B	Engine & Auxiliary Module Wiring Materials: Wiring & Terminations	X	X		Engine Instrumentation & Wiring
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals		X		Engine Instrumentation & Wiring
02-689	Off Engine Wiring Level Switch	X	X		Engine Instrumentation & Wiring
02-690	On Engine Alarm Sensors	X	X		Engine Instrumentation & Wiring
02-691	Off-Engine Alarm Sensors	X	X		Engine Instrumentation & Wiring
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	X	X		Engine Shutdown & Equipment
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	X	X		Engine Shutdown & Equipment
02-695C	Engine Shutdown Trip Switches	X	X		Engine Shutdown & Equipment

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

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

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	X	X		Lube Oil
02-717J	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	X	X		Fuel Oil
02-717K	Aux Sub Base & Oil & Water Piping - Fuel Oil Valves	X	X		Fuel Oil Injection
02-717L	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	X	X		Fuel Oil Injection
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil: Supports	X	X		Fuel Oil Injection
02-795	Reassembly Spares-Gaskets			X	
02-805A	Flex Connection	X	X		Turbo, Intake, Intercooler & Exhaust
02-805B	Intake Air Silencer		X		Turbo, Intake, Intercooler & Exhaust
02-805C	Intake Air Filter	X	X		Turbo, Intake, Intercooler & Exhaust
02-805D	Exhaust Silencer			X	
02-810A	Jacket Water Heat Exchanger	X	X		Jacket Water
02-810B	Jacket Water Standby Heater Pump		X		Jacket Water
02-810C	Thermostatic Valve	X	X		Jacket Water

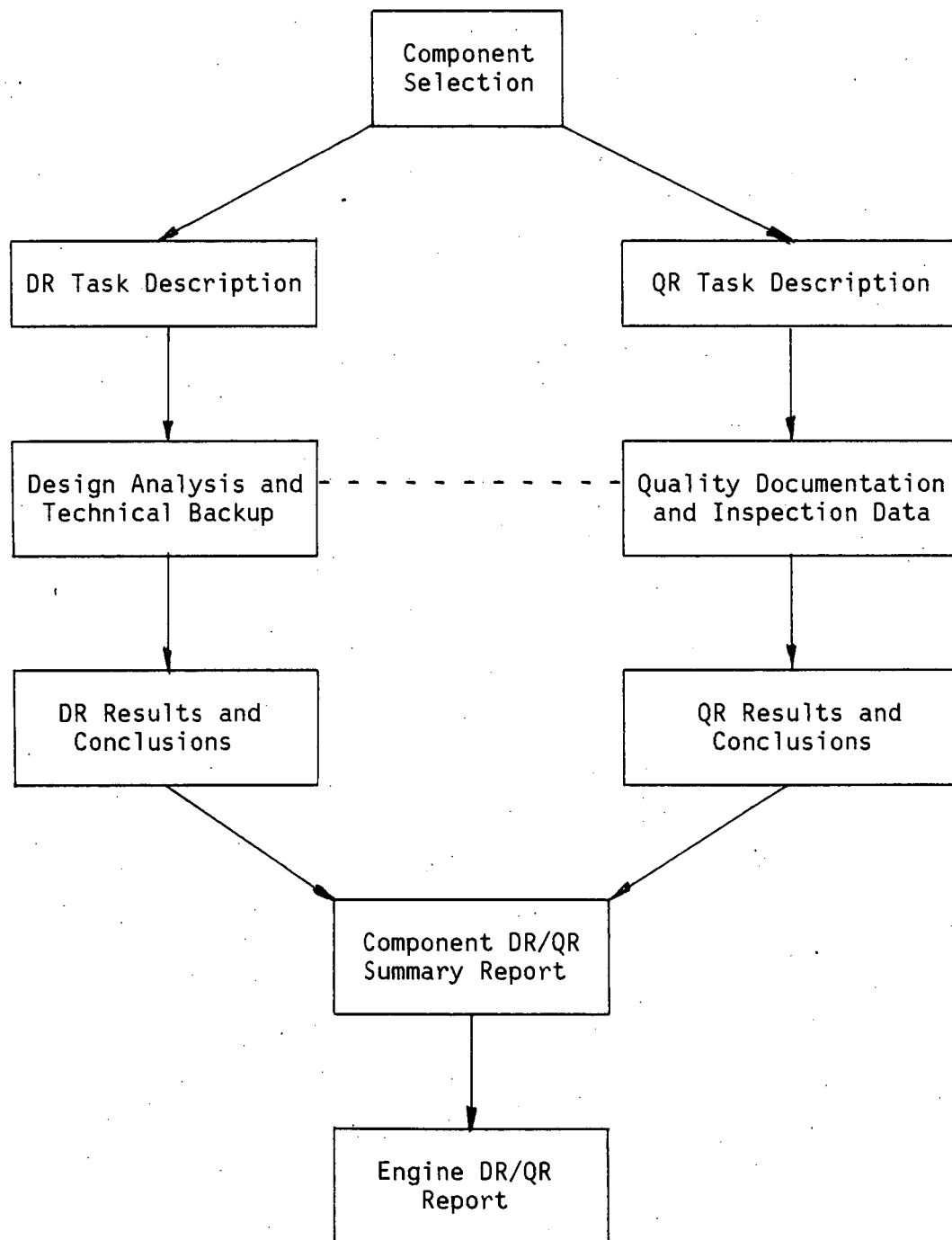
TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-810D	Misc. Equipment- Heater-Jacket Water		X		Jacket Water
02-820A	Lube Oil Heat Exchanger	X	X		Lube Oil
02-820B	Lube Oil System-Auxiliary Lube Oil Pump		X		Lube Oil
02-820C	Lube Oil Full Pressure Strainer	X	X		Lube Oil
02-820D	Full Flow Lube Oil Filter	X	X		Lube Oil
02-820E	Oil Keep-Warm Filter	X	X		Lube Oil
02-820F	Lube Oil Lines External- Valves	X	X		Lube Oil
02-820G	Before & After Lube Oil Pump	X	X		Lube Oil
02-820H	Lube Oil Sump Heater		X		Lube Oil
02-825A	Fuel Oil Booster Pump			X	
02-825B	DC Magnetic Starter			X	
02-825C	Fuel Oil Transfer Pump	X	X		Fuel Oil Injection
02-825D	Fuel Oil Drip Waste Pump			X	
02-825E	Fuel Oil Valves, Bolting			X	
02-835A	Starting Air Tank	X	X		Air Start & Bearing Device
02-835B	Starting Air Compressor			X	
02-835C	Air Dryer			X	
02-835D	Skid Base - Starting Air Equipment	X	X		Air Start & Barring Device

TABLE 2-2
BELLEFONTE COMPONENT SELECTION RESULTS

Component Number	Component Description	DR Req'd	QR Req'd	No Review	Category
02-835E	Air Start System Starting Air Piping, Fittings, Tubing			X	
02-835F	Starting Air Float Trap	X			Air Start & Barring Device
02-835G	Air Start System- Starting Air Pressure Gauge			X	
02-835H	Air Start Tank Relief Valve	X	X		Air Start & Barring Device
02-835I	Misc. Equipment: After Cooler Support			X	
02-835J	Misc. Equipment: After Cooler			X	
02-835K	Misc. Equipment: After Cooler Bolting			X	

FIGURE 2.1



3.0 Results of Design Review and Quality Revalidation

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

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

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

3.1 Summary Resolution of Sixteen Generic Components (Phase I)

The results of the Phase I program have been submitted to the NRC in a series of reports and supplements (Refs. 2 through 44) that covered the 16 generic components. The results of these reviews are summarized below.

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

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Fuel Injection Equipment: Tube Assembly (03-365C)	Unlimited Life	Additional testing and maintenance requirements. Procurement specification requirement.
Main and Connector Pushrods (03-390C, 03-390D)	Unlimited Life	Additional procurement requirement. Additional inspections recommended. Random destructive testing recommended.
Rocker Arm Capscrews (03-390F)	Unlimited Life	Additional maintenance requirements.
Jacket Water Pump (03-425A)	Unlimited Life	Additional maintenance and inspection requirements.
Wiring and Terminations (03-688B)	Unlimited Life	None

3.2 Summary Resolution of Phase II Components

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
<u>TURBO, INTAKE, INTERCOOLER & EXHAUST</u>		
Intercooler (F-068)	Unlimited Life	Additional maintenance recommendations.
Turbocharger (MP-022/023)	Unlimited Life	Additional maintenance and modification recommendations to increase reliability and performance. Additional Quality inspections recommended.
Turbocharger Thrust Bearing Drip Lube System (Small Bore Scope Only) (02-CFR)	Modifications	Addition of two-directional lateral restraints. Installation of Engine 1A should be consistent with Engine 1B.
Intake Manifold & Piping (Large Bore Scope Only) (02-375)	Unlimited Life	Additional maintenance recommendation. Additional Quality inspections recommended.
Exhaust Manifold (02-380A)	Modifications	Additional maintenance recommendations. Modify slip joints. Refer to Component Design Review Checklist 02-380A for details. Additional inspections recommended.
Exhaust Manifold: Gasket & Bolting (02-380B)	Unlimited Life	Additional Quality inspections recommended.
Intercooler Piping-Pipe (Large Bore Scope Only) (02-436A&B)	Unlimited Life	None
Turbo Water Piping-Pipe and Fittings (Small Bore Scope Only) (02-437)	Unlimited Life	Leaking Dresser Style 65 couplings should be replaced with Dresser Style 90 couplings with Viton gaskets.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Turbocharger- Bracket: Bolting & Gaskets (02-475A&C)	Unlimited Life	Additional inspections recommended. Additional Quality inspections recommended.
Air Butterfly Valve Assembly (02-475B)	Modifications	Addition of grease fittings per TDI SIM 322. Additional maintenance recommendations. Additional Quality inspections recommended.
Flex Connections (02-805A)	Unlimited Life	None
Intake Air Silencer (02-805B)	Unlimited Life	None
Intake Air Filter (02-805C)	Unlimited Life	Inspect intake air filter oil distribution plate and change oil in filter at each outage.

LUBE OIL

Lube Oil Pressure Regulating Valve (00-420)	Unlimited Life	Additional maintenance recommendations.
Lube Oil Fittings - Internal: Headers (Large Bore Scope Only) (02-307A-LB)	Unlimited Life	None
Lube Oil Fittings- Internal: Headers (Small Bore Scope Only) (02-307A-SB)	Unlimited Life	Verify supports as indicated in Component Design Review Checklist 02-307D.
Lube Oil Fittings - Internal - Tubing and Fittings (Large Bore Scope Only) (02-307B-SB)	Unlimited Life	None
Lube Oil Fittings - Internal: Supports (Small Bore Scope Only) (02-307D)	Modifications	Modify U-bolts. Refer to Component Design Review Checklist 02-307D for details.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Engine Driven Lube Oil Pump (02-420)	Modifications	Addition of a Style 90 or 165 Dresser coupling with Viton gaskets to the pump suction line.
Lube Oil Lines - External Tubing, Fittings, Couplings (Large Bore Scope Only) (02-465A-LB)	Modifications	Replace 12-inch Dresser coupling with a Viton gasket. Ensure a minimum installation gap of 0.171 inches, between pipe ends, exists at the 12-inch Dresser coupling.
Lube Oil Lines External - Tubing, Fittings, Couplings (Small Bore Scope Only) (02-465A-SB)	Modifications	Addition/modification of supports. Refer to DR/QR Report 02-465B for details. Engine A piping and tubing should be verified or modified to be consistent with Engine B.
Lube Oil Liner - External Supports (Large Bore Scope Only) (02-465B-LB)	There are no supports for this component at Bellefonte. No design review required.	
Lube Oil Lines External: Supports (Small Bore Scope Only) (02-465B-SB)	Modifications	Addition of restraints. Refer to DR/QR Report 02-465B for details. Engine 1A piping and tubing should be verified or modified to be consistent with Engine 1B.
Turbocharger - Lube Oil Fittings: Pipe, Tubing, Fitting & Flexible Coupling (Large Bore Scope Only) (02-467A-LB)	Modifications	Replace 2½-inch Dresser couplings with 2½-inch 150 lb sump oil flanges with A307 bolts.
Turbocharger - Lube Oil Fittings - Pipe, Tubing, Fittings and Flexible Couplings (Small Bore Scope Only) (02-467A-SB)	Modifications	Addition/modification of supports. Refer to DR/QR Report 02-467B for details. Engine A piping and tubing should be verified or modified to be consistent with Engine B.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Turbocharger - Lube Oil Fittings: Supports (Large Bore Scope Only) (02-467B-LB)	Modifications	The multiple support located between the lube oil sump tank and Dresser coupling requires reinforcement of its support members and increases in their welds.
Turbocharger - Lube Oil Fittings: Supports (Small Bore Scope Only) (02-467B-SB)	Modifications	Modify two-directional lateral restraints to three-directional restraints. Installation of Engine 1A should be consistent with that of Engine 1B.
Lube Oil Sump Tank and Mounting Hardware (02-540A&C)	Unlimited Life	Additional Quality inspections recommended.
Lube Oil Sump Tank: Miscellaneous Fittings, Gaskets, Pipe Bolting Material and Valve (02-540B)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping - Lube Oil: Pipe and Fittings (Small Bore Scope Only) (02-717F)	Modifications	Addition of supports. Refer to DR/QR Report 02-717I for details.
Auxiliary Sub-Base & Oil & Water Piping - Lube Oil: Valves (02-717G)	Unlimited Life	Check the relief valve lift pressure every 5 years.
Auxiliary Sub-Base & Oil & Water Piping - Lube Oil: Oil-Gaskets & Bolting (02-717H)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Auxiliary Sub-Base & Oil & Water Piping - Lube Oil: Supports and Mounting Hardware (Large Bore Scope Only) (02-717I-LB)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping - Lube Oil: Supports and Mounting Hardware (Small Bore Scope Only) (02-717I-SB)	Modifications	Addition of two-directional lateral restraints. Refer to DR/QR Report 02-717I for details.
Lube Oil Heat Exchanger (02-820A)	Unlimited Life	Additional maintenance recommend- ations.
Lube Oil System - Auxiliary Lube Oil Pump (02-820B)	Unlimited Life	None
Lube Oil Full Pressure Strainer (02-820C)	Unlimited Life	Additional maintenance recommend- ations.
Full Flow Lube Oil Filter (02-820D)	Unlimited Life	Additional maintenance recommend- ations.
Oil Keep-Warm Filter (02-820E)	Unlimited Life	Additional maintenance recommend- ations.
Lube Oil Lines External - Valves (02-820F)	Unlimited Life	None
Before and After Lube Oil Pump (02-820G)	Unlimited Life	None
Lube oil sump Heater (02-820H)	Unlimited Life	None

ComponentAcceptabilityRecommended ActionENGINE BASE & BEARING CAPS

Base and Bearing
Caps - Base Assembly,
Main Bearing Studs
and Nuts, and Main
Bearing Caps
(02-305A,C,D)

Unlimited Life

Additional maintenance recommend-
ations. Additional Quality
inspections recommended.

CRANKSHAFT & BEARINGS

Crankshaft
(02-310A)

Unlimited Life
(provided that
a torsigraph
test verifies
that the actual
level of stress
does not exceed
that calculated)

Additional Quality inspections
recommended.

Main Bearings
(02-310B)

Unlimited Life

Main bearings should be inspected
for misalignment at the first
refueling outage. Additional
Quality inspections recommended.

Crankshaft &
Bearings: Thrust
Bearing Ring
(02-310C)

Unlimited Life

Additional maintenance recommend-
ations.

Crankcase:
Crankcase Assembly
(02-311A)

Unlimited Life

Additional maintenance recommend-
ations. Additional Quality
inspections recommended.

Crankcase:
Crankcase
Mounting Hardware
(02-311D)

Unlimited Life

None

Crankcase:
Crankcase Gaskets
and Mounting
Hardware
(02-386B)

Unlimited Life

Additional Quality inspections
recommended.

ComponentAcceptabilityRecommended ActionCYLINDER BLOCK, LINERS, & WATER MANIFOLD

Cylinder Block
(02-315A)

Implementation of routine inspections. Perform a material microstructure evaluation on each cylinder block. Perform a dimensional check on liner bore and mating block. Verify Quality inspection results on block tops.

Cylinder Block
Liners & Water
Manifold - Cylinder
Liner
(02-315C)

Unlimited Life

Additional maintenance recommendations. Additional Quality inspections recommended.

Cylinder Block
Liners & Water
Manifold: Studs
(02-315E)

Unlimited Life

Changes to installation torque to lower the stresses in the cylinder block recommended. Additional Quality inspections recommended.

Cylinder Block
Liner & Water
Manifold -
Cylinder Head
Nuts
(02-315F)

Unlimited Life

Additional Quality Revalidation inspections recommended.

Cylinder Block -
Liners and Water
Manifold: Seals
and Gaskets
(02-315G)

Unlimited Life

Perform a review of applicable site documentation to verify that the proper cylinder liner seals (TDI P/N JF-019-000) have been installed.

Cylinder Block
Covers: Gaskets
& Bolts
(02-385B)

Unlimited Life



Additional Quality inspections recommended.

AIRSTART & BARRING DEVICE

Starting Air
Distributor:
Distributor
Assembly
(00-442A)

Unlimited Life

Additional maintenance recommendations. Additional Quality inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Starting Air Distributor - Tubing, Fittings and Gaskets (00-442B)	This design review report has been deleted. All air distributor tubing is addressed under component numbers 02-441A&C and 02-307B.	
 Air Start Valves (02-359)	Modifications	Implementation of TDI SIMs 329 and 360. Additional maintenance recommendations. Additional Quality inspections recommended.
Starting Air Manifold: Piping (Large Bore Scope Only) (02-441A-LB)	A design review for this component can not be performed. The off-engine piping connecting the start air receiving tanks to the diesel generators are being removed and are scheduled to be rerouted. Design details of the new routing have not been made available. Review of this component should be done by the utility at a later date.	
Starting Air Manifold - Piping, Tubing and Fittings (Small Bore Scope Only) (02-441A-SB)	Modifications	Addition of supports. Refer to DR/QR Report 02-441C for details.
 Starting Air Manifold: Valves, Strainers and Filter (02-441B)	Modifications	Implementation of TDI SIM 323. Additional maintenance recommendations.
Starting Air Manifold: Supports (Large Bore Scope Only) (02-441C-LB)	Unlimited Life	None
Starting Air Manifold - Supports (Small Bore Scope Only) (02-441C-SB)	Modifications	Addition of two-directional lateral restraints. Engine 1A tubing should be verified to be consistent with that of Engine 1B.
Barring Device - Pneumatic: Regulator Valve, Shutoff Valve (02-525B)	Unlimited Life	Additional maintenance recommendations.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Start Air Tank (02-835A)	Unlimited Life	Additional maintenance recommendations.
Skid Base - Starting Air Equipment (02-835D)	Unlimited Life	None
Starting Air Float Trap (02-835F)	Unlimited Life	Additional maintenance recommendations.
Air Start Tank Relief Valves (02-835H)	Unlimited Life	None

CONNECTING RODS

Connecting Rods: Rods and Bushings (02-340A)	Unlimited Life	Additional maintenance recommendations. Additional Quality Revalidation inspections recommended.
Connecting Rod Bearing Shells (02-340B)	Unlimited Life	Additional maintenance recommendations. Additional Quality Revalidation inspections recommended.

PISTONS

Pistons (02-341A)	Unlimited Life	Additional Quality inspections recommended.
Piston: Rings (02-341B)	Unlimited Life	Additional maintenance recommendations. Additional Quality Revalidation inspections recommended.
Piston: Pin Assembly (02-341C)	Modifications	Replace the spiral ring retainers with Waldes snap ring retainers (P/N GE-003-067). Additional maintenance recommendations. Additional Quality inspections recommended.

CAMSHAFT & VALVE TRAIN

Tappets and Guides: Intake & Exhaust Tappet Assembly (02-345A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
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<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Tappets and Guides: Fuel Tappet Assembly (02-345B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Tappets and Guides: Fuel Pump Base Assembly (02-345C)	Unlimited Life	None
Camshaft: Camshaft Assembly (02-350A)	Unlimited Life	Additional maintenance recommendations. Additional Quality Revalidation inspections recommended.
Camshaft: Camshaft Bearing (02-350B)	Unlimited Life	None
Camshaft - Supports Bolting and Gear; Idler Gear Assembly - Crank to Pump Gear; Idler Gear Assembly - Idler Gear Assembly (02-350C, 02-355A&B)	Unlimited life	Additional maintenance recommendations. Additional Quality inspections recommended.
Rocker Shaft Assemblies: Intake/Intermediate & Exhaust (02-390A&B)	Unlimited Life	Additional Quality Revalidation Revalidation inspections recommended.
Main and Connector Pushrods (02-390C&D)	Unlimited Life	Additional Quality inspections recommended. The purchase order should specify destructive verification of weld quality by sectioning random samples from each manufacturing lot.
Rocker Arms & Pushrods: Bushings (02-390E)	Unlimited Life	Additional maintenance recommendations.
Rocker Arms & Pushrods: Lifters (02-390F)	Unlimited Life	Additional maintenance recommendations. Additional Quality Revalidation inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Rocker Arms and Pushrods - Miscellaneous Bolts and Drive Studs (02-390G)	Unlimited Life	Additional maintenance recommend- ations. Additional Quality inspections recommended.

IDLER GEAR ASSEMBLY & FRONT GEAR CASE

Front Gearcase Bolting (02-335B)	Unlimited Life	Additional inspections recommend- ed. Addition of positive locking features on bolts recommended. Bolts should be properly torqued. Additional Quality inspections recommended.
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FLYWHEEL

Flywheel (02-330A)	Unlimited Life	None
Flywheel Bolting (02-330B)	Unlimited Life	Additional Quality inspections recommended.

ENGINE INSTRUMENTATION & WIRING

Pyrometer Conduit Assembly Thermocouples (02-630D)	Unlimited Life	Additional maintenance recommend- ations.
Engine & Auxiliary Module Wiring Material and Fittings Pyrometer Conduit Assembly - Conduit, Fittings and Supports (02-688A, 02-630A,B,C)	Modifications	Perform an upgrade to tighten/ fix, replace or add missing conduit supports.
Engine & Auxiliary Module Wiring Materials: Wiring & Terminations (02-688B)	Modifications	Implementation of TDI SIM No. 361.
Engine & Auxiliary Module Wiring Material - Boxes & Terminals (02-688C)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
On-Engine Alarm Sensors (02-690)	Unlimited Life	None
Off-Engine Alarm Sensors (02-691/02-689)	Unlimited Life	None
<u>OVERSPEED TRIP & GOVERNOR</u>		
Overspeed Trip Governor (02-410A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Overspeed Trip: Governor and Accessory Drive Assembly (02-410B)	Unlimited Life	Additional Quality inspections recommended.
Overspeed Trip: Couplings (Flexible & Spider) (02-410C)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Overspeed Trip Vent Valve (02-410D)	Unlimited Life	Replace valve O-rings every 5 years.
Governor Drive: Governor & Tachometer Drive Gear & Shaft (02-411A)	Unlimited Life	Additional Quality Revalidation inspections recommended.
Governor Drive: Couplings, Pins & Keys (02-411B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Governor Linkage & Cross Shaft Assembly (02-413A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Governor Assembly: Woodward Governor (02-415A)	Unlimited Life	Additional maintenance recommendations.
Governor Assembly Booster Servomotor (02-415B)	Unlimited Life	Additional Quality inspections recommended.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Governor Assembly Heat Exchanger (02-415C)	Unlimited Life	Additional Quality inspections recommended.

ENGINE SHUTDOWN & EQUIPMENT

Engine Shutdown Equipment - Tubing/Fittings & Supports (Small Bore Scope Only) (02-695A)	Modifications	Modify supports. Addition of two-directional lateral restraints and two-way supports. Refer to DR/QR Report 02-695A for details. Engine 1A tubing should be verified or modified to be consistent with Engine 1B.
Engine Shutdown Equipment - Valves, Regulators, Orifices (02-695B)	Unlimited Life	Additional maintenance recommendations.
Engine Shutdown Trip Switches (02-695C)	Unlimited Life	None

JACKET WATER

Jacket Water Standpipe and Miscellaneous Bolting (00-700F)	Unlimited Life	Additional inspections recommended.
Jacket Water Manifold Piping (Large Bore Scope Only) (02-315D)	Unlimited Life	None
Jacket Water Manifold - Manifold Assembly with Hardware, Coupling and Gaskets (Large Bore Scope Only) (02-316A&B)	Modifications	The tie rod assembly surrounding the 6-inch Dresser coupling requires double-nutting to prevent inward axial movement. 1-inch diameter rods are required to accomodate the compression load. The second support west of the 6-inch TDI custom flanges requires stiffening.
Jacket Water Inlet Manifold - Vent Line to Discharge Manifold (02-316C)	Modifications	Modify supports to have sufficient moment connection at the support to structural steel interface.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Jacket Water Discharge Manifold Piping (Large Bore Scope Only) (02-317A&B)	Modifications	Replace Style 65 Dresser couplings with Style 90 or Style 165 Dresser couplings with Viton gaskets.
Water Discharge Manifold: Supports (Large Bore Scope Only) (02-317C)	<i>Unlimited Life/Modific</i> Modifications	Ensure that the supports on the two 5-inch headers have a minimum weld of 3-inches long on both sides of the longer end of the plate. Ensure that the welds between the existing 3/4-inch plate and engine block have a minimum weld of 1/4-inch along the total width of the plate.
Engine Driven Jacket Water Pump (02-425A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Jacket Water Fittings - Pipe and Fittings (Small Bore Scope Only) (02-435A)	Unlimited Life	Leaking Dresser Style 65 couplings should be replaced with Dresser Style 90 couplings with Viton gaskets.
Jacket Water Standpipe: Pipe Fittings, Gaskets (Small Bore Scope Only) (02-700A)	Modifications	Addition of supports. Refer to DR/QR Report 02-700C for details.
Jacket Water Standpipe: Supports (Small Bore Scope Only) (02-700C)	Modifications	Addition of two-directional lateral restraints. Modification of U-bolts and restraints. Refer to DR/QR Report 02-700C for details.
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Valves (02-717B)	Unlimited Life	Inspect the valves for packing leakage monthly.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, and Y-Strainers (Large Bore Scope Only) (02-717C-LB)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, and Y-Strainers (Small Bore Scope Only) (02-717C)	Modifications	Addition/modification of supports. Refer to DR/QR Report 02-717C for details.
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting (02-717D)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping-Jacket Water: Supports (Large Bore Scope Only) (02-717E-LB)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Supports (Small Bore Scope Only) (02-717E)	Modifications	Modify U-bolts in order to provide sufficient restraint and to maintain consistency with Engine 1A. Suitable locking devices should be installed on the new U-bolts.
Jacket Water Heat Exchanger (02-810A)	Unlimited Life	Additional maintenance recommend- ations.

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

CYLINDER HEADS & VALVES

Cylinder Heads (02-360A)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Cylinder Head Valves: Intake and Exhaust Valves (02-360B)	Unlimited Life	Additional Quality Revalidation inspections recommended.
Cylinder Head and Valves: Bolting and Gaskets (02-360C)	Unlimited Life	Additional Quality Revalidation inspections recommended.
Cylinder Head and Valves: Springs and Retainers (02-360D)	Unlimited Life	Additional Quality Revalidation inspections recommended.
Subcover (02-362A)	Unlimited Life	Additional Quality and maintenance inspections recommended.

FUEL OIL INJECTION

Fuel Oil Day Tank (00-620A)	Unlimited Life	The fuel oil day tank documentation should be checked for consistency with the installed tank.
Fuel Oil Drip Tank Assembly (00-621A)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Fuel Injection Equipment: Fuel Injection Pump (02-365A)	Unlimited Life	Additional maintenance recommendations.
Fuel Injection Equipment: Fuel Injection Tips (02-365B)	Unlimited Life	Additional maintenance recommendations.
Fuel Injection Equipment - Tube Assembly (02-365C)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Fuel Injection Equipment: Supports (Small Bore Scope Only) (02-365D)	Unlimited Life	Additional maintenance recommendations.
Fuel Pump Linkage: Fuel Pump Control Shaft; Linkage Assembly & Bearing (02-371A&B)	Unlimited Life	Additional maintenance recommendations. Additional Quality inspections recommended.
Fuel Pump Linkage: Automatic Shutdown Cylinder (02-413B)	Unlimited Life	None
Fuel Oil Booster Pump (02-445)	Modifications	Inspect and install fuel oil booster pump drive coupling in accordance with TDI SIM 363.
Fuel Oil Header: Piping/Tubing (Small Bore Scope Only) (02-450B)	Modifications	Replace 1-inch threadolet with a socket welded tee. Addition/modification of supports. Refer to DR/QR Report 02-450D for details. Engine A piping and tubing should be verified as consistent with Engine B.
Fuel Oil Header: Fuel Oil Supports (Small Bore Scope Only) (02-450D)	Modifications	Addition/modification of restraints and U-bolts. Refer to DR/QR Report 02-450D for details.

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Fuel Oil Filters & Strainers: Filters (02-455A)	Unlimited Life	Additional maintenance recommendations.
Fuel Oil Filters & Strainers: Strainers (02-455B)	Unlimited Life	Replace strainer with one with a coarser design to enhance operation, but is not required for system operation. Additional maintenance recommendations.
Fuel Oil Fitter and Strainers Mounting Hardware (02-455C)	Unlimited Life	Additional Quality inspections recommended.
Auxiliary Sub-Base & Oil & Water Piping - Fuel Oil: Piping and Fittings (Small Bore Scope Only) (02-717J)	Modifications	Addition/modification of supports. Refer to DR/QR Report 02-717M for details.
Auxiliary Sub-Base & Oil & Water Piping: Fuel Oil Valves (02-717K)	Unlimited Life	Inspect and clean valves at each refueling outage.
Auxiliary Sub-Base & Oil & Water Piping - Fuel Oil: Bolting and Gaskets (02-717L)	Unlimited Life	None
Auxiliary Sub-Base & Oil & Water Piping - Fuel Oil: Supports (Small Bore Scope Only) (02-717M)	Modifications	Modification of U-bolts. Addition of two-directional lateral restraints.
Fuel Oil Transfer Pump (02-825C)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
<u>GENERATOR</u>		
Emergency Diesel Generator (BL-101A)	Unlimited Life	Compliance to recommended Standards should be verified by Bellefonte.
Generator Controls (BL-101B)	Modifications	Review design of circuits. Additional inspections of generator controls cabinet recommended. Replace field flashing relay with an enclosed relay. Recommendations to increase long-term reliability and performance.
Generator: Shaft & Bearings (BL-101C)	Unlimited Life	None
<u>CONTROL PANEL ASSEMBLY</u>		
Control Panel Assembly-Cabinet/System (02-500A)	Unlimited Life	None
Control Panel Assembly-Accumulator (02-500F)	Unlimited Life	None
Control Panel Valves (02-500G)	Unlimited Life	Additional maintenance recommendations.
Control Panel Assembly - Pressure Switches (02-500H)	Unlimited Life	None
Control Panel Assembly - Control Relays (02-500J)	Unlimited Life	None
Control Panel Assembly - Solenoid Valves (02-500K)	Unlimited Life	None

<u>Component</u>	<u>Acceptability</u>	<u>Recommended Action</u>
Control Panel Assembly - Piping, Tubing & Fittings (02-500M)	Unlimited Life	None
Control Panel Assembly - Terminal Boards/ Switches, Wiring (02-500N)	Unlimited Life	Verify that no Multi-Amp States Division terminal blocks, manufactured between 1974 and 1976, are installed..

AUXILIARY SUB-BASE & FOUNDATION BOLTS

Foundation Bolts- Anchor Bolts, Miscellaneous Hardware. (02-550)	Unlimited Life	Additional maintenance recommen- dations
Auxiliary Skid (02-717A)	Unlimited Life	None

4.0 SUMMARY/CONCLUSIONS

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

The scope and depth of this review as outlined in this report represents a significant effort by the TDI Diesel Generator Owners Group Technical Staff and Tennessee Valley Authority.

Nuclear standby diesel generator reliability has been a major concern of the industry and the NRC. Although previous programs have been sponsored by the NRC, EPRI, and other industry groups to quantify and improve this reliability, the Design Review and Quality Revalidation effort summarized in this report is unprecedented in its approach and analytical detail. This effort has produced a detailed assessment of 169 TDI diesel generator components. Many of these components have been analyzed using analytical techniques which exceed the detailed engineering effort of the original design.

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

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

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

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

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

5.0 RECOMMENDATIONS

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

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

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

6.0 REFERENCES

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

Ref.

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

Ref. #

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

Ref. #

35	OGTP-181	8-10-84	Design Review of Engine Base and Bearing Caps for TDI DSRV-16 Diesel Engines
36	OGTP-190	8-14-84	Design Review of Elliott Model 90G Turbo-charger used on TDI DSR-48 and DSRV-16 Emergency Diesel Generator Sets
37	OGTP-260	9-7-84	Design Review of Connecting Rods for TDI DSRV-4 Series Diesel Generators
38	OGTP-261	9-7-84	Design Review of Engine Base and Bearing Caps for TDI Diesel Engines
39	OGTP-263	9-7-84	Evaluation of Cylinder Heads of TDI Series R-4 Diesel Engines
40	OGTP-306	9-28-84	Survey of Start Experiences and Cause of Unscheduled Shutdowns of TDI Diesel Engines
41	OGTP-403	10-17-84	Baseline Vibration Survey for Shoreham Nuclear Power Station DG 101
42	OGTP-485	11-6-84	Design Review of Connecting Rod Bearing Shells for TDI Engines, March 12, 1984
43	OGTP-591	11-27-84	Phase I Report - Turbocharger - Nozzle Ring Supplement for DSR-48 and DSRV-16-4 Engines
44	OGTP-593	11-27-84	Investigation of Types AN and AH Piston Skirts

Title BLN DESIGN REVIEW AND QUALITY REVALIDATION REPORT		Project BLN		Meds No. MEB 850227 652	
Manufacturer/Subvendor		Contract Number TV-65137A		Vendor DUKE POWER	
Vendor Letter Number DG-6		Document Number DRQR REP. VOL II		Revision Level 0	
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(Response) Changepaper? YES NO		(Circle response) Subject to changepaper? YES NO			
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TDI DIESEL GENERATOR

**DESIGN REVIEW
AND
QUALITY REVALIDATION
REPORT**

Prepared For

TENNESSEE VALLEY AUTHORITY

BELLEFONTE NUCLEAR PLANT

By

TDI DIESEL GENERATOR OWNERS GROUP

VOLUME 2

How To Use This Report

Tabs in this report identify the following categories:

Turbo, Intake, Intercooler & Exhaust
Lube Oil
Engine Base & Bearing Caps
Crankshaft & Bearings
Cylinder Block, Liners & Water Manifold
Air Start & Barring Device
Connecting rods
Pistons
Camshaft & Valve Train
Idler Gear Assembly & Front Gear Case
Flywheel
Engine Instrumentation & Wiring
Overspeed Trip & Governor
Engine Shutdown & Equipment
Jacket Water
Cylinder Heads & Valves
Fuel Oil Injection
Generator
Control Panel Assembly
Engine & Auxiliary Sub-Base & Foundation Bolts

These categories have been defined to allow the reader to review a complete diesel generator subsystem in a convenient manner.

Within each category tabs identify Bellefonte specific component numbers.

A given component report can be found by:

- a) If the component number is known - use the alpha - numeric index which identifies the volume number and category in which the component report is located.
- b) If only the component name is known - Section 3.2 may be used as a cross-reference to find the volume number where the component report may be found.

Some reports address more than one component. A tab is provided for each component. However, some components are combined under one report. Slip sheets are provided where required to reference back to the appropriate tab. Some components required more than one report. These are identified by the abbreviation LB-Large Bore and SB-Small Bore on the component number tabs.

INDEX (continued)

Component Number	Component Description	Category	Volume No.
BL-101A	Emergency Diesel Generator	Generator	4
BL-101B	Generator Controls	Generator	4
BL-101C	Generator: Shaft & Bearings	Generator	4
F-068	Intercooler	Turbo, Intake Intrclr. & Exhaust	2
MP022/23	Turbocharger	Turbo, Intake, Intrclr. & Exhaust	2
00-420	Lube Oil Pressure Regulating Valve	Lube Oil	2
00-442A	Starting Air Distributor: Distributor Assembly	Air Start & Barring Device	3
00-442B	Starting Air Distributor: Tubing, Fittings, Gaskets	Air Start & Barring Device	3
00-620A	Fuel Oil Day Tank	Fuel Oil Injection	4
00-621A	Fuel Oil Drip Tank Assy	Fuel Oil Injection	4
02-CFR	Turbocharger Thrust Bearing Drip Lube System	Turbo, Intake Intercooler & Exhaust	2
02-305A	Base and Bearing Caps: Base Assembly	Engine Base & Bearing Caps	2
02-305C	Base and Bearing Caps: Main Bearing Studs & Nuts	Engine Base & Bearing Caps	2
02-305D	Base and Bearing Caps: Main Bearing Caps	Engine Base & Bearing Caps	2
02-307A	Lube Oil Fittings: Internal - Headers	Lube Oil	2
02-307B	Lube Oil Fittings: Internal - Tubing & Fittings	Lube Oil	2

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-307D	Lube Oil Fittings Internal: Supports	Lube Oil	2
02-310A	Crankshaft	Crankshaft & Bearings	2
02-310B	Main Bearings	Crankshaft & Bearing	2
02-310C	Crankshaft & Bearings: Thrust Bearing Rings.	Crankshaft & Bearing	2
02-311A	Crankcase: Crankcase Assy	Crankshaft & Bearing	2
02-311D	Crankcase: Crankcase Mounting Hardware	Crankshaft & Bearings	2
02-315A	Cylinder Block	Cyl. Block & Liners & Water Manifold	2
02-315C	Cylinder Block Liners & Water Manifold - Cylinder Liner	Cyl. Block & Liners & Water Manifold	2
02-315D	Jacket Water Manifold Piping	Cyl. Block & Liners & Water Manifold	2
02-315E	Cylinder Block Liners & Water Manifold: Studs	Cyl. Block & Liners & Water Manifold	2
02-315F	Cylinder Block Liners & Water Manifold: Cylinder Head Nuts	Cyl. Block & Liner & Water Manifold	2
02-315G	Cylinder Block Liners & Water Manifold: Seals & Gaskets	Cyl. Block & Liners & Water Manifold	2
02-316A	Jacket Water Inlet Manifold: Manifold Assembly W/Hardware and Coupling and Gaskets	Jacket Water	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	Jacket Water	4
02-316C	Jacket Water Inlet Manifold: Vent Line to Discharge Manifold	Jacket Water	4
02-317A	Jacket Water Discharge Manifold, Coupling and Seals	Jacket Water	4
02-317B	Water Discharge Manifold: Coupling & Seals	Jacket Water	4
02-317C	Water Discharge Manifold: Supports	Jacket Water	4
02-330A	Flywheel	Flywheel	3
02-330B	Flywheel Bolting	Flywheel	3
02-335B	Front Gearcase - Bolting	Idler Gear Assembly & Front Gear Case	3
02-340A	Connecting Rods: Rods & Bushings	Connecting Rods	3
02-340B	Connecting Rod Bearing Shells	Connecting Rods	3
02-341A	Pistons	Pistons	3
02-341B	Pistons: Rings	Pistons	3
02-341C	Piston Pin Assembly	Pistons	3
02-345A	Tappets and Guides: Intake & Exhaust Tappet Assembly	Camshaft & Valve Train	3
02-345B	Tappets and Guides: Fuel Tappet Assembly	Camshaft & Valve Train	3
02-345C	Tappets and Guides: Fuel Pump Base Assembly	Camshaft & Valve Train	3

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-350A	Camshaft: Camshaft Assembly	Camshaft & Valve Train	3
02-350B	Camshaft: Camshaft Bearing	Camshaft & Valve Train	3
02-350C	Camshaft: Supports, Bolting and Gear	Camshaft & Valve Train	3
02-355A	Idler Gear Assembly: Crank To Pump Gear	Idler Gear Assembly & Front Gear Case	3
02-355B	Idler Gear Assembly	Idler Gear Assembly & Front Gear Case	3
02-359	Air Start Valves	Air Start & Barring Device	3
02-360A	Cylinder Heads	Cylinder Heads & Valves	4
02-360B	Cylinder Head Valves: Intake & Exhaust Valves	Cylinder Heads & Valves	4
02-360C	Cylinder Head and Valves: Bolting and Gaskets	Cylinder Heads & Valves	4
02-360D	Cylinder Head & Valves: Springs and Retainers	Cylinder Heads & Valves	4
02-362A	Subcover	Camshaft & Valve Train	3
02-365A	Fuel Injection Equipment: Fuel Injection Pump	Fuel Oil Injection	4
02-365B	Fuel Injection Equipment - Fuel Injection Tips	Fuel Oil Injection	4
02-365C	Fuel Injection Equipment - Tube Assembly	Fuel Oil Injection	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-365D	Fuel Injection Equipment: Supports	Fuel Oil Injection	4
02-371A	Fuel Pump Linkage: Fuel Pump Control Shaft	Fuel Oil Injection	4
02-371B	Fuel Pump Linkage: Linkage Assembly and Bearing	Fuel Oil Injection	4
02-375	Intake Manifold and Piping	Turbo, Intake, Intrclr. & Exhaust	2
02-380A	Exhaust Manifold	Turbo, Intake, Intrclr. & Exhaust	2
02-380B	Exhaust Manifold: Gasket and Bolting	Turbo, Intake, Intrclr. & Exhaust	2
02-385B	Cylinder Block Covers: Gaskets and Bolting	Cyl. Block & Liners & Water Manifold	2
02-386B	Crankcase: Crankcase Gaskets and Mounting Hardware	Crankshaft & Bearings	2
02-390A	Intake & Intermediate and Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390B	Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly	Camshaft & Valve Train	3
02-390C	Main and Connector Pushrods	Camshaft & Valve Train	3
02-390D	Rocker Arms and Pushrods: Pushrods Connector.	Camshaft & Valve Train	3
02-390E	Rocker Arms and Pushrods: Bushings	Camshaft & Valve Train	3

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-390F	Rocker Arms and Pushrods: Lifters	Camshaft & Valve Train	3
02-390G	Rocker Arms and Pushrods Misc. Bolts & Drive Studs	Camshaft & Valve Train	3
02-410A	Overspeed Trip Governor	Overspeed Trip & Governor	3
02-410B	Overspeed Trip: Governor and Accessory Drive Assembly	Overspeed Trip & Governor	3
02-410C	Overspeed Trip: Couplings (Flexible and Spider)	Overspeed Trip & Governor	3
02-410D	Overspeed Trip Vent Valve	Overspeed Trip & Governor	3
02-411A	Governor Drive: Governor & Tachometer Drive Gear & Shaft	Overspeed Trip & Governor	3
02-411B	Governor Drive: Couplings, Pins & Keys	Overspeed Trip & Governor	3
02-413A	Governor Linkage & Cross Shaft Assembly	Overspeed Trip & Governor	3
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	Fuel Oil Injection	4
02-415A	Governor Assembly: Woodward Governor	Overspeed Trip & Governor	3
02-415B	Governor Assembly - Booster Servomotor	Overspeed Trip & Governor	3
02-415C	Governor Assembly - Heat Exchangers	Overspeed Trip & Governor	3
02-420	Engine Driven Lube Oil Pump	Lube Oil	3
02-425A	Engine Driven Jacket Water Pump	Jacket Water	4
02-435A	Jacket Water Fittings: Pipe & Fittings	Jacket Water	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-436A	Intercooler Piping - Pipe	Turbo, Intake Intercooler & Exhaust	2
02-436B	Intercooler Piping Coupling, Gaskets, Bolting	Turbo, Intake Intercooler & Exhaust	2
02-437	Turbo Water Piping: Pipe & Fittings	Jacket Water	4
02-441A	Starting Air Manifold: Piping, Tubing and Fitting	Air Start & Barring Device	3
02-441B	Starting Air Manifold Valves, Filters & Strainer	Air Start & Barring Device	3
02-441C	Starting Air Manifold: Supports	Air Start & Barring Device	3
02-445	Fuel Oil Booster Pump	Fuel Oil Injection	4
02-450B	Fuel Oil Header: Piping/Tubing	Fuel Oil Injection	4
02-450D	Fuel Oil Header: Fuel Oil Supports	Fuel Oil Injection	4
02-455A	Fuel Oil Filters & Strainers: Filters	Fuel Oil Injection	4
02-455B	Fuel Oil Filters & Strainers: Strainers	Fuel Oil Injection	4
02-455C	Fuel Oil Filters & Strainer: Mounting Hardware	Fuel Oil Injection	4
02-465A	Lube Oil Lines External: Tubing, Fittings, Couplings	Lube Oil	2
02-465B	Lube Oil Lines External - Supports	Lube Oil	2

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-467A	Turbocharger: Lube Oil Fitting - Piping	Lube Oil	2
02-467B	Turbocharger: Lube Oil Fittings - Supports	Lube Oil	2
02-475A	Turbocharger: Bracket	Turbo, Intake, Intrclr. & Exhaust	2
02-475B	Air Butterfly Valve Assembly	Turbo, Intake, Intrclr. & Exhaust	2
02-475C	Turbocharger: Bracket - Bolting & Gaskets	Turbo, Intake, Intrclr. & Exhaust	2
02-500A	Control Panel Assembly Cabinet/System	Control Panel Assembly	4
02-500F	Control Panel Assembly Accumulator	Control Panel Assembly	4
02-500G	Control Panel Valves	Control Panel Assembly	4
02-500H	Control Panel Assembly Pressure Switch	Control Panel Assembly	4
02-500J	Control Panel Assembly: Control Relays	Control Panel Assembly	4
02-500K	Control Panel Assembly: Solenoid Valves	Control Panel Assembly	4
02-500M	Control Panel Assembly - Piping, Tubing, Fittings	Control Panel Assembly	4
02-500N	Control Panel Assembly: Terminal Boards/Switches/Wiring	Control Panel Assembly	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-525B	Barring Device - Pneumatic: Regulator Valve/Shutoff Valve	Air Start & Barring Device	3
02-540A	Lube Oil Sump Tank and Mounting Hardware	Lube Oil	2
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Pipe & Bolting Material, Valves	Lube Oil	2
02-540C	Lube Oil Sump Tank: Mounting Hardware	Lube Oil	2
02-550	Foundation Bolts: Anchor Bolts, Misc. Hardware	Engine & Aux. Sub Base & Foundation Bolts	4
02-630A	Pyrometer Conduit Assembly: Conduit	Engine Instru-mentation & Wiring	3
02-630B	Pyrometer Conduit Assembly: Conduit Fittings	Engine Instru-mentation & Wiring	3
02-630C	Pyrometer Conduit Assembly: Support	Engine Instru-mentation & Wiring	3
02-630D	Pyrometer Conduit Assembly: Thermocouples	Engine Instru-mentation & Wiring	3
02-688A	Engine & Aux Module Wiring Material- Conduit & Fittings; Pyrometer Assembly - Conduit, Fitting, Supports	Engine Instru-mentation & Wiring	3
02-688B	Engine & Aux Module Wiring Materials: Wiring & Terminations	Engine Instru-mentation & Wiring	3

x

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals	Engine Instru- mentation & Wiring	3
02-689	Off Engine Wiring Level Switch	Engine Instru- mentation & Wiring	3
02-690	On Engine Alarm Sensors	Engine Instru- mentation & Wiring	3
02-691	Off-Engine Alarm Sensors	Engine Instru- mentation & Wiring	3
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	Engine Shut- down & Equip- ment	3
02-695B	Engine Shutdown Equipment: Valves, Regulator, Orifices	Engine Shut- down & Equip- ment	3
02-695C	Engine Shutdown Trip Switches	Engine Shut- down & Equip- ment	3
02-700A	Jacket Water Standpipe: Pipe, Fittings, Gaskets	Jacket Water	4
02-700C	Jacket Water Standpipe: Supports	Jacket Water	4
02-700F	Jacket Water Standpipe and Misc. Bolting	Jacket Water	4
02-717A	Auxiliary Skid	Jacket Water	4
02-717B	Aux Sub Base & Oil & Water Piping - Jacket Water: Valves	Jacket Water	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-717C	Aux Sub Base & Oil & Water Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers	Engine & Aux. Sub Base & Foundation Bolts	4
02-717D	Aux Sub Base & Oil & Water Piping - Jacket Water: Gaskets & Bolting	Jacket Water	4
02-717E	Aux Sub Base & Oil & Water Piping - Jacket Water: Supports	Jacket Water	4
02-717F	Aux. Sub Base & Oil & Water Piping - Lube Oil: Pipe and Fittings	Lube Oil	2
02-717G	Aux Sub Base & Oil & Water Piping - Lube Oil Valves	Lube Oil	2
02-717H	Aux. Sub-Base & Oil & Water Piping - Lube Oil: Gaskets & Bolting	Lube Oil	2
02-717I	Aux Sub Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	Lube Oil	2
02-717J	Aux Sub Base & Oil & Water Piping - Fuel Oil - Piping & Fittings	Fuel Oil	4
02-717K	Aux Sub Base & Oil & Water Piping - Fuel Oil Valves	Fuel Oil Injection	4
02-717L	Aux Sub Base & Oil & Water Piping - Fuel Oil - Gaskets & Bolting	Fuel Oil Injection	4
02-717M	Aux Sub Base & Oil & Water Piping - Fuel Oil: Supports	Fuel Oil Injection	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-805A	Flex Connection	Turbo, Intake, Intercooler & Exhaust	2
02-805B	Intake Air Silencer	Turbo, Intake, Intercooler & Exhaust	2
02-805C	Intake Air Filter	Turbo, Intake, Intercooler & Exhaust	2
02-810A	Jacket Water Heat Exchanger	Jacket Water	4
02-810B	Jacket Water Standby Heater Pump	Jacket Water	4
02-810C	Thermostatic Valve	Jacket Water	4
02-810D	Misc. Equipment-Heater-Jacket Water	Jacket Water	4
02-820A	Lube Oil Heat Exchanger	Lube Oil	2
02-820B	Lube Oil System-Auxiliary Lube Oil Pump	Lube Oil	2
02-820C	Lube Oil Full Pressure Strainer	Lube Oil	2
02-820D	Full Flow Lube Oil Filter	Lube Oil	2
02-820E	Oil Keep-Warm Filter	Lube Oil	2
02-820F	Lube Oil Lines External-Valves	Lube Oil	2
02-820G	Before & After Lube Oil Pump	Lube Oil	2
02-820H	Lube Oil Sump Heater	Lube Oil	2
02-825C	Fuel Oil Transfer Pump	Fuel Oil Injection	4

INDEX (continued)

Component Number	Component Description	Category	Volume No.
02-835A	Starting Air Tank	Air Start & Bearing Device	3
02-835D	Skid Base - Starting Air Equipment	Air Start & Barring Device	3
02-835F	Starting Air Float Trap	Air Start & Barring Device	3
02-835H	Air Start Tank Relief Valve	Air Start & Barring Device	3

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1COMPONENT IntercoolerUTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. F-068TASK DESCRIPTION NO. DR-13-F-068-0SNPS GPL NO. F-068CLASSIFICATION TYPE BTASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that already addressed in the lead engine report and below. There was no site experience. Nuclear and non-nuclear industry experience shows a number of intercooler problems mainly due to engine vibration. TDI has issued SIM No. 365 which contains suggested modifications to prevent intercooler problems such as these, and it is recommended that this SIM be implemented at Bellefonte.
- A review of the lead engine DR/QR report (Comanche Peak).
- Both Bellefonte and Comanche Peak intercoolers were manufactured by Young Radiator and are Model No. D264836.

The following maintenance recommendation from the lead engine DR/QR report should be implemented:

- The intercooler should be inspected for external leaks every month.
- The intercooler should be disassembled as necessary and cleaned every refueling outage.
- The drain connection on the intake air system low point should be verified open and cleaned daily.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

BF3710/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-F-068-0

SPECIFIED STANDARDS

Not required

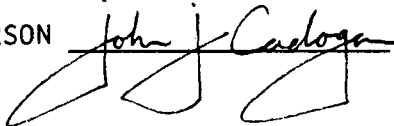
REFERENCES

Not required

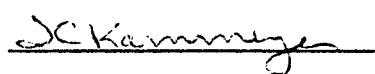
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to read "John J. Cadogan".

PROGRAM MANAGER

A handwritten signature in black ink, appearing to read "JC Kammerer".

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Turbocharger UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. MP-022/23 TASK DESCRIPTION NO. DR-13-MP-022/23-0
SNPS GPL NO. MP-017 CLASSIFICATION TYPE A

TASK DESCRIPTIONS

A design review for this component is not required, based on the following:

- Design reviews for the lead engines, Shoreham and Comanche Peak, as well as Grand Gulf and Catawba, establish the acceptability of the Elliott Model BC0-90G turbocharger. This model turbocharger is used on all Owners Group DSRV-16 and DSR-48 diesel engines.
- The turbocharger operating conditions at Bellefonte are approximately equal to those at Comanche Peak and other Owners Group DSRV-16 and DSR-48 diesel engines with full load ratings of 225 BMEP.
- The lube oil system is similar to Comanche Peak and Grand Gulf. These engines have a full flow auxiliary oil pump that can be started before diesel startup to assure turbocharger bearing lubrication.

The EDG Component Tracking System was reviewed for any applicable experience. The primary adverse experience associated with the turbocharger was rapid thrust bearing wear and broken nozzle ring capscrews and vanes. The thrust bearing wear was attributed to insufficient lubrication prior to engine start. Nozzle ring vane failures were caused by high cycle fatigue arising either from diesel engine exhaust gas pulsations or vibration during operation. The capscrews failed by means of intergranular cracking as the result of improper heat treatment during manufacturing, or in another case, because of high cycle fatigue, probably from improper torquing during assembly. Vane failures have not affected engine operability in the past and capscrew failures are rare events and are not expected to recur provided that the installation torque is to specification and that manufacturing defects are not present. Thus, the current nozzle ring and attachment design is adequate for nuclear standby service.

The following Quality inspections should be performed:

- Perform a visual inspection on the bearings and nozzle ring and signs of wear and cracks.
- Determine the end clearances (rotor float).

TASK DESCRIPTIONS (continued)

- Verify that the proper number of bolts on the turbine inlet casing are installed.
- Verify that the proper torque loads are applied to the bolts of the turbine inlet casing.
- Perform a liquid penetrant test on the stationary nozzle ring for signs of adverse wear and cracking.
- Verify that SIM 300 was implemented and perform a liquid penetrant test on the welds retaining the core plug (hub nut). In addition, verify that the core plug is staked.

The following modifications and inspections were recommended in previous DR/QR reports and apply to the turbochargers at Bellefonte as well. These modifications/inspections will help assure turbocharger reliability and performance:

- Revise appropriate operating procedures to use the auxiliary lube oil pump to prelube the turbocharger bearings. Prelube oil flow should be initiated 1 to 2 minutes prior to engine starts, and stopped approximately 30 seconds after the engine reaches rated speed.
- The TDI recommended drip system should be retained for minimizing thrust bearing wear associated with automatic fast starts. The quantity of oil passing through the orifice should be measured and be at least 0.1 gph. Increased flow rates up to 0.35 gph are recommended to improve effectiveness of the drip system.
- For improved confidence in the reliability of the turbocharger, inspection of a thrust bearing for signs of excessive wear should be performed to verify the adequacy of the full flow prelube system. This inspection should be performed on a thrust bearing installed during or after implementation of the full flow prelube system and following an initial 100 engine starts or at the closest plant refueling outage but not to exceed 130 starts.
- The rotor axial clearance should be routinely checked in accordance with the TDI Instruction Manual. In addition, since trends of increasing clearance could signify thrust bearing degradation (even if the total displacement is within specification), any such trends should be reviewed.
- Since the nuclear standby diesel generator sets may undergo non-prelubed automatic fast starts not associated with a potential LOOP/LOCA event, the turbocharger thrust bearings of any diesel engine should be inspected for excessive wear and, if necessary, replaced after experiencing no more than 40 such starts. This recommendation is applicable to all thrust bearings installed.

COMPONENT DESIGN REVIEW CHECKLIST

Page 3 of 3
DR-13-MP-022/23-0

TASK DESCRIPTIONS (continued)

- Spectrochemical engine oil analysis should be incorporated into the TDI Instruction Manual. In addition, to further expand the preventive monitoring of the turbocharger thrust bearing, ferrographic engine oil analysis may be utilized. Particular attention should be paid to copper level and particulate size, which could signify thrust bearing degradation.
- At any turbocharger disassembly there should be a visual inspection of nozzle ring components for any apparent damage, failure or apparent mispositioning of vanes. Replace all affected nozzle ring components. During reassembly ensure that capscrews are properly installed with recommended pretorque.
- Monitor engine operation to ensure exhaust gas temperatures do not exceed those specified.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

GROUP CHAIRPERSON

Kevin T. L. L. L. L. L.

PROGRAM MANAGER

X Kammerer

UNIT 1

MP-022/23 - Turbochargers

Acceptability of the turbochargers is documented in the following
Sequence Control Charts (SCC):

<u>SCC No.</u>	<u>Accession No</u>
1RT-M216	B44 850918 827
1RT-M217	B44 850918 828
1RT-M226	B44 850918 867
1RT-M227	B44 850918 877
1RT-M219	B44 850904 772
1RT-M236	B44 850918 890
1RT-M237	B44 850918 889
1RT-M238	B44 850918 844
1RT-M239	B44 850918 891
1RT-M245	B44 850918 857
1RT-M255	B44 850918 845
1RT-M259	B44 850918 831
1RT-M260	B44 850904 771
1RT-M261	B44 850904 773
1RT-M262	B44 850918 832
1RT-M349	B44 850918 858

TDI OWNERS GROUP

for

BELLEFONTE NUCLEAR PLANT - UNIT 1

TURBOCHARGER THRUST BEARING DRIP LUBE SYSTEM
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-CFR

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews of the structural adequacy of the turbocharger thrust bearing drip lube system components and supports to withstand the effects of normal operating and earthquake loadings. The primary function of this tubing is to provide lube oil to the turbocharger thrust bearing prior to engine startup.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the tubing and supports to assure that the component will perform its intended design function during normal operating and earthquake loadings.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the Bellefonte site, nuclear, and non-nuclear industry experience. See Appendix C for results.
- The Quality Revalidation Checklist results were reviewed for acceptability.

Refer to the review procedures as described in Reference 1 for a detailed methodology for this evaluation.

IV RESULTS AND CONCLUSIONS

The tubing and supports as defined by this Component Design Review have been evaluated in accordance with Reference 1 and have been found acceptable with modifications. The conclusions of this report are based upon the field walkdown of Engine 1B only. This component was not installed on Engine 1A at the time of the walkdown.

There are no Quality Revalidation Checklist results or TERs associated with this component.

Based on the above review, it is concluded from References 1 and 2 that the tubing and supports will perform their intended design functions at Bellefonte under all normal operating and earthquake loadings with the provision that the following recommended modifications be implemented as detailed in Reference 3:

It is recommended that two-directional lateral restraints be added as follows:

- Midway between the sight glass and the first restraint downstream for both left and right bank turbochargers.
- Midway between the nupro filter and the first restraint upstream.
- At/near the nupro filter.

Upon installation of this component for Engine 1A, it is recommended that the installation be made consistent with that of Engine 1B.

V. REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.
2. Stone & Webster Calculation number 11600.60-NP(B)-1301-XH.
3. Memo No. 6595 from C. Malovrh (SWEC) to J. Kammeyer (SWEC) dated 12/20/84.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Turbocharger Thrust
Bearing Lubricant System
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO.02-CFR TASK DESCRIPTION NO.: DR-13-02-CFR-0
SNPS GPL NO. 03-CFR CLASSIFICATION TYPE C

TASK DESCRIPTIONS

Perform an engineering review of the tubing and supports to provide additional assurances that the component will perform its intended design function during normal operating and earthquake loading.

PRIMARY FUNCTION

To provide lube oil to the turbocharger thrust bearing prior to engine startup.

ATTRIBUTE TO BE VERIFIED

Structural adequacy of the tubing and supports due to the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

IEEE 387

REFERENCES

"Engineering Review Criteria Report for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.

DOCUMENTATION REQUIRED

Delaval design documentation (specifications, calculations, drawings, etc.). In lieu of information from Delaval, the following information is required: verified support sketches and piping isometrics, material specifications, pipe size and schedule, and operating parameters (pressure, temperature, load combinations)

GROUP CHAIRPERSON
BF3553/1

PROGRAM MANAGER

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Turbocharger Thrust Bearing Lubricant System	UTILITY	Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1
GPL NO.	02-CFR	REV. NO.	1
SNPS GPL NO.	03-CFR		

TASK DESCRIPTIONS

Engine A

1. Assemble and review existing documentation.
2. Obtain sufficient data to support the Design Review effort. This may be accomplished by developing quality verified as-builts in accordance with DG-7, or by the Design Group performing a field walkdown.

Engine B

Same as Engine A

ATTRIBUTES TO BE VERIFIED

Engine A

1. Quality status of Component Document Package
2. Information necessary for the design review effort.

Engine B

Same as Engine A

ACCEPTANCE CRITERIA

Engine A

1. Satisfactory Document Package
2. Review of detailed information by the Design Group

ACCEPTANCE CRITERIA (continued)

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Procedure DG-7

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
2. Quality verified as-built isometric drawing for the lubricant system if available from the owner.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Steven M. Schwartz

PROGRAM MANAGER

J. C. Kammeyer

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
2. The Design Group will be responsible for closing out the as-built drawings as per Procedure DG-7. The as-built drawings will be Quality verified by the appropriate site Quality organization. The performance of an engineering walkdown by the Design Group, precludes the issuance of a quality verified as-built drawing or sketch.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
13-02-CFR

COMPONENT REVIEW (continued)

Engine B

Same as Engine A

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Victor A. Saleta

PROGRAM MANAGER

J. Kammeyer

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-CFR

Effective Printout Date: 11/30/84

COMPONENT TYPE: Turbocharger Thrust Bearing Lubricant System

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
<u>BELLEFONTE</u>		
None		
<u>NUCLEAR</u>		
Report concerning possible thrust bearing damage under hot start conditions while lube oil is above 160°F.	St. Lucie 1 LER: 335-79021 790625	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Potential problem with turbo bearing lubrication/ bearing smear if engines receive a repeat rapid start coincident with a loss of AC power.	Pt. Beach 1 LER: 266-79007 790424	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
GM notified Vepco of potential thrust bearing problems under certain repeat start operating modes.	Surry 1 LER: 280-79017 790502	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
During normal operation the engine may reach operating speed prior to oil pressure being established at thrust.	Monticello LER: 263-79010 790426	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Turbocharger failure; inspections indicated a deteriorated soak back oil pump was not providing sufficient lubrication to turbo.	St. Lucie LER: 335-82024 820616	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
During normal operation the turbocharger failed. Investigation revealed a broken coupling on the soak back oil pump causing insufficient lube oil supply to turbo.	St. Lucie LER: 335-82033 820721	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Inspection of turbo(s) revealed worn thrust bearing from lack of lube oil during prelube while in the standby mode.	San Onofre 1 LER: 206-80039-2 801211	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Under repeat start modes there is a possibility that the turbo thrust bearing could be damaged.	Arkansas Nuclear I LER: 313-79006, 790607	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
GM identified potential problem with turbo thrust bearing lube.	Conn. Yankee LER: 213-79009 790831	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Several repairs were made because of thrust bearing failures and insufficient oil during startup on TDI 8 cylinder engines in Taiwan.	Telex from PEI to LILCO 11/28/83	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Lube oil system supplies oil to turbo bearing during operating mode(s) only. Turbo thrust bearings may experience rapid wear because of this system.	Cleveland Electric (Perry) I & E 83-51 08/05/83	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.
Distress on the turbine end bearing thrust face and shaft thrust face resulting from a dry start. Require instant oil flow at start signal.	Taiwan Power So. Calif. Edison Letter from E.S. Ncilhatten (Elliott Co.) to A. Fleischer (TDI) 04/06/81 T-33	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE
STATUS

Thrust bearing totally burned, possibly from lack of lubricant prior to engine start.

Kuosheng 2
TPC Nuc. Plant No. 2
06/03/83
File No. T-45

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

Turbocharger thrust bearings experienced excessive wear from lack of prelube oil during multiple fast starts of the diesel.

Catawba
04/05/84
File no. T-53
Pg. 7-2

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

Lube oil is not supplied to the turbocharger thrust bearing until lube oil pump initiates upon engine start.

Grand Gulf
No. 83-024
10/22/83

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

Fast repeat starts of diesels may result in engine reaching operating speed before required oil pressure is reached at turbocharger thrust bearing. Cumulative damage from similar starts would result in turbocharger failure.

Kewaunee
LER 305-79024,
790922
I & E 79-12

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

Thrust bearing damage may occur from relatively long intervals between diesel operations because of the drainage of lube oil from the turbocharger.

10CFR50.55E
LILCO letter SNRC-549
and 10CFR21;
TDI letter to O.I.&E
US NRC dated 12/16/80

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

Diesel tripped because of low turbocharger oil pressure.

Zion 1
EPRI 121574

Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes occurrence of this problem at Bellefonte.

NON-NUCLEAR

None

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Intake Manifold & Piping (Large Bore Scope Only)</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-375</u>	TASK DESCRIPTION NO.	<u>DR-13-02-375-0</u>
SNPS GPL NO.	<u>03-375</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable site experience.
- Industry experiences at Comanche Peak and Grand Gulf include cases of elbows cracking during installation. The maintenance recommendation presented below addresses this concern.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the intake manifold and piping spool pieces, fittings and supports for Bellefonte with Comanche Peak.

The following maintenance recommendations are made to avoid cracking caused by misalignment during installation:

- Other castings may be tried in an attempt at a better fit.
- Bolt hole diameter on the intake manifold elbows may be increased from 1/16-inch oversize to 1/8-inch oversize. However, under no circumstances shall any component be jacked to fit.

Modification recommendations made on the lead engine DR/QR report have been incorporated.

The following inspections from the CQRC should be performed on all station engines:

- Visually inspect all intake manifolds for cracks at both flange faces.
- Upon reinstallation, ensure that the manifold installation does not cause excessive stress on flange bolt holes because of misalignment.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-375-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

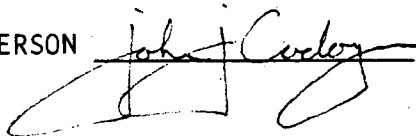
REFERENCES

Not required

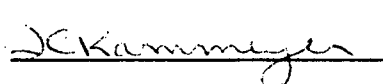
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



UNIT 1

02-375 - Intake Manifold and Piping
(Large Bore Scope Only)

Acceptability of the large bore portion of the intake manifold and piping is documented in the following Sequence Control Charts (SCC):

SSC No.

Accession No.

1RT-M301
1RT-M302

B44 850918 840
B44 850904 784

P. O. BOX 33189

DUKE POWER COMPANY
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28242

TELEPHONE: AREA 704
373-4011

November 5, 1985

Mr T A Hogan
Mechanical Engineering Supervisor
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: Management and Technical Services
TDI Diesel Generator Owners Group
Bellefonte Nuclear Plant - Unit 1
Exhaust Manifold Piping
Supplemental Report, Revision 1
File: MTS-4086

Dear Mr. Hogan:

Attached please find one copy of Supplemental Report No. 1, Rev. 1, for Component 02-380A. This revision adds References 3 and 4.

If you have any questions or require additional information, please contact S E Eckert at 704-373-3818.

Very truly yours,

A P Cobb, Jr, Manager
Project Management Division


By: A M Segrest
Senior Engineer

AMS/SEE/gla/E10-22/2

cc: C L Ray (w/o attach)

SUPPLEMENT 1
TDI OWNERS GROUP
BELLEFONTE NUCLEAR PLANT - UNIT 1
REVISION 1

Exhaust Manifold Piping
(Large Bore Scope Only)

Component Part No. 02-380A

Performed By:
Duke Power Company
Management and Technical Services
October 31, 1985

SUPPLEMENT 1

TDI OWNERS GROUP

BELLEFONTE NUCLEAR PLANT - UNIT 1

Revision 1

Exhaust Manifold Piping (Large Bore Scope Only)

Component Part No. 02-380A

I. INTRODUCTION

The purpose of this supplement is to summarize the evaluation performed to justify eliminating the recommended modifications as stated in the original report.

The exhaust manifold piping contains a sliding span of pipe with a slip joint at each end. These slip joints allow movement along the pipe axis. As stated in the original calculation (Reference No. 1), in a linear elastic analysis using simplified boundary conditions, this type of component is unstable. Therefore, the original report recommended replacing one slip joint at the end of the sliding spans with a slip-on flange in order to analyze the manifold using normal linear elastic analysis methods. The present exhaust manifold was not shown to be deficient in the original analysis.

II. METHODOLOGY

The effects of dead weight loads and thermal movements on the sliding span of pipe were evaluated using conventional techniques (Reference No. 2). To account for the seismic loading, several bounding cases were evaluated. These cases were developed using the sections of pipe connecting to each end of the sliding span. Each section was analyzed with and without the weight of sliding span lumped at the end (see Figures 1 and 2).

It is expected that friction from the seals in the slip joints will provide sufficient force (approximately 142 lb.) to move the sliding span along with the adjoining pipe during a seismic event while allowing relative thermal movements. The seismic displacements and rotations at the slip joint are negligible (displacements approximately .1 inches, rotations approximately .015 radians). Even if the friction force is inadequate to keep the sliding span moving with the adjoining pipe sections, restraining devices are provided to prevent separation of exhaust piping. The gap associated with the slip joint at both normal operating and ambient temperatures is much larger than the total relative movements of the adjacent piping. Therefore, no significant impact between the sliding span and adjacent piping will occur.

III. RESULTS AND CONCLUSIONS

Based on this evaluation (Reference No. 2), the exhaust manifold piping has been found to be acceptable without modification. All stress levels remain well below code allowables (maximum stress ratio of approximately 0.4). Nozzle loads are not significantly increased from those approved in the original calculation. Relative movements at the slip joints are very small and the restraining devices are adequate to prevent any lock up or separation of the exhaust piping.

The exhaust manifold piping as designed and installed by Transamerica Delaval, Inc. is adequate to perform its intended design function.

FIGURE 1
EXHAUST MANIFOLD PIPING

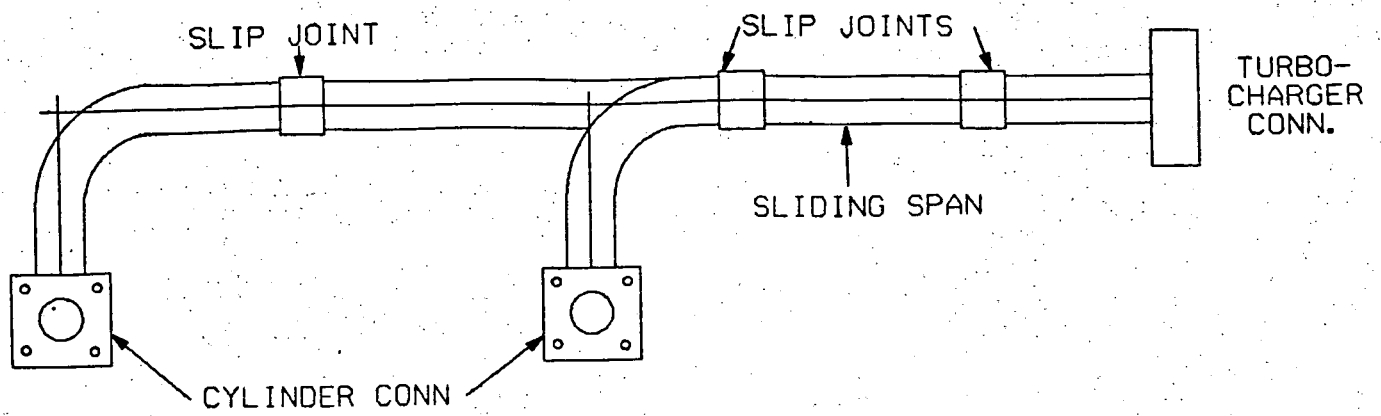
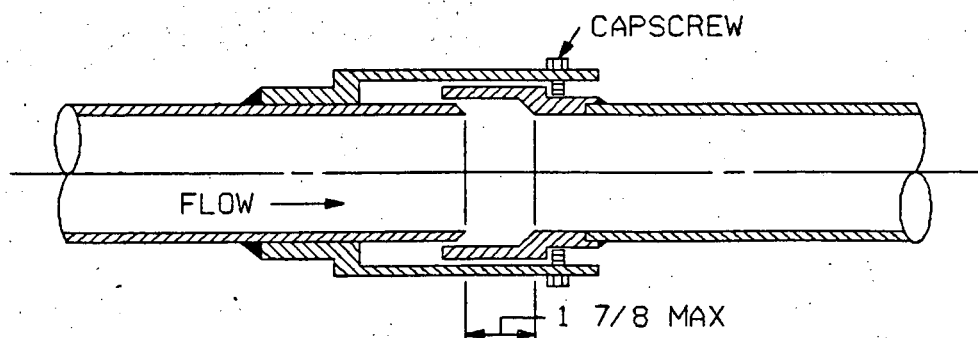


FIGURE 2
SLIP JOINT CONFIGURATION



IV. REFERENCES

1. "Supporting Calculations for the Evaluation of Comanche Peak Diesel Generator Large Diameter Piping and Supports," Impell Report No. 02-0630-1230, Rev. 0, August, 1984. Calculation No. CP-EM-001.
2. "Qualification of the Diesel Generator Exhaust Manifold Assembly," Duke Power Company, Calculation No. CNC-1206.02-50-0001, Rev. 0.
3. "Supporting Calculations for the Evaluation of Catawba Generator Skid Mounted Large Diameter Piping and Supports," Impell Report No. 02-0630-1251, Rev. 0, September, 1984. Calculation No. CA-EM-001.
4. "Supporting Calculations for the Evaluation of Bellefonte Generator Skid Mounted Large Diameter Piping and Supports," Impell Report No. 02-0630-1309, Rev. 0, December, 1984. Calculation No. BF-EM-001.

P. O. BOX 33189

DUKE POWER COMPANY
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28242

TELEPHONE: AREA 704
373-4011

September 27, 1985

Mr. T A Hogan
Mechanical Engineering Supervisor
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: Management and Technical Services
TDI Diesel Generator Owners Group
Bellefonte Nuclear Plant - Unit 1
Exhaust Manifold Piping
Supplemental Report
File: MTS-4086

Dear Mr. Hogan:

Attached please find one copy of Supplemental Report No. 1 for component 02-380A. This report excepts the requirement in the original report that four of the twelve slip joints for this component be removed and replaced by 150 lb. slip-on flanges. Also, please note that Transamerica Delaval, Inc. has reviewed this report and is in complete concurrence with its findings.

If you have any questions or require additional information, please contact S E Eckert at 704-373-3818.

Very truly yours,

A P Cobb, Jr, Manager
Project Management Division


By: A M Segrest
Senior Engineer

AMS/SEE/kfb/E9-29/2

cc: C L Ray (w/o attach)

B44 '85 1007 014

10/7/85--TAH:PM

cc: C. A. Chandley, W7 C126 C-K

10/7/85--CAC:TAH:PM

cc: RIMS, SL26 C-K

J. S. Belk, 9-117 SB-K)*

L. S. Cox, Bellefonte OC (3))*

J. A. Raulston, W10 C126 C-K)*

J. C. Standifer, 9-113 SB-K)*

*Please file this report in your Diesel
Generator DR/QR report for item 02-380A.

DUKE | MANAGEMENT AND
POWER | TECHNICAL SERVICES

SUPPLEMENT 1
TDI OWNERS GROUP
BELLEFONTE NUCLEAR PLANT - UNIT 1

Exhaust Manifold Piping
(Large Bore Scope Only)
Component Part No. 02-380A

Performed By:
Duke Power Company
Management and Technical Services
September 27, 1985

SUPPLEMENT 1

TDI OWNERS GROUP

BELLEFONTE NUCLEAR POWER PLANT - UNIT 1

Exhaust Manifold Piping (Large Bore Scope Only)

Component Part No. 02-380A

I. INTRODUCTION

The purpose of this supplement is to summarize the evaluation performed to justify eliminating the recommended modifications as stated in the original report.

The exhaust manifold piping contains a sliding span of pipe with a slip joint at each end. These slip joints allow movement along the pipe axis. As stated in the original calculation (Reference No. 1), in a linear elastic analysis using simplified boundary conditions, this type of component is unstable. Therefore, the original report recommended replacing one slip joint at the end of the sliding spans with a slip-on flange in order to analyze the manifold using normal linear elastic analysis methods. The present exhaust manifold was not shown to be deficient in the original analysis.

II. METHODOLOGY

The effects of dead weight loads and thermal movements on the sliding span of pipe were evaluated using conventional techniques (Reference No. 2). To account for the seismic loading, several bounding cases were evaluated. These cases were developed using the sections of pipe connecting to each end of the sliding span. Each section was analyzed with and without the weight of sliding span lumped at the end (see Figures 1 and 2).

It is expected that friction from the seals in the slip joints will provide sufficient force (approximately 142 lb.) to move the sliding span along with the adjoining pipe during a seismic event while allowing relative thermal movements. The seismic displacements and rotations at the slip joint are negligible (displacements approximately .1 inches, rotations approximately .015 radians). Even if the friction force is inadequate to keep the sliding span moving with the adjoining pipe sections, restraining devices are provided to prevent separation of exhaust piping. The gap associated with the slip joint at both normal operating and ambient temperatures is much larger than the total relative movements of the adjacent piping. Therefore, no significant impact between the sliding span and adjacent piping will occur.

III. RESULTS AND CONCLUSIONS

Based on this evaluation (Reference No. 2), the exhaust manifold piping has been found to be acceptable without modification. All stress levels remain well below code allowables (maximum stress ratio of approximately 0.4). Nozzle loads are not significantly increased from those approved in the original calculation. Relative movements at the slip joints are very small and the restraining devices are adequate to prevent any lock up or separation of the exhaust piping.

The exhaust manifold piping as designed and installed by Transamerica Delaval, Inc. is adequate to perform its intended design function.

FIGURE 1
EXHAUST MANIFOLD PIPING

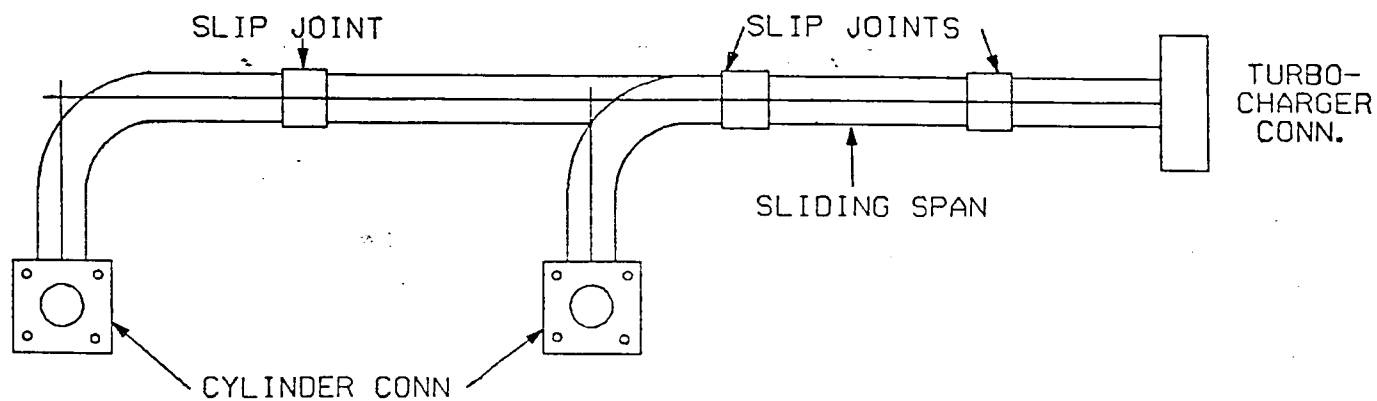
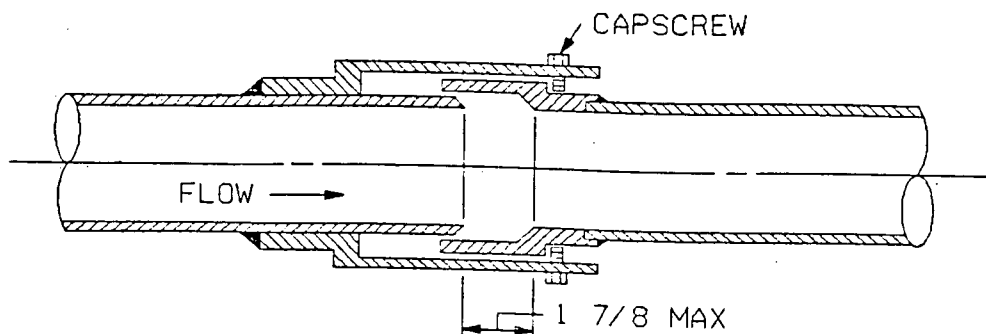


FIGURE 2
SLIP JOINT CONFIGURATION



IV. REFERENCES

1. "Supporting Calculations for the Evaluation of Comanche Peak Diesel Generator Large Diameter Piping and Supports," Impell Report No. 02-0630-1230, Rev. 0, August, 1984. Calculation No. CP-EM-001.
2. "Qualification of the Diesel Generator Exhaust Manifold Assembly," Duke Power Company, Calculation No. CNC-1206.02-50-0001, Rev. 0.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Exhaust Manifold</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-380A</u>	TASK DESCRIPTION NO. <u>DR-13-02-380A-0</u>
SNPS GPL NO. <u>03-380A</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the exhaust manifold and piping spool pieces, fittings and supports for Bellefonte with Comanche Peak.

Based on projected operating hours and temperatures, the existing manifold is acceptable (Ref: Record of Conversation between Jim Bowen (TVA) and A. Palumbo (Impell) - dated 12/09/84).

The following modification recommendations made on the lead engine DR/QR report should be implemented:

- 1) The second 6" slip joint from the No. 8 cylinder head, on both right and left banks is to be removed and replaced with 6" 150 lb. S.O. flanges with A449 bolts.
- 2) The first 6" slip joint from the No. 2 cylinder head (second from the No. 7 cylinder head), on both the right and left banks, is to be removed and replaced with 6" 150 lb. S.O. flanges with A449 bolts.
- 3) The first 6" slip joint from the No. 3 cylinder head (second from the No. 6 cylinder head), on both the right and left banks, is to be removed and replaced with 6" 150 lb. S.O. flanges with A449 bolts.
- 4) The first slip joint from the No. 4 cylinder head (second from the No. 5 cylinder head), on both the right and left banks, is to be removed and replaced with 6" 150 lb. S.O. flanges with A449 bolts.
- 5) In the event of an SSE, the cap screws, which hold the water jacket to the exhaust manifold assembly support, will require inspection at some time subsequent to the SSE event and replaced if the inspection warrants.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-380A-0

The following maintenance recommendation is required to be performed on the exhaust manifold:

- Perform a visual inspection and a magnetic particle test on a sample of the circumferential pipe welds and corresponding heat affected zones. This is to be performed during the first refueling outage and alternate outages thereafter. However, diesel operation should not exceed 200 hours between inspections.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

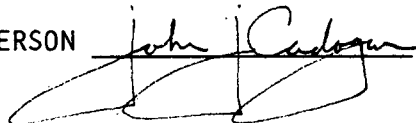
REFERENCES

Not required

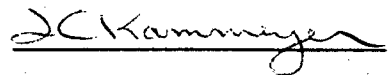
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



UNIT 1

02-380A - Exhaust Manifold

No inspections or modifications were required, however, the exhaust expansion joints were cleaned and inspected. Acceptability is documented in the following Sequence Control Charts (SCC):

SCC No.

Accession No.

1RT-M320
1RT-M321

B44 850904 758
B44 850904 757

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Exhaust Manifold:
COMPONENT Gasket & Bolting UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-380B TASK DESCRIPTION NO. DR-13-02-380B-0
SNPS GPL NO. 03-380B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience. There is no site experience reported in the EDG Component Tracking System.

There are no maintenance or modification recommendations for this component.

The following Quality inspections should be performed on all station engines:

- Verify that the proper torque was applied to the exhaust pipe flange capscrews;
- Verify that the proper gasket and bolting material are installed at the manifold and flange connections;
- Verify at reinstallation that no binding exists on the exhaust manifold and no cracks exist at the manifold flange fillets by a visual inspection;
- Perform a dimensional check of the flange to head capscrews.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

BF3664/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-380B-0

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Fitzpatrick PROGRAM MANAGER JC Kammeyer

UNIT 1

02-380B - Exhaust Manifold: Gasket and Bolting

Acceptability of the gaskets and bolting for the exhaust manifold is documented in the following Sequence Control Charts (SCC):

SCC No.

Accession No.

1RT-M303

B44 850904 712

1RT-M304

B44 850918 849

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Intercooler Piping -
Pipe
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-436A&B TASK DESCRIPTION NO. DR-13-02-436A&B-0
SNPS GPL NO. 99-436A&B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the intercooler piping spool pieces and fittings for Bellefonte with Comanche Peak.

There are no maintenance or modification recommendations for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-436A&B-0

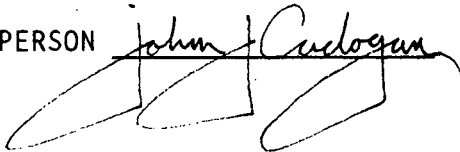
REFERENCES

Not required

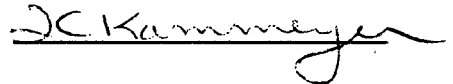
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A stylized, handwritten signature in dark ink, appearing to read "John J. Cudogian". The signature is written over a horizontal line.

PROGRAM MANAGER

A stylized, handwritten signature in dark ink, appearing to read "J.C. Kammerer". The signature is written over a horizontal line.

TDI OWNERS GROUP

FOR

BELLEFONTE NUCLEAR PLANT

INTERCOOLER PIPING - COUPLING, GASKETS, BOLTING

COMPONENT PART NO.: 02-436B

See Component Part No.: 02-436A

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Turbo Water Piping-
Pipe and Fittings
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-437 TASK DESCRIPTION NO. DR-13-02-437-0
SNPS GPL NO. 03-437A CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR reports (Comanche Peak, Grand Gulf and Catawba) and the applicable industry experience from the EDG Component Tracking System. There is no site experience for this component in the Component Tracking System.

There are no modification recommendations for this component.

Leaking Dresser Style 65 couplings, should be replaced with Dresser Style 90 couplings with Viton gaskets. This recommendation is made on the basis that the maximum suggested operating temperature of 150°F for the Style 65 coupling may be exceeded. The maximum suggested operating temperature of the Style 90 coupling with Viton gaskets is 400°F.

A field walkdown was performed at Bellefonte in accordance with the small bore piping criteria document (Ref. 1). However, a review of this component in its entirety was not possible since portions of piping and tubing on Engine A were not installed at the time of the walkdown. Therefore, component acceptability and any subsequent recommendations shall be based upon the lead engine reports (Comanche Peak, Grand Gulf and Catawba) and the field walkdown of Engine B. It is concluded that this component will perform its intended function at Bellefonte under all normal operating and earthquake loadings.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-437-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

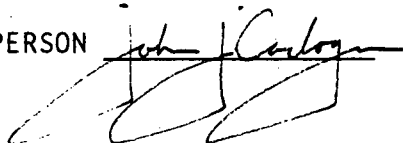
REFERENCES

"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.

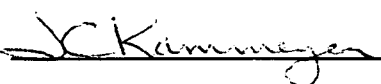
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Turbocharger-Bracket:</u> <u>Bolting and Gaskets</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-475A,C</u>	TASK DESCRIPTION NO.	<u>DR-13-02-475A,C-0</u>
SNPS GPL NO.	<u>03-475A,D</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review for these components is not required based on a review of the following:

- The Comanche Peak lead engine DR/QR report (Ref. 1).
- TDI Parts Manuals, Volume II for Bellefonte and Comanche Peak (Refs. 2 and 3).
- TDI drawings (Ref. 4).
- The EDG Component Tracking System for applicable industry and site experience (Refs. 5 and 6). Nuclear and non-nuclear experience identifies a few incidents of broken welds on fabricated items or piping supported by the turbocharger bracket; such events were caused by loosened or broken turbocharger hold-down bolts, all resulting from engine vibration. To prevent recurrence of similar events, verification of the torque values applied to the turbocharger hold-down bolts and the bracket mounting bolts during installation is required.

The Comanche Peak lead engine DR/QR report indicates that the pipe thermal loads, along with the engine vibration loads, are the most significant loads experienced by the brackets and the mounting bolts. The design of the water jacketed, multi-pipe, exhaust manifold connecting the cylinders to each turbocharger is identical for both stations. The adapter piece at the compressor outlet connection and its intake manifold is also similar. Therefore the thermal loads experienced by the turbocharger brackets and the associated mounting hardware for both stations should remain similar.

Review of the amplified response acceleration spectra curves for Bellefonte (Ref. 7) indicates that the seismic loadings are more favorable than those at the Comanche Peak.

TASK DESCRIPTIONS (continued)

Based on the above review the turbocharger brackets at Bellefonte should be adequate to resist the seismic inertia loads, deadweight, thermal loads, and engine vibration loads. Similarly, the 3/4 in. capscrews (12 screws for each bracket) attaching the bracket to the engine block should be satisfactory; however, based on the DR/QR report for Comanche Peak Station, the review of the turbocharger bracket and bolting finds that in the worst case load condition, vibration and manifold nozzle loads could potentially produce bolt loads in excess of preloads. Therefore, the bracket to engine and bracket to turbo base screws (P.N. GB-001-143 and GB-001-120) are recommended to be inspected on a regular basis as discussed below:

- Each month for the first three months of commercial operation these screws should be inspected to assure that no screw has loosened because of engine operating loads. If during these inspections none of the screws are found loosened or damaged, from then on inspections are to be conducted on a yearly basis (or during plant shutdown). But if any time during inspection any screw is found loosened or damaged, it must then be replaced (if damaged) and all screws retorqued as follows; 125 ft-lbs for the bracket to engine screws and 75 ft-lbs for the bracket to turbo base screws.

To avoid damage to bracket to engine, and/or bracket to turbo, base screws, the proper torques as delineated above should be utilized for each respective bracket bolting application.

There are no modification recommendations for these components.

The following inspections as described in the Component Quality Revalidation Checklist for Component No. 02-475C should be performed on both engines:

- Verification of compliance to the TDI Instruction Manual for bolt torque loads applied to the bolted connections through review of existing documentation.
- Verification of the material of the bracket-to-engine bolting.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

1. Comanche Peak Steam Electric Station - Unit 1, DR/QR Report for Group Parts List No. 02-475A and C.
2. TDI Manual Volume II, for Model DSRV-16-4 Diesel Engine/Generator, Bellefonte Nuclear Power Plant, Units 1 and 2, Parts List No. 02-475-22-02, dated October 22, 1979, and Drawing 02-475-22, dated
3. TDI Manual Volume II for Model DSRV-16-4 Diesel Engine/Generator, Comanche Peak Steam Electric Station - Unit 1, Parts List No. 02-475-22-02, Rev. C.
4. TDI Drawings

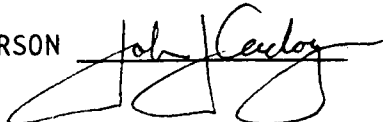
<u>Drawing No.</u>	<u>Description</u>
02-475-22-AL	Bar Support Outer
02-475-22-AK	Bar Support Inner
02-475-21-AD	Adapter, Intercooler Inlet - Right Bank
02-475-21-AE	Adapter, Intercooler Inlet - Left Bank
02-475-21-AF	Bracket, Turbo G-90 - Right Bank
02-475-21-AG	Bracket, Turbo G-90 - Left Bank
02-475-22-AA	Adapter, Intercooler Outlet - Right Bank
02-475-22-AB	Adapter, Intercooler Outlet - Left Bank

5. Emergency Diesel Generator Component Tracking System - Nuclear and Non-nuclear Industry Experience dated November 5, 1984.
6. Emergency Diesel Generator Component Tracking System - Bellefonte Nuclear Power Station dated December 21, 1984.
7. Specification 2411, Diesel Engine Driven Emergency Generator Power Packages for Bellefonte Nuclear Plant Units 1 and 2 Seismic Design Criteria Document #61-86181, B-DC-20-22

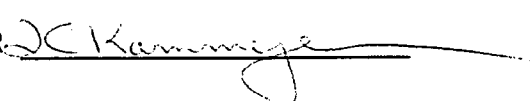
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



UNIT 1

02-475A, C - Turbocharger Bracket: Bolting and Gaskets

Acceptability of the turbocharger bracket bolting and gaskets is documented in the following Sequence Control Charts (SCC):

SCC No.

Accession No.

1RT-M306

B44 850904 709

1RT-M292

B44 850918 811

1RT-M305

B44 850904 781

1RT-M293

B44 850918 800

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Air Butterfly Valve Assembly UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-475B TASK DESCRIPTION NO. DR-13-02-475B-0
SNPS GPL NO. 03-475B CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except TDI SIM 322 which is addressed below. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR reports (Shoreham and Comanche Peak).
- Similarities between the Bellefonte component and lead engine component.

The following maintenance recommendation from the lead engine report should be implemented:

- Locking devices on the valve linkages should be verified to be snug on a monthly basis.

Modification should be made to add grease fittings as per TDI SIM 322.

The following Quality inspections are recommended in order to ensure that the valve is capable of operating satisfactorily:

- Inspect butterfly to shaft attachment pins for signs of wear and distress.
- Inspect shaft conditions for signs of proper lubrication, wear, and distress.
- Verify installation and alignment of butterfly valve for freedom of movement.
- Determine the microhardness of the shaft (TDI P/N 02-475-15AS).

NOTE: Inspection need only be performed on one engine if condition of valve is found acceptable.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-475B-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

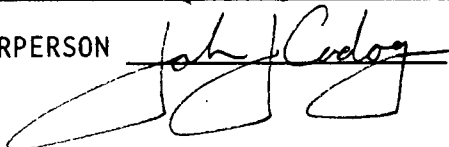
REFERENCES

Not required

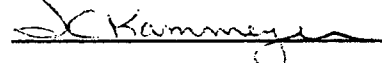
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



UNIT 1

02-475B - Air Butterfly Valve Assembly

Acceptability of the air butterfly valve assembly is documented in the following Sequence Control Charts (SCC):

SCC No.

1RT-M294

Accession No.

B44 850904 750

TDI OWNERS GROUP

FOR

BELLEFONTE NUCLEAR PLANT

TURBOCHARGER & BRACKET - BOLTING & GASKETS

COMPONENT PART NO.: 02-475C

See Component Part No.: 02-475A

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1COMPONENT Flex ConnectionsUTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. 02-805ATASK DESCRIPTION NO. DR-13-02-805A-0SNPS GPL NO. 10-109CLASSIFICATION TYPE CTASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak).

The exhaust flex connection resides downstream of the turbocharger. A failure of the exhaust flex connection would result in exhaust gases penetrating the boundary and escaping into the diesel room. This would not impair diesel operability and is, therefore, deemed acceptable.

There are no maintenance or modification recommendations for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-12-02-805A-0

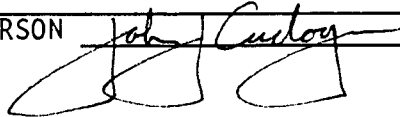
REFERENCES

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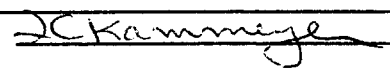
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Intake Air Silencer UTILITY Tennessee Valley Authority
Bellefonte Nuclear Plant - Unit 1
GPL NO. 02-805B REV. NO. 1
SNPS GPL NO. 99-805

TASK DESCRIPTIONS

No further review of component 02-717P is required for the following reasons:

- a) There is no site or industry experience in evidence.
- b) The Intake Air Silencer was manufactured by American Air Filter, a subsidiary of Allis Chalmers. Their products including the Intake Air Silencer are widely used in the nuclear and non-nuclear industry. Their products are designed to AFI standards. A review of their air filters was performed at Shoreham with satisfactory results.

GROUP CHAIRPERSON Victor A. Salita

PROGRAM MANAGER JC Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Intake Air Filter</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-805C</u>	TASK DESCRIPTION NO. <u>DR-13-02-805C-0</u>
SNPS GPL NO. <u>10-114</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR report (Comanche Peak).
- The lead engine and Bellefonte intake air filters are manufactured by American Air Filter Co. However, unlike the lead engine, Bellefonte uses an oil-bath type intake air filter. This type of filter is used throughout industry.

The following maintenance should be performed:

- Inspect intake air filter oil distribution plate and change oil in filter at each outage.

No modifications are required for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-805C-0

SPECIFIED STANDARDS

Not required

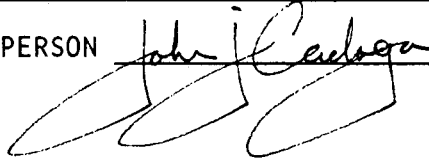
REFERENCES

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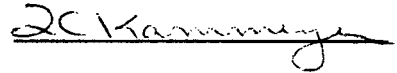
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Lube Oil Pressure Regulating Valve</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>00-420</u>	TASK DESCRIPTION NO:	<u>DR-13-00-420-0</u>
SNPS GPL NO.	<u>00-420</u>	CLASSIFICATION TYPE	<u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no industry or site experience.
- A review of the lead engine DR/QR report (Comanche Peak)
- Lube oil regulator valves at Comanche Peak and Bellefonte are identical. (TDI Part No. 00-420-01-0C).

The following maintenance recommendation from the lead engine DR/QR report should be implemented:

- Disassemble and clean valve at each refueling outage.
- If valve plugging becomes a problem, measure the dimensions of the valve internals for proper clearance and increase frequency of valve cleaning.

There are no modifications recommended for this component, based on the lead engine report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-00-420-0

SPECIFIED STANDARDS

Not required

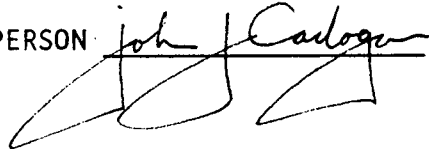
REFERENCES

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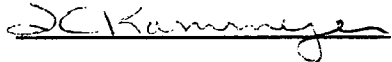
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Fittings -
Internal: Headers
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO 02-307A TASK DESCRIPTION NO.: DR-13-02-307A-0
SNPS GPL NO. 03-307A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR Reports (Shoreham/Comanche Peak).
- A comparison of the Lube Oil Fittings - Internal Headers and piping spool pieces and fittings for Bellefonte with Comanche Peak.

There are no maintenance or modification recommendations made on the lead engine DR/QR report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-307A-0

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kevin T. Fitzpatrick

PROGRAM MANAGER

X Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Fittings -
Internal: Headers
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO 02-307A TASK DESCRIPTION NO.: DR-13-02-307A-1
SNPS GPL NO. 03-307A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience. There is no site experience for this component in the EDG Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine report does address site specific modifications to supports. The necessity for similar modifications on Bellefonte is addressed below.

A field walkdown was not possible due to component inaccessibility. However, this component will perform its intended function for all normal and earthquake loadings provided the supports are verified as indicated in Component Design Review Checklist 02-307D. It is to be noted that the verification recommendations are based on the review of the DR/QR reports for Comanche Peak and Grand Gulf.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-307A-1

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON K.T. Fitzpatrick PROGRAM MANAGER X Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1Lube Oil Fittings -
Internal - Tubing and
FittingsCOMPONENT (Small Bore Scope Only)UTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO 02-307BTASK DESCRIPTION NO.: DR-13-02-307B-1SNPS GPL NO. 03-307BCLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience. There is no site experience for this component in the EDG Component Tracking System.

There are no maintenance recommendations for this component.

A field walkdown was not performed due to component inaccessibility. However, it should be noted that due to spatial restrictions, all sections of unsupported tubing will meet acceptable span lengths. Therefore, this component will perform its intended function for all normal and earthquake loadings.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTES TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-307B-1

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON K.T. Fitzpatrick PROGRAM MANAGER X Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Fittings -
Internal - Supports
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO 02-307D TASK DESCRIPTION NO.: DR-13-02-307D-0
SNPS GPL NO. 03-307D CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR reports (Comanche Peak/Grand Gulf). There is no site or industry experience for this component in the EDG Component Tracking System.

There are no maintenance recommendations for this component. The lead engine reports do address the following recommended modifications to supports:

- Replace all 1/4-inch U-bolts with 3/8-inch U-bolts.
- The U-bolts should be torqued sufficiently to prevent the header from moving axially without overstressing the header. Nuts should have suitable locking devices installed.
- The U-bolts radius should be coincident with the radius of the header to provide a snug fit.

A field walkdown was not possible due to component inaccessibility. However, this component will perform its intended function for normal and earthquake loading provided that the 3/8-inch U-bolts are verified to be installed as per the TDI parts manual (Vol. II) and the other aforementioned lead engine recommendations are verified to be implemented.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-307D-0

ATTRIBUTES TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

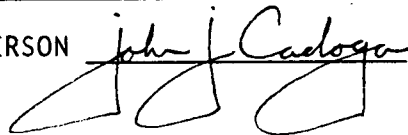
REFERENCES

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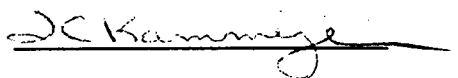
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Engine Driven L.O. Pump</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-420</u>	TASK DESCRIPTION NO. <u>DR-13-02-420-0</u>
SNPS GPL NO. <u>03-420</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that previously addressed in the lead engine report. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR report (Comanche Peak).
- Similarity of Bellefonte component to lead engine component. Both are IMO Model 3JK-437D.

There are no maintenance recommendations for this component.

It is recommended that a Style 90 or 165 Dresser coupling with Viton gaskets be added on the pump suction line to mitigate the thermal expansion loading and stresses on the pump inlet nozzle. The coupling should be located between the relief valve branch connection and the pump inlet nozzle.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-420-0

SPECIFIED STANDARDS

Not required

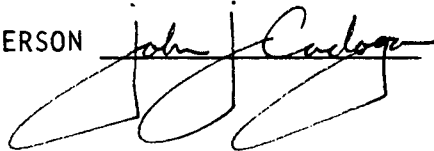
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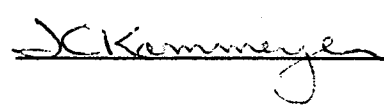
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Lines - External
Tubings, Fittings, Couplings
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-465A TASK DESCRIPTION NO. DR-13-02-465A-0
SNPS GPL NO. 03-465A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the lube oil lines - external piping spool pieces fittings and couplings for Bellefonte with Comanche Peak.

The following maintenance and modification recommendations made on the lead engine DR/QR report should be implemented:

- The 12-inch Dresser coupling gasket is to be replaced with a Viton gasket should leaks develop.
- Ensure a minimum installation gap of 0.171 inches, between pipe ends, exists at the 12-inch Dresser coupling.

Note that these items are to be incorporated upon installation.

There were no modification recommendations made on the lead engine DR/QR report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-465A-0

SPECIFIED STANDARDS

Not required

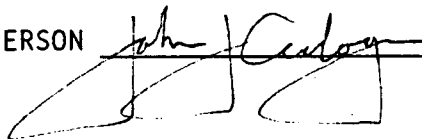
REFERENCES

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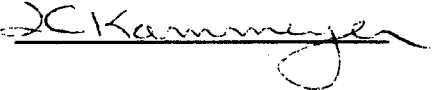
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Lines-External-
Tubing, Fittings, Couplings
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-465A TASK DESCRIPTION NO. DR-13-02-465A-0
SNPS GPL NO. 03-465A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience from the EDG Component Tracking System. There is no site experience for this component in the Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine reports do address site specific modifications/additions to supports. The necessity for similar modifications/additions on Bellefonte is addressed below.

A field walkdown was performed at Bellefonte in accordance with the small bore piping criteria document (Ref. 1). However, a review of this component was not possible since the piping and tubing on engine A was inaccessible at the time of the walkdown. Therefore, component acceptability and any subsequent recommendations shall be based upon the field walkdown of engine B. It is concluded that this component will perform its intended function at Bellefonte under all normal operating and earthquake loadings provided that supports are added/modified as indicated in DR/QR report 02-465B. Also, it is recommended that the engine A piping and tubing be verified or modified to be consistent with engine B.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

BF3574/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-465A-0

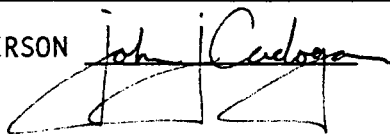
REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.

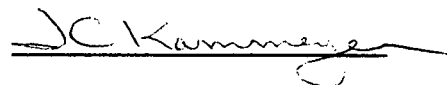
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Liner-External
Supports
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-465B TASK DESCRIPTION NO. DR-13-02-465B-0
SNPS GPL NO. 03-465B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

There are no supports for this component at Bellefonte.

No design review required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON John Cadogan

PROGRAM MANAGER DC Kammerer

TDI OWNERS GROUP

for

BELLEFONTE NUCLEAR PLANT - UNIT 1

LUBE OIL LINES EXTERNAL: SUPPORTS
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-465B

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews of the structural adequacy of the lube oil external supports to withstand the effects of normal operating and earthquake loadings. The primary function of these supports is to provide adequate restraint to the external lube oil small bore piping/tubing.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the small bore piping/tubing supports to assure that the component will perform its intended design function during normal operating and earthquake loadings.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the Bellefonte site, nuclear, and non-nuclear industry experience. See Appendix C for results.
- The Quality Revalidation Checklist results were reviewed for acceptability.

Refer to the review procedures as described in Reference 1 for a detailed methodology of this evaluation.

IV RESULTS AND CONCLUSIONS

The supports, as defined by this Component Design Review, have been evaluated in accordance with Reference 1 and have been found acceptable with modifications. The conclusions of this report are based on the field walkdown of Engine 1B only. The on-engine piping and tubing of Engine 1A was inaccessible at the time of the walkdown.

There are no Quality Revalidation Checklist results or TERs associated with this component.

Based on the above review, it is concluded from References 1 and 2 that the supports will perform their intended design function at Bellefonte under all normal operating and earthquake loadings if the following recommended modifications are implemented as detailed in Reference 3:

In order to support the piping/tubing of Component 02-465A, it is recommended that:

- A two-directional lateral restraint be added on the riser of the 1½-inch diameter gear case lube oil line to provide support of the cantilevered configuration.
- A three-directional restraint be added on the 1½-inch lube oil to front crossover supply line to provide support of the piping system between the lube oil strainers and front crossover header.
- A two-directional lateral restraint be added on the 3/8-inch lube oil line midway between the gear case lube oil header and the left bank outboard cam bearing connection.

The Engine 1A piping and tubing should be verified or modified to be consistent with Engine 1B.

V REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.
2. Stone & Webster Calculation number 11600.60-NP(B)-1301-XH.
3. Memo No. 6595 from C. Malovrh/SWEC to J. Kammeyer/SWEC 12/20/84.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Lube Oil Lines -
External: Supports
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
COMPONENT PART NUMBER 02-465B TASK DESCRIPTION NO.: DR-13-02-465B-0
SNPS GPL NO. 03-465B CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Perform an engineering review of the small bore piping/tubing supports to provide additional assurances that the component will perform its intended design function during normal operating and earthquake loading.

PRIMARY FUNCTION

Provide adequate restraint of the small bore piping/tubing system, in the intended support load direction.

ATTRIBUTE TO BE VERIFIED

Structural adequacy of the small bore pipe/tube supports due to the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

IEEE 387

REFERENCES

"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1

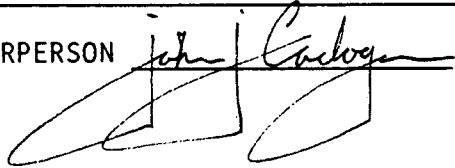
COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-13-02-465B-0

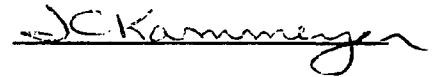
DOCUMENTATION REQUIRED

Delaval design documentation (specifications, calculations, drawings, etc.).
In lieu of information from Delaval, the following information is required:
verified support sketches and piping isometrics, material specifications, pipe
size and schedule, and operating parameters (pressure, temperature, load
combinations)

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to read "John Carlson", written over a horizontal line.

PROGRAM MANAGER

A handwritten signature in black ink, appearing to read "J. C. Kammerer", written over a horizontal line.

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil Lines</u> <u>External - Supports</u>	UTILITY	<u>Tennessee Valley Authority</u> <u>Bellefonte Nuclear Plant - Unit 1</u>
GPL NO.	<u>02-465B</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-465B</u>		

TASK DESCRIPTIONSEngine A

1. Assemble and review existing documentation.
2. Obtain sufficient data to support the design Review effort. This may be accomplished by developing quality verified as-builts in accordance with DG-7, or by the Design Group performing a field walkdown.

Engine BSame as Engine A

ATTRIBUTES TO BE VERIFIEDEngine A

1. Quality status of Component Document Package
2. Information necessary for the design review effort

Engine BSame as Engine A

ACCEPTANCE CRITERIA

Engine A

1. Satisfactory Document Package
2. Review of detailed information by the Design Group

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Procedure DG-7

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
2. Quality verified as-built isometric drawing for the supports if available from the owner.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Steven M. Schwartz

PROGRAM MANAGER

J. Kammeyer

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
2. The Design Group will be responsible for closing out the as-built drawings per Procedure DG-7. The as-built drawings will be Quality verified by the appropriate site Quality organization. The performance of an engineering walkdown by the Design Group, precludes the issuance of a quality verified as-built drawing or sketch.

Engine B

Same as Engine A

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Nita A. Salto

PROGRAM MANAGER

J. K. Korman

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARYCOMPONENT NO. 02-465B

Effective Printout Date: 11/30/84

COMPONENT TYPE: Lube Oil Lines External: Supports

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
<u>BELLEFONTE</u>		
None		
<u>NUCLEAR</u>		
None		
<u>NON-NUCLEAR</u>		
None		

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Turbocharger - Lube Oil
Fittings: Pipe, Tubing,
Fitting & Flexible Coupling
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-467A TASK DESCRIPTION NO. DR-13-02-467A-0
SNPS GPL NO. 03-467A CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the turbocharger-lube oil fittings piping spool pieces and fittings for Bellefonte with Comanche Peak.

The following modification recommendation made on the lead engine DR/QR report should be implemented:

- The 2½-inch Dresser couplings (located between the turbocharger and lube oil sump tank for both drain lines) are to be removed and replaced with 2½-inch 150 lb. sump oil flanges with A307 bolts.

There are no maintenance recommendations applicable to this component.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

BF3760/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-467A-0

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

John F. Cadogan

PROGRAM MANAGER

2C. Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1Turbocharger-Lube Oil Fitting-
Pipe, Tubing, Fittings and
Flexible Couplings

COMPONENT (Small Bore Scope Only)

UTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. 02-467ATASK DESCRIPTION NO. DR-13-02-467A-0SNPS GPL NO. 03-467ACLASSIFICATION TYPE BTASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience from the EDG Component Tracking System. There is no site experience for this component in the Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine report does address site specific additions of supports. The necessity for similar additions on Bellefonte is addressed below.

A field walkdown was performed at Bellefonte in accordance with the small bore piping criteria document (Ref. 1). However, a review of this component was not possible since the piping and tubing on engine A was inaccessible at the time of the walkdown. Therefore, component acceptability and any subsequent recommendations shall be based upon the field walkdown of engine B. It is concluded that this component will perform its intended function at Bellefonte under all normal operating and earthquake loadings provided that supports are added/modified as indicated in DR/QR report 02-467B. Also, it is recommended that the engine A piping and tubing be verified or modified to be consistent with engine B.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-467A-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

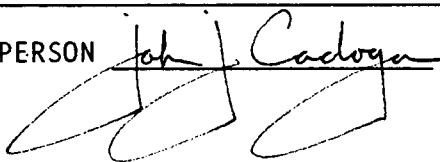
REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.
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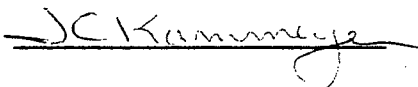
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Turbocharger - Lube Oil
Fittings: Supports
COMPONENT (Large Bore Scope Only) _____ UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-467B TASK DESCRIPTION NO. DR-13-02-467B-0
SNPS GPL NO. 03-467B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak)
- A comparison of the turbocharger-lube oil fittings supports for Bellefonte with Comanche Peak.

The following modification recommendation made on the lead engine DR/QR report should be implemented:

- The multiple support (attached to both 2½-inch drain lines) located between the lube oil sump tank and Dresser coupling require reinforcement of its support members and increases in their welds.

There are no maintenance recommendations applicable to this component.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-467B-0

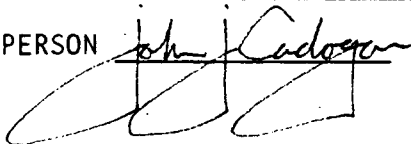
REFERENCES

Not required

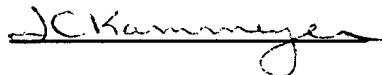
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to read "John Cadogan", written over a rectangular box.

PROGRAM MANAGER

A handwritten signature in black ink, appearing to read "J.C. Kammerer", written over a rectangular box.

TDI OWNERS GROUP

for

BELLEFONTE NUCLEAR PLANT - UNIT 1

TURBOCHARGER - LUBE OIL FITTINGS: SUPPORTS
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-467B

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews of the structural adequacy of the turbocharger lube oil tubing supports to withstand the effects of normal operating and earthquake loadings. The primary function of these supports is to provide adequate restraint of the tubing system in the intended support load direction.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the tubing supports to assure that the component will perform its intended design function during normal operating and earthquake loadings.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the Bellefonte site, nuclear, and non-nuclear industry experience. See Appendix C for results.
- The Quality Revalidation Checklist results were reviewed for acceptability.

Refer to the review procedures as described in Reference 1 for a detailed methodology for this evaluation.

IV RESULTS AND CONCLUSIONS

The tubing supports, as defined by this Component Design Review, have been evaluated in accordance with Reference 1 and have been found acceptable with modification. The conclusions of this report are based upon the field walkdown of Engine 1B only. This component was not installed on Engine 1A at the time of the walkdown.

There are no Quality Revalidation Checklist results or TERs associated with this component.

Based on the above review, it is concluded from References 1 and 2 that the tubing supports will perform their intended design function at Bellefonte under all normal operating and earthquake loadings if the following recommended modification is implemented as detailed in Reference 3:

In order to support the tubing of Component 02-467A, it is recommended that the existing two-directional lateral restraints (one per line) be modified to provide three directions of restraint. Upon installation of this component for Engine 1A, it is recommended that the installation be made consistent with that of Engine 1B.

V. REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.
2. Stone & Webster Calculation number 11600.60 NP(B)-1301-XH
3. Memo No. 6595 from C. Malovrh (SWEC) to J. Kammeyer (SWEC), dated 12/20/84.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Turbocharger - Lube Oil
Fittings: Supports
COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-467B TASK DESCRIPTION NO. DR-13-02-467B-0
SNPS GPL NO. 03-467B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Perform an engineering review of the tubing supports to provide additional assurances that the component will perform its intended design function during normal operating and earthquake loading.

PRIMARY FUNCTION

Provide adequate restraint of the tubing system in the intended support load directions.

ATTRIBUTE TO BE VERIFIED

Structural adequacy of the tubing supports due to the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

IEEE-387

REFERENCES

"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," Report No. 11600.60-DC-02, Revision 1.

DOCUMENTATION REQUIRED

Delaval design documentation (specifications, calculations, drawings, etc.). In lieu of information from Delaval, the following information is required: verified support sketches and piping isometrics, material specifications, pipe size and schedule, and operating parameters (pressure, temperature, load combinations)

GROUP CHAIRPERSON
BF3554/1

PROGRAM MANAGER

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Turbocharger-Lube Oil Fittings: Supports	UTILITY	Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1
GPL NO.	02-467B	REV. NO.	1
SNPS GPL NO.	03-467B		

TASK DESCRIPTIONSEngine A

1. Assemble and review existing documentation.
2. Obtain sufficient data to support the design review effort. This may be accomplished by developing quality verified as-builts in accordance with Procedure DG-7, or by the Design Group performing a field walkdown.

Engine B

Same as Engine A

ATTRIBUTES TO BE VERIFIEDEngine A

1. Quality status of Component Document Package
2. Information necessary for the design review effort.

Engine B

Same as Engine A

ACCEPTANCE CRITERIAEngine A

1. Satisfactory Document Package
2. Review of detailed information by the Design Group

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Procedure DG-7

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
2. Quality verified as-built isometric drawings for the supports if available from the Owner.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Steven M. Schwartz

PROGRAM MANAGER

DC Kammerer

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
2. The Design Group will be responsible for closing out the as-built drawings as per Procedure DG-7. The as-built drawings will be Quality verified by the appropriate site Quality organization. The performance of an engineering walkdown by the Design Group, precludes the issuance of a quality verified as-built drawing or sketch.

Engine B

Same as Engine A

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON Victor A. Jalota PROGRAM MANAGER JC Kammeyer

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-467B

Effective Printout Date: 11/30/84

COMPONENT TYPE: Turbocharger - Lube Oil Fittings: Supports

EXPERIENCE

REFERENCE
DOCUMENTS

BELLEFONTE
STATUS

BELLEFONTE

None

NUCLEAR

None

NON-NUCLEAR

None

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Lube Oil Sump Tank and Mounting Hardware</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-540A&C</u>	TASK DESCRIPTION NO.	<u>DR-13-02-540A&C-0</u>
SNPS GPL NO.	<u>03-540A&C</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review for this component for Bellefonte is not required based on following:

- A review of applicable industry experience from the EDG Component Tracking System indicated that no significant experience items have been reported. No site experience items have been reported at Bellefonte in the Component Tracking System.
- The sump tank and its mounting at Bellefonte is very similar to that at Comanche Peak, which was previously reviewed and found acceptable. Some tank components are identical.
- A detailed analysis was performed to seismically qualify the sump tank, Ref. 3.

There are no maintenance or modification recommendations for these components.

The following quality inspection is recommended for both engines.

- Verify that the proper torques were applied to the bolting via documentation.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-540A&C-0

SPECIFIED STANDARDS

Not required

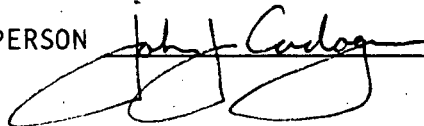
REFERENCES

1. Specification 2411, Diesel Engine Driven Emergency Generator Power Packages for Bellefonte Nuclear Plant Units 1 and 2.
 2. Final Report, Volume III, Seismic Qualification of Delaval Turbine Inc. Diesel Generator Sets, Serial Numbers 75080-75083, for Tennessee Valley Authority, Bellefonte Nuclear Plant Units 1 and 2 III. 9 Lube Oil Sump Tank.
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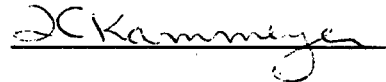
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



UNIT 1

02-540A and C - Lube Oil Sump Tank and Mounting Hardware

Acceptability of the lube oil sump tank is documented in the following
Sequence Control Charts (SCC):

SCC No.

1RT-M376
1RT-M375

Accession No.

B44 860225 703
B44 860225 702

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1Lube Oil Sump Tank: Misc.
Fittings, Gaskets, Pipe
Bolting Material and Valve

COMPONENT	<u>(Small Bore Scope Only)</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-540B</u>	TASK DESCRIPTION NO.	<u>DR-13-02-540B-0</u>
SNPS GPL NO.	<u>03-540B</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak). There is no site or industry experience for this component in the EDG Component Tracking System.

There are no maintenance or modification recommendations for this component.

A field walkdown was performed in accordance with the small bore piping criteria document (Ref. 1) and concluded that this component will perform its intended function for normal and earthquake loadings.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTES TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

1. Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," report No. 11600.60-DC-02, Revision 1.
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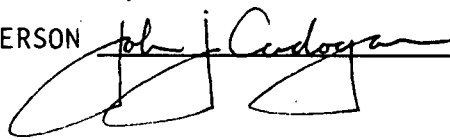
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-540B-0

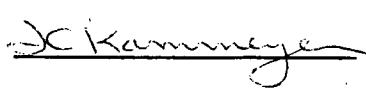
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP
FOR
BELLEFONTE NUCLEAR PLANT
LUBE OIL SUMP TANK: MOUNTING HARDWARE

COMPONENT PART NO.: 02-540C

See Component Part No.: 02-540A

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Aux. Sub Base & Oil &
Water Piping-Lube Oil
Pipe and Fittings
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-717F TASK DESCRIPTION NO. DR-13-02-717F-0
SNPS GPL NO. 03-717G CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on a review of the applicable industry experience in the EDG Component Tracking System (dated 11/21/84) and the lead engine DR/QR report (Comanche Peak). There is no site experience listed in the Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine report does address site specific modifications to the skid piping and/or supports. Generic application of these modifications is not required for Bellefonte since the Comanche Peak modifications were recommended in order for the subject piping to meet the intent and philosophy of the ASME Code for the boundary conditions and assumptions used in the Owners Group analysis. These boundary conditions and assumptions may be somewhat different from those used in the manufacturer's analysis. Lead engine skid mounted large bore pipe modifications, as they apply to equipment nozzle loads, are addressed, if necessary, in the individual equipment design reviews.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-717F-0

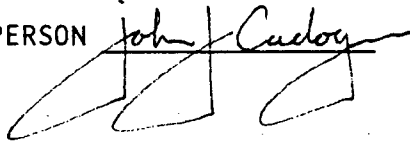
REFERENCES

Not required

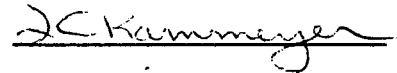
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1Auxiliary Sub Base and Oil
and Water Piping- Lube Oil:
Pipe and Fittings

COMPONENT	<u>(Small Bore Scope Only)</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-717F</u>	TASK DESCRIPTION NO.	<u>DR-13-02-717F-0</u>
SNPS GPL NO.	<u>03-717F</u>	CLASSIFICATION TYPE	<u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak). There is no site or industry experience for this component in the EDG Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine report does address site specific additions of supports. The necessity for similar additions on Bellefonte has been assessed by a field walkdown.

A field walkdown was performed in accordance with the small bore piping criterial document (Ref. 1) and concluded that this component will perform its intended function for normal and earthquake loadings provided that the supports are added as indicated in DR/QR report 02-717I.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

1. Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," report No. 11600.60-DC-02, Revision 1.

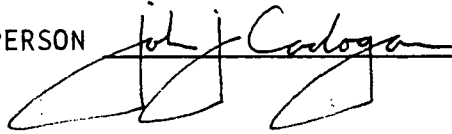
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-717F-0

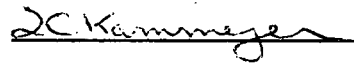
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

 J. J. Cadogan

PROGRAM MANAGER

 J. C. Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Aux. Sub-Base & Oil & Water
COMPONENT Piping-Lube Oil: Valves UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-717G TASK DESCRIPTION NO. DR-13-02-717G-0
SNPS GPL NO. 03-717I CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR report (Comanche Peak).
- Similarities between Bellefonte and lead engine components. Both plants have Crosby relief valves, Wm. Powell globe valves and Tufline plug valves.

The following maintenance from the lead engine DR/QR report should be implemented.

- Check the relief valve lift pressure every 5 years.

Proper orientation of the relief valves should be verified by field inspection (i.e., vertical installation). Pending satisfactory completion of this inspection, there are no modifications required for this component based on the lead engine report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-717G-0

SPECIFIED STANDARDS

Not required

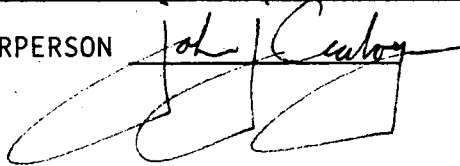
REFERENCES

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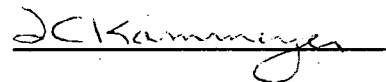
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

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PROGRAM MANAGER

A handwritten signature, likely "J. C. Kamminger", is written over a horizontal line. The signature is in cursive.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Auxiliary Sub-Base &
Oil and Water Piping
COMPONENT Lube Oil-Gaskets & Bolting UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-717H TASK DESCRIPTION NO. DR-13-02-717H-0
SNPS GPL NO. 03-717J CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of applicable industry experience and the lead engine DR/QR reports (Shoreham/Comanche Peak). There is no site experience for this component.

There are no maintenance or modification recommendations for this component.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kenneth T. Fitzgerald PROGRAM MANAGER R. Kammeyer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Auxiliary Sub-Base & Oil &
Water Piping-Lube Oil:
Supports & Mounting Hardware
COMPONENT (Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-717I TASK DESCRIPTION NO. DR-13-02-717I-0
SNPS GPL NO. 03-717I CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on a review of the applicable industry experience in the EDG Component Tracking System and the lead engine DR/QR report (Comanche Peak). There is no site experience listed in the Component Tracking System.

There are no maintenance recommendations for this component. However, the lead engine report does address site specific modifications to the skid piping and/or supports. Generic application of these modifications is not required for Bellefonte since the Comanche Peak modifications were recommended in order for the subject piping to meet the intent and philosophy of the ASME Code for the boundary conditions and assumptions used in the Owners Group analysis. These boundary conditions and assumptions may be somewhat different from those used in the manufacturer's analysis. Lead engine skid mounted large bore pipe modifications, as they apply to equipment nozzle loads, are addressed, if necessary, in the individual equipment design reviews.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-717I-0

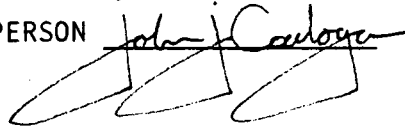
REFERENCES

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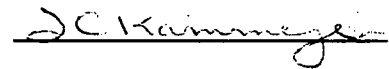
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

BELLEFONTE NUCLEAR PLANT - UNIT 1

AUXILIARY SUB-BASE AND OIL AND WATER PIPING - LUBE OIL:
SUPPORTS AND MOUNTING HARDWARE
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-7171

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews of the structural adequacy of the auxiliary sub-base and oil and water piping - lube oil supports and mounting hardware to withstand the effects of normal operating and earthquake loadings. The primary function of these supports is to provide adequate restraint of the small bore piping/tubing system in the intended support load direction.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the small bore piping/tubing supports to assure that the component will perform its intended design function during normal operating and earthquake loadings.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the Bellefonte site, nuclear, and non-nuclear industry experience. See Appendix C for results.
- The Quality Revalidation Checklist results were reviewed for acceptability.

Refer to the review procedures as described in Reference 1 for a detailed methodology for this evaluation.

IV RESULTS AND CONCLUSIONS

The small bore piping/tubing supports, as defined by this Component Design Review have been evaluated in accordance with Reference 1 and have been found acceptable with modifications.

There are no Quality Revalidation Checklist results TERs associated with this component.

Based on the above review, it is concluded from References 1 and 2 that the small bore piping/tubing supports will perform their intended design function at Bellefonte under all normal operating and earthquake loadings with the provision that the following recommended modifications be implemented as detailed in Reference 3:

In order to support the piping and tubing of component 02-717F, it is recommended that two-directional lateral restraints be added on the following lines such that the between support spans are limited to a maximum of 4 feet 6 inches:

- Lube oil filter vent lines
- Prelube filter vent line

It is also recommended that two-directional lateral restraints be added as indicated:

- On the lube oil filter differential pressure lines midspan between the large bore connections and the first restraint downstream.
- On the lube oil tank drain line on Engine 1B in order to reduce the unsupported span length and maintain consistency with Engine 1A.

V REFERENCES

1. "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners Group," Report No. 11600.60-DC-02 Revision 1.
2. Stone & Webster Calculation numbers: 11600.60-NP(B)-1301-XH
3. Memo No. 6595 from C. Malovrh/SWEC to J. Kammeyer/SWEC dated 12/20/84.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Auxiliary Sub-Base and
Oil and Water Piping
Lube Oil: Supports and
Mounting Hardware

COMPONENT (Small Bore Scope Only) UTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. 02-717I TASK DESCRIPTION NO. DR-13-02-717I-0SNPS GPL NO. 03-717K CLASSIFICATION TYPE BTASK DESCRIPTIONS

Perform an engineering review of the small bore piping/tubing supports to provide additional assurances that the component will perform its intended design function during normal operating and earthquake loading.

PRIMARY FUNCTION

Provide adequate restraint of the small bore piping/tubing system, in the intended support load direction.

ATTRIBUTES TO BE VERIFIED

Structural adequacy of the small bore pipe/tube supports due to the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

ANSI B31.1, "Power Piping"

REFERENCES

"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners Group" Report No. 11600.60-DC-02, Revision 1.

DOCUMENTATION REQUIRED

DeLaval design documentation (specifications, calculations, drawings, etc.). In lieu of information from DeLaval, the following information is required: verified support sketches and piping isometrics, material specifications, pipe size and schedule, and operating parameters (pressure, temperature, load combinations).

GROUP CHAIRPERSON
BF3551/1

PROGRAM MANAGER

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Aux. Sub. Base & Oil & Water Piping - Lube Oil: Supports & Mounting Hardware	UTILITY	Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1
GPL NO.	02-717I	REV. NO.	1
SNPS GPL NO.	03-717K		

TASK DESCRIPTIONSEngine A

1. Assemble and review existing documentation.
2. Obtain sufficient data to support the design review effort. This may be accomplished by developing quality verified as-builts in accordance with Procedure DG-7, or by the Design Group performing a field walkdown.

Engine B

Same as Engine A

ATTRIBUTES TO BE VERIFIEDEngine A

1. Quality status of Component Document Package
2. Information necessary for the design review effort

Engine B

Same as Engine A

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
13-02-7171

ACCEPTANCE CRITERIA

Engine A

1. Satisfactory Document Package
2. Review of detailed information by the Design Group

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Procedure DG-7

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
2. Quality verified as-built isometric drawings for the supports and mounting hardware if available from the Owner.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Steve M. Schwartz

PROGRAM MANAGER

J. Kammerer

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
13-02-7171

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
2. The Design Group will be responsible for closing out the as-built drawings as per Procedure DG-7. The as-built drawings will be Quality verified by the appropriate site Quality organization. The performance of an engineering walkdown by the Design Group, precludes the issuance of a quality verified as-built drawing or sketch.

Engine B

Same as Engine A

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Nata A. Salete

PROGRAM MANAGER

X. Kammerer

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-717I

Effective Printout Date: 11/30/84

COMPONENT TYPE: Auxiliary Sub-Base and Oil and Water Piping
Lube Oil: Supports and Mounting Hardware

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE
STATUSBELLEFONTE

None

NUCLEAR

10CFR50.55E filed
after inspection
revealed ASME III
Class NF code
requirements were
violated.

Cleveland Electric
10CFR50.55E
DAR No. 117

DR/QR reviews provide
assurance that components
will perform their intended
design functions during
normal operating and
earthquake loadings.

NON-NUCLEAR

None

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Lube Oil Heat Exchanger</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-820A</u>	TASK DESCRIPTION NO. <u>DR-13-02-820A-0</u>
SNPS GPL NO. <u>10-104</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience, except that already addressed in the lead report and below. The majority of industry experience with lube oil heat exchangers has been problems with leakage, usually caused by corrosion of the tubes. This is not expected to be a problem at Bellefonte since the engine jacket water, which cools the lube oil in the exchanger, will be treated with a corrosion inhibitor.
- A review of the lead engine DR/QR report (Comanche Peak).
- Both lead engine and Bellefonte heat exchangers were single pass and manufactured by Thermxchanger. The lube oil heat exchanger at Bellefonte is manufactured in accordance with ASME VIII.

The following maintenance recommendations from the lead engine DR/QR Report should be implemented:

- During refueling outages, the heat exchanger tube side should be inspected to assess the condition of the tubes and the tube sheets for fouling, corrosion, and other symptoms of deterioration. Gaskets and the packing rings at the floating tube sheet should be replaced during reassembly.
- Spectrochemical analysis of lube oil samples should be performed approximately every three months to monitor the condition of the diesel engine. The results of their analysis are helpful in identifying jacket water leakage, first by direct indication of the weight percent of water and secondly by interpretation of the concentration of chemical elements that are present in the corrosion inhibitor of the jacket water system.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820A-0

There are no modifications required for this component based on the lead engine report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

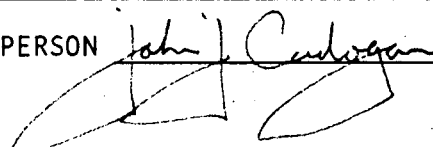
REFERENCES

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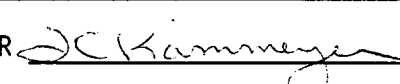
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Lube Oil Full Pressure Strainer</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-820C</u>	TASK DESCRIPTION NO. <u>DR-13-02-820C-0</u>
SNPS GPL NO. <u>04-000</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that which was previously addressed in the lead engine report. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR reports (Shoreham and Comanche Peak).
- Similarity of the Bellefonte and lead engine component. Both plants use Air Maze Simplex strainers with 100%, 80 micron filtration.

The following maintenance recommendation based on the lead engine DR/QR report should be implemented:

- The strainer differential pressure should be checked during each engine operation (per TDI Manual) and the strainer element should be cleaned/replaced at 15 psid or at any significant increase in ΔP .

There are no modifications recommended for this component, based on the lead engine report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820C-0

SPECIFIED STANDARDS

Not required

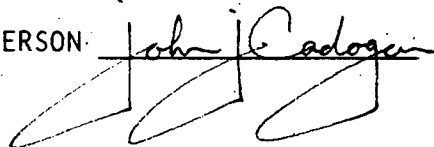
REFERENCES

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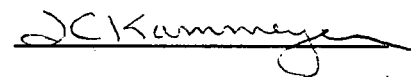
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Full Flow Lube Oil Filter</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-820D</u>	TASK DESCRIPTION NO. <u>DR-13-02-820D-0</u>
SNPS GPL NO. <u>10-106</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that previously addressed in the lead engine DR/QR report. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR report (Comanche Peak).
- The Comanche Peak and Bellefonte full flow lube oil filters are manufactured by Commercial Filter, Model No. P9-3-6FG2K2 (10-micron) and are built in accordance with the ASME code.

The following maintenance recommendation from the lead engine DR/QR report should be implemented:

- The TDI Instruction Manual specifies that the filter differential pressure will be checked monthly. Procedures should be established to change filter before manufacturer's recommended maximum differential pressure of 30 psid.

There are no modification recommendations from the lead engine DR/QR report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820D-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

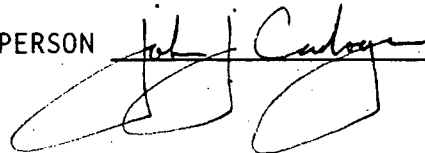
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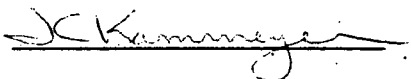
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Oil Keep-Warm Filter

UTILITY Tennessee Valley Authority

GROUP PARTS LIST NO. 02-820E

TASK DESCRIPTION NO. DR-13-02-820E-0

SNPS GPL NO. 10-117

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry experience, except that previously addressed in the lead engine report. There was no site experience in the Component Tracking System.
- A review of the lead engine DR/QR report (Comanche Peak).

Prelube filters at both Bellefonte and Comanche Peak were manufactured by Commercial Filters (Model P3-2-25FG2K1). Both are manufactured to ASME III and are rated to 10 microns filtration.

The following maintenance from the lead engine report should be implemented:

- Check filter differential pressure monthly.
- Guidelines should be established for replacing filter cartridges at or below the manufacturer's recommended maximum differential pressure of 30 psid.

There are no modifications recommended from the lead engine DR/QR report.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820E-0

SPECIFIED STANDARDS

Not required

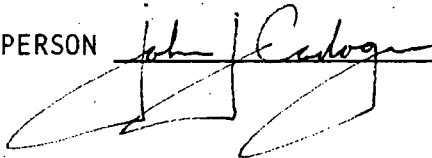
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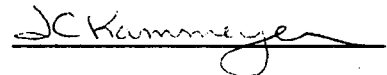
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Lube Oil Lines External -
Valves

UTILITY Tennessee Valley Authority

GROUP PARTS LIST NO. 02-820F

TASK DESCRIPTION NO. DR-13-02-820F-0

SNPS GPL NO. 99-465A

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no industry or site experience.
- A review of the lead engine DR/QR report (Comanche Peak).
- Similarity of Bellefonte and the lead engine component.
- The Tufline 3-way valve model 037-AX used at Bellefonte is the same type valve used at Comanche Peak Component No. 02-717G.

There are no maintenance or modification recommendations from the lead engine DR/QR report.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820F-0

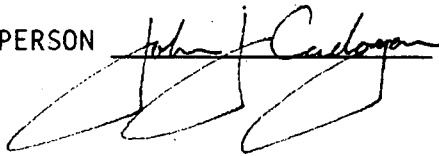
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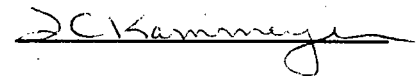
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Before and After Lube
COMPONENT Oil Pump UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-820G TASK DESCRIPTION NO. DR-13-02-820G-0
SNPS GPL NO. 10-113 CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience, except that already addressed in the lead engine report.
- A review of the lead engine DR/QR report (Comanche Peak).
- The before and after lube oil pump at Bellefonte is the same as the component in the lead engine.

A review of pump nozzle loads indicates that the applied piping loads are above the manufacturers recommended allowables. There has however been no experience of pump leakage due to these loads at Comanche Peak or other V-16 installations. As such the following inspection should be performed as part of the daily engine walkdown:

- The pump should be inspected for signs of leakage and corrective modifications (addition of flexible piping connections) be implemented as required.

There are no modification recommendations for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-820G-0

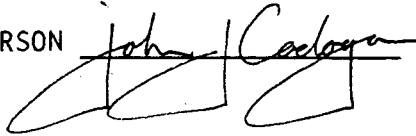
REFERENCES

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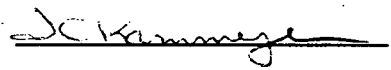
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil Sump Heater</u>	UTILITY	<u>Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1</u>
GPL NO.	<u>02-820H</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>99-805</u>		

TASK DESCRIPTIONS

No further review of component 02-820H is required for the following reasons:

- a) There is no site or industry experience for this component.
- b) Type C component - Failure has little bearing on the effective use or operation of the diesel generator.

GROUP CHAIRPERSON Victor A. Saleta PROGRAM MANAGER X Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Base and Bearing Caps -
Base Assembly, Main Bearing
Studs and Nuts, and
COMPONENT Main Bearing Caps UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-305A,C&D TASK DESCRIPTION NO. DR-13-02-305A,C&D-0
SNPS GPL NO. 03-305A,C&D CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review is not required for these components based on a review of the applicable industry and site experience listed in the EDG Component Tracking System, and the lead engine DR/QR report (Comanche Peak). The component parts at Bellefonte are the same as those at Comanche Peak.

The following maintenance items are recommended to ensure reliability of this component:

- At each refueling outage, a visual inspection of the area adjacent to the main bearing stud nut pockets of each bearing saddle should be conducted. The inspection should be done several minutes after a thorough wipe down of the surfaces. Good lighting should be used for this inspection. Any crack thus detected must be investigated further before the engine is allowed to return to service.
- The mating surfaces of the base and cap should be thoroughly cleaned with solvent before any reassembly.

There are no modification recommendations for these components.

The Quality inspections listed below are recommended to be performed:

- Verify preload torque applied to the bearing cap stud nuts during engine installation. Torque values of nuts to be in compliance with approved site NDE Procedures and TDI manual, engines A and B.
 - Perform a visual inspection of the main bearing cap mating surface for evidence of fretting, engines A and B.
 - Perform a liquid penetrant inspection of base, No. 5 main bearing saddle area, as indicated on Bellefonte Component Revalidation Checklist, Task Description No. QR-02-305A, engines A and B.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-305A,C&D-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kevin T. Fitzpatrick

PROGRAM MANAGER

X Kammerer

UNIT 1

02-305A, C, D - Base and Bearing Caps: Base Assembly, Main Bearing
Studs and Nuts, and Main Bearing
Caps

Acceptability of the base and bearing caps is documented in the following
Sequence Control Charts (SCC):

<u>SCC No.</u>	<u>Accession No.</u>
1RT-M147	B44850904 809
1RT-M148	B44 850904 812
1RT-M149	B44 850904 811
1RT-M235	B44 850918 839
1RT-M232	B44 850904 782
1RT-M233	B44 850904 717

TDI OWNERS GROUP

FOR

BELLEFONTE NUCLEAR PLANT

BASE & BEARING CAPS: MAIN BEARING STUDS & NUTS

COMPONENT PART NO.: 02-305C

See Component Part No.: 02-305A

TDI OWNERS GROUP

FOR

BELLEFONTE NUCLEAR PLANT

BASE & BEARING CAPS: MAIN BEARING CAPS

COMPONENT PART NO.: 02-305D

See Component Part No.: 02-305A

TDI OWNERS GROUP

for

BELLEFONTE NUCLEAR PLANT - UNIT 1

CRANKSHAFT

COMPONENT PART NO. 02-310A

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews to determine the adequacy of the crankshafts for their intended service at Bellefonte. The primary function of the crankshaft is to convert reciprocating motion of the piston to rotary motion, and to transfer the resulting torque to the generator rotor. The manufacturer's part number for the crankshafts at Bellefonte is 02-310-08-AC. The forging and machining of the crankshafts was done by National Forge Company.

II OBJECTIVE

The objective of this review was to evaluate the adequacy of the crankshafts for their intended use at Bellefonte.

III METHODOLOGY

The Emergency Diesel Generator Component Tracking System records were reviewed to determine the nuclear, non-nuclear, and Bellefonte site experience of the crankshafts. Bellefonte pertinent literature specified on the Component Tracking System records was examined for information on the performance of the crankshafts (see Appendix C).

The TDI Holzer calculations were reviewed by comparing the results with those obtained from vibrational analysis (Refs. 1 and 3).

A modal superposition analysis of the crankshaft was performed. The pressure loading was obtained from the dynamic test at Shoreham Nuclear Power Station (Ref. 2). This analysis calculates the nominal shear stresses at each crankpin and main journal location.

The stress levels in the main journal oil holes were compared with the endurance limit.

The Component Quality Revalidation Checklist results were reviewed for acceptability.

IV RESULTS AND CONCLUSIONS

The TDI Holzer calculations were found to be accurate. The torsigraph test has not been conducted to date. The results of the torsigraph test should be compared with the TDI Holzer calculations and the vibrational analysis when available.

The modal superposition analysis determined the maximum amplitude of nominal stress to be 5438 psi between cylinder numbers 5 and 6 for a load at 7000 kW (Ref. 3). The nominal stresses were found to satisfy the requirements of DEMA, and are less than 5000 psi for a single order, and less than 7000 psi for combined orders (Ref. 4).

The material certification reports for the crankshafts at Bellefonte indicate that the tensile strengths for the crankshaft material in Engine Serial Nos. 75080 and 75081 are within the original design specifications (Ref. 5). The factor of safety against fatigue failure in the main journal oil holes was found to be 1.29 based on a minimum ultimate tensile strength of 83.0 ksi for Engine Serial No. 75081 (Ref. 3).

There are no TERs associated with this component.

The Bellefonte Component Quality Revalidation Checklist has been reviewed in preparation of this report. Since no documents are in evidence that fulfill these requirements, it is recommended that the Quality Revalidation inspections listed in Appendix B be performed.

Based on the above review, it is concluded that the crankshafts in Engine Serial Nos. 75080 and 75081 are acceptable for their intended function at Bellefonte provided that a torsigraph test verifies that the actual level of stress does not exceed that calculated, and that crankshaft inspections verify that the vital areas are free of unacceptable flaws.

V REFERENCES

1. Yang, Roland, "Tennessee Valley Authority, Bellefonte Nuclear Plant, Delaval Enterprise DSRV-16-4, 7000 kW, 9734 BHP at 450 rpm, 225 BMEP, Engine Serial No. 75080/83," Transamerica Delaval Inc., Engine and Compressor Division, Oakland, California.
2. "Evaluation of Emergency Diesel Generator Crankshafts at Shoreham and Grand Gulf Nuclear Power Stations," Report No. FaAA-84-3-16, Failure Analysis Associates, Palo Alto, California, May 22, 1984.
3. FaAA Support Package SP-84-6-10(1).
4. Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines, Diesel Engine Manufacturers Association, 6th ed., 1972.
5. "Material Certification Report," Numbers 4-01850 and 0-06707, National Forge Company.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Crankshaft</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-310A</u>	TASK DESCRIPTION NO.	<u>DR-13-02-310A-0</u>
SNPS GPL NO.	<u>03-310A</u>	CLASSIFICATION TYPE	<u>A</u>

TASK DESCRIPTIONS

Review of Bellefonte site, nuclear and non-nuclear experience.

Review of TDI Holzer calculations and torsigraph tests.

Perform modal superposition of the crankshaft.

Compare stress levels at the oil holes with the endurance limit.

Review Quality Revalidation Checklist for acceptability.

Review information provided on TERs.

PRIMARY FUNCTION

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

ATTRIBUTE TO BE VERIFIED

Sufficient strength, stiffness, frequency characteristics: material properties, surface finish, and bearing characteristics for EDG service.

SPECIFIED STANDARDS

Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines, Diesel Engine Manufacturer's Association; 6th ed., 1972.

REFERENCES

None

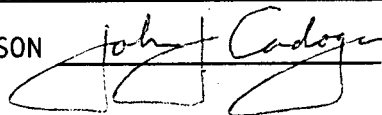
COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-13-02-310A-0

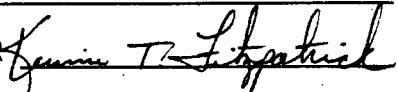
DOCUMENTATION REQUIRED

TDI drawings, test reports, experimental pressure vs. time curves, Holzer calculations for DSRV-16-4 engine.

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Crankshaft & Bearings - Crankshaft & Turning Gear	UTILITY	Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1
GPL NO.	02-310A	REV. NO.	2
SNPS GPL NO.	03-310A		

TASK DESCRIPTIONS

Engine A

1. Assemble and review existing documentation.
2. Perform a visual inspection of all crankpin and main journals for signs of scoring, wear or damage. Document with photographs.
3. Perform an Eddy Current test on the main journal oil holes 4, 6 and 8. If inspection is unsatisfactory perform an Eddy Current test on the remaining main journal oil holes and on all crankpin journal oil holes.
4. Perform a torsigraph on the crankshaft.

Engine B

1. Assemble and review existing documentation.
2. Perform a visual inspection of all crankpin and main journals for signs of scoring wear or damage. Document with photographs.
3. Perform an Eddy Current test on the main journal oil holes 4, 6 and 8. If inspection is unsatisfactory perform an Eddy Current test on the remaining main journal oil holes and on all crankpin journal oil holes.

ATTRIBUTES TO BE VERIFIED

Engine A

1. Quality status of Component Document Package

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 5
13-02-310A

ATTRIBUTES TO BE VERIFIED (continued)

Engine A (continued)

- 2-3. Surface integrity of crankpin and main journals
- 4. Stress on the crankshaft

Engine B

- 1. Quality status of Component Document Package
 - 2-3. Surface integrity of the crankpin journals
-

ACCEPTANCE CRITERIA

Engine A

- 1. Satisfactory Document Package
- 2. Review of inspection report by the Design Group
- 3. See Attachment A
- 4. Review of inspection report by the Design Group

Engine B

- 1. Satisfactory Document Package
 - 2. Review of inspection report by the Design Group
 - 3. See Attachment A
-

REFERENCES

Engine A

- 1. QCI No. 52
 - 2. Approved Site NDE Procedures
 - 3. Approved Site NDE Procedures, TER# 99-015
-

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 5
13-02-310A

REFERENCES (continued)

Engine B

1. QCI No. 52
 - 2-3. Approved Site NDE Procedures
-

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
- 2-4. Inspection Report

Engine B

1. Document Summary Sheet
- 2-3. Inspection Report

GROUP CHAIRPERSON

Steve M. Schwartz

PROGRAM MANAGER

J. Kammerer

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
- 2-4. No inspection reports have been received which fulfill these requirements.

Engine B

1. No EDGCTS site experience documents are in evidence.
 - 2-3. No inspection report have been received which fulfill these requirements.
-

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B4 of 5
13-02-310A

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON

Victor A. Salata

PROGRAM MANAGER

J. Kammerer

TABLE 1

Main Journal Oil Hole Inspections for DSRV-16-4 Crankshafts

Journal Location	Depth of Notch* (mils)		
	0" to 1" from Journal Surface	1" to 2" from Journal Surface	2" to 3" from Journal Surface
Front End	No inspection	No inspection	No inspection
Between Cylinders 1 and 2	40	No inspection	No inspection
Between Cylinders 2 and 3	30	40	No inspection
Between Cylinders 3 and 4+	10	15	20
Between Cylinders 4 and 5	10	15	30
Between Cylinders 5 and 6+	10	15	20
Between Cylinders 6 and 7	10	15	30
Between Cylinders 7 and 8+	10	15	20
Flywheel End	15	20	40

TABLE 2

Crankpin Oil Hole Inspections for DSRV-16-4 Crankshafts

Crankpin Location	Depth of Notch* (mils)		
	0" to 1" from Journal Surface	1" to 2" from Journal Surface	2" to 3" from Journal Surface
Cylinder 1	No inspection	No inspection	No inspection
Cylinder 2	No inspection	No inspection	No inspection
Cylinder 3	20	30	40
Cylinder 4	20	30	40
Cylinder 5	20	30	40
Cylinder 6	20	30	40
Cylinder 7	20	30	40
Cylinder 8	20	30	40

* Width of notch is twice the depth.

+ Initial inspection - only inspect remaining locations if initial inspection is unsatisfactory.

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-310A

Effective Printout Date: 11/31/84

COMPONENT TYPE: Crankshaft

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
<u>BELLEFONTE</u>		
None		
<u>NUCLEAR</u>		
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 resulted from a broken crankshaft. Inspection of the engine did not reveal a cause for the failure. A metallurgical analysis of the crankshaft is being conducted. Manufacturer: Electro-Motive Div. of GM.	LER, Trojan; 344-7700, 770324	Failure of a different design crankshaft. Crankshaft at Bellefonte is adequately designed.
During performance of surveillance procedures, 2303-N16 "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 vertical shaft between upper and lower crankshaft. Manufacturer: Fairbanks-Morse	EPRI TMI 2, 052078, DG-28	Not a crankshaft failure.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
A Delaval diesel generator at Shoreham fractured its crankshaft at the crankpin and crankarm. Examination of 2 other diesels showed cracks on the crankshaft and crankpin bearing failure. Manufacturer: TDI	I&E Shoreham notice 83-58, 08/30/83	Problem associated with inadequate design. Bellefonte crankpins are adequately designed.
Cylinder No. 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. Manufacturer: TDI.	10CFR50.55E MP&L Grand Gulf 12/10/81, 04/15/82.	Problem not related to design.
Info-procedure to measure crankshaft thrust clearance. Manufacturer: TDI.	TDI SIM 283	No impact on adequacy of crankshafts.
Crankshaft overall lengths have increased and therefore require a modified inspection cover. Installation is prevented because of interference with the lube oil strainer. Interference may be eliminated by effecting reduction in the length of the cover by reducing the flange thickness and facing the end plate from 11/16-inch to 1/4-inch thickness.	TDI Letter to LILCO 01/10/84 S/N 74010/12 to Mike Herlihy (LILCO)	No impact on adequacy of crankshafts.
Info-instructions for flushing lube oil header.	TDI SIM 141	No impact on adequacy of crankshafts.

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE
STATUSNON-NUCLEAR

Crankshaft oilway plugs cracking from the use of improper gauge of material issued for plugs.
(M/V Pride of Texas)

Titan Navigation, Inc., Letter dated July 22, 1982

The TVA parts manual indicates that there were no revisions prior to the modification calling for use of thinner gauge material. Oil plugs installed at Bellefonte use proper gauge material and are adequate for use.

Experienced engine vibration at crankshaft caused by vibration damper coupling failure.
(M/V Columbia)

Hunton & Williams (12/29/83) to C. Seaman. Letter from M. Zbinden (State of Alaska) to D. Martini (TDI) dated 03/19/79. Letter from M. Zbinden to W. Hudson dated 02/02/79.

Not applicable since engines at Bellefonte do not have vibration dampers.

Currently checking the cause of excessive main engine crankshaft distortion.
(M/V Columbia)

Hunton & Williams (12/29/83) to C. Seaman. Memo from M. Zbinden (State of Alaska) to R. Ward dated 12/10/80.

Insufficient information in reference document for evaluation.

During normal operation engine experienced a low lube oil pressure alarm. Engine was shut down for inspection and two cracks were found at the No. 5 crank pin.

Failure Analysis Report No. 0135 12/10/80 (File T-39). Memo TDI H. Schilling 12/15/80 to G.E. Trussell (File T-1). Memo TDI H. Schilling 12/14/80 to G.E. Trussell (File T-1).

Resulted from inadequate repair following failure of another component.

Crankshaft failed at No. 6 main bearing journal. Indications started at discontinuity that is located about 3/4-inch from oil hole opening. Failure was caused by fatigue.

Failure Analysis Report No. 0124 dated 12/11/79 (File T-16).

Not applicable since this engine had a 4th order critical at operating speed, and Bellefonte does not.

EXPERIENCE

REFERENCE
DOCUMENTS

BELLEFONTE
STATUS

A bend is suspected on the crankshaft and the shaft consequently does not have the required support from each bearing. The risk of cracking is prevalent because of fatigue stressing during operation and load variations.

Telex from Bailey (TDI) to Delaval HQ. (File T-33).
Enclosure 2 to SWEC letter dated 04/29/81 by G. Sandstrom (File T-36).

No indication of a bent crankshaft at Bellefonte.

Broken crankshaft and further extensive damage to the engine. City of St. Cloud, Fla.

Letter from Village of Rockville Centre to Smith & Gillespie Eng. Inc. 11/09/81
Eng. DG-SRV-16-4
Unit No. 7 City of St. Cloud
(File T-63).

Resulted from failure of another component.

The original crankshaft was bent during the overspeed.

Sales order No. W-25354 07/13/81.
Rafha Electric Co.
Eng. No. 79003.
Model DSR-F48
(File T-57)

No indication of a bent crankshaft at Bellefonte.

Repaired crankshaft No. 2 crankpin journal was reduced in diameter by 0.273 thousandths of an inch.

Telex from C. Just to Pratt (TDI) 07/27/83

Not relevant to design considerations at Bellefonte.

UNIT 1

02-310A - Crankshaft

Acceptability of crankshaft vibration is documented in the "Crankshaft Torsional Vibration Measurements" report issued by Stone and Webster Engineering Corporation (B44 860212 701).

Acceptable completion of all other inspections on the crankshaft are documented in the following Sequence Control Charts (SCC):

<u>SCC No.</u>	<u>Accession No.</u>
1RT-M224	B44 850904 776
1RT-M338	B44 850904 760
1RT-M157	B44 850904 807
1RT-M274	B44 850904 703
1RT-M146	B44 850918 881
1RT-M234	B44 850904 803
1RT-M230	B44 850904 743
1RT-M275	B44 850904 739
1RT-M322	B44 850918 863

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Main Bearings</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-310B</u>	TASK DESCRIPTION NO. <u>DR-13-02-310B-0</u>
SNPS GPL NO. <u>03-310B</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- The DR/QR report for the lead engine at Comanche Peak included analysis of the main bearing shells and determined that they were acceptable for their intended application with a margin of safety suitable for small variations in loading and oil film pressures.
- The diesel engines at Bellefonte and Comanche Peak use identical bearing shells (TDI Part Numbers R-3313, R-3315 and R-3317). The engine operating parameters, main engine components, and loads at Bellefonte are similar to those at Comanche Peak.

A review of the nuclear and non-nuclear experiences listed in the EDG Component Tracking System reports several diesels were found with overheated and scored bearings. These problems were caused by abnormal operating conditions involving contaminated oil or loss of lubrication, and not because of the bearing design. There is no site experience listed for this component.

Because of the low operating hours on the engines, it is recommended that at the first refueling outage the main bearings be inspected for evidence of misalignment. If harmful misalignment is discovered, corrective procedures should be implemented.

There are no modification recommendations for this component.

The following Quality inspections should be performed to assure component quality:

- Perform a dimensional check of the bearing shells to verify thickness is within TDI specifications.
- Perform a visual or liquid penetrant inspection of the main bearing shells for signs of scoring, galling or cracking. Minimum sample to be the #5 main bearing shell.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-310B-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kevin T. Letpatrick

PROGRAM MANAGER

JC Kammerer

UNIT 1

02-310B - Main Bearings

Acceptability of the main bearings is documented in the following
Sequence Control Charts (SCC):

<u>SCC No.</u>	<u>Accession No.</u>
1RT-M150	B44 850918 866
1RT-M144	B44 850918 813
1RT-M231	B44 850918 874
1RT-M206	B44 850918 855

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Crankshaft & Bearings:	
COMPONENT <u>Thrust Bearing Ring</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO. <u>02-310C</u>	TASK DESCRIPTION NO: <u>DR-13-02-310C-0</u>
SNPS GPL NO. <u>03-310C</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the Comanche Peak and Shoreham DR/QR reports, which establish the acceptability of the thrust bearing ring assembly for its intended purpose.
- The applicable engine dimensions and operating parameters at Bellefonte are identical or very similar to those for the same component at Comanche Peak (lead engine).
- A review of the EDG Component Tracking System indicated that there was no site experience and no significant applicable nuclear or non-nuclear industry experience.

Maintenance recommendations based on the Comanche Peak DR/QR report to ensure proper performance under normal operating conditions are as follows:

- Measure thrust bearing ring clearance via "bump check" method to be performed in conjunction with crankshaft web deflection measurements at every outage. If the clearance is greater than the maximum allowed in the TDI Instruction Manual, then at least one bearing must be replaced. Bearings should also be replaced if they are cracked or gouged.
- Visually inspect thrust bearing ring for signs of cracks, gouges, wear or degradation at alternate outages.

There are no modification recommendations for this component.

Quality revalidation is not required for this component.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-310C-0

PRIMARY FUNCTION

Not required

ATTRIBUTES TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kenneth T. Litzsch

PROGRAM MANAGER

J. Kammerer

UNIT 1

02-310C - Crankshaft and Bearings: Thrust Bearing Ring

The inspection of the thrust bearing rings was accomplished during the inspections of the crankshaft and the main bearings. The inspection results for these components show the acceptability of the thrust bearing ring. See 02-310A and 02-310B.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Crankcase: Crankcase Assembly UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-311A TASK DESCRIPTION NO: DR-13-02-311A-1
SNPS GPL NO. 99-311A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review of this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience. There is no reported site experience in the EDG Component Tracking System for this component.

The crankcase at Bellefonte is the same part number as the one used at Comanche Peak (TDI P/N 02-311-03-AL), which is considered acceptable for its intended service. Additionally, the foundry records were reviewed and the material was found to be acceptable

The maintenance recommendation for this component is as follows:

- Perform a visual examination of the vertical crankcase arch wall and the crankcase-to-base nut pocket area. This inspection should be performed during each refueling outage. The first inspection which occurs after 185 hours, at or near full load, can be used to justify the discontinuation of future inspections.

There are no modification recommendations for this component.

The following Quality inspection should be performed on all station engines:

- Perform a visual examination of the vertical crankcase arch wall and crankcase-to-base nut pocket area for machined surfaces with sharp corners. Crankcase vertical arch wall should be as-cast surface. Nut pocket shall be free of cracks.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-311A-1

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

GROUP CHAIRPERSON K.T. Fitzpatrick

PROGRAM MANAGER X Kammer

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Crankcase - Crankcase <u>Assembly</u>	UTILITY	Tennessee Valley Authority Bellefonte Nuclear Plant <u>- Unit 1</u>
GPL NO.	<u>02-311A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>99-311A</u>		

TASK DESCRIPTIONS

Engine A

1. Assemble and review existing documentation.
2. Perform a visual inspection on the vertical portion of the casting arch wall of the crankcase for machined surfaces with sharp corners in the surface configuration. See attached sketch.
3. Verify the material of the crankcase based on foundry records.

Engine B

Same as Engine A

ATTRIBUTES TO BE VERIFIED

Engine A

1. Quality status of Component Document Package
2. No machined surface or sharp corner exists on the casting arch wall of the crankcase.
3. Proper crankcase material composition and strength

Engine B

Same as Engine A

ACCEPTANCE CRITERIA

Engine A

1. Satisfactory Document Package
2. Surface of the crankcase is smooth. Any indications of sharp corners is to be reviewed by the Design Group.
3. Review of the submitted foundry records by the Design Group.

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Approved Site NDE Procedures
3. Foundry records

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

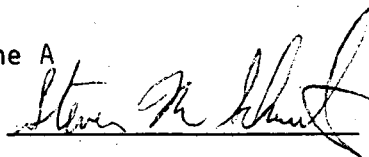
Engine A

1. Document Summary Sheet
2. Inspection Report
3. Foundry records

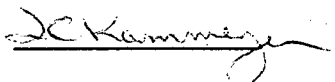
Engine B

Same as Engine A

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
2. No inspection report has been received which fulfills this requirements.
3. Crankcase foundry records were transmitted by TER# 13-002.

Engine B

Same as Engine A

RESULTS AND CONCLUSION

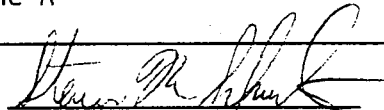
Engine A

The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

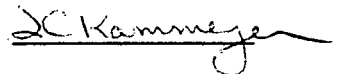
Engine B

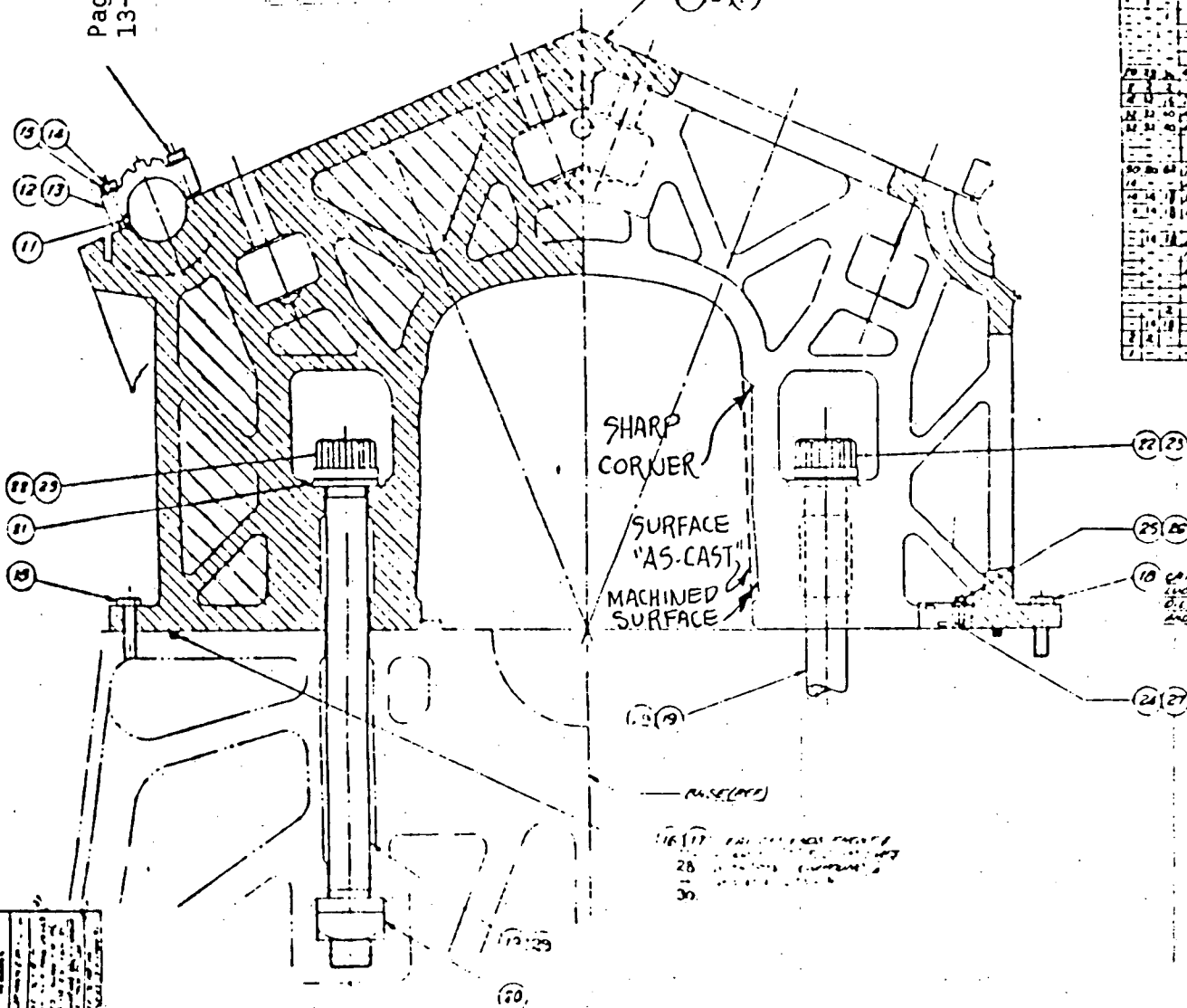
Same as Engine A

GROUP CHAIRPERSON



PROGRAM MANAGER



[illegible]

Case	2000-2001	2002
1-0	10 000	10 11 1000
1-01	10 000	10 11 1000
1-02	10 000	10 11 1000
1-03	10 000	10 11 1000
1-04	10 000	10 11 1000
1-05	10 000	10 11 1000
1-06	10 000	10 11 1000
1-07	10 000	10 11 1000
1-08	10 000	10 11 1000
1-09	10 000	10 11 1000
1-10	10 000	10 11 1000
1-11	10 000	10 11 1000
1-12	10 000	10 11 1000
1-13	10 000	10 11 1000
1-14	10 000	10 11 1000
1-15	10 000	10 11 1000
1-16	10 000	10 11 1000
1-17	10 000	10 11 1000
1-18	10 000	10 11 1000
1-19	10 000	10 11 1000
1-20	10 000	10 11 1000
1-21	10 000	10 11 1000
1-22	10 000	10 11 1000
1-23	10 000	10 11 1000
1-24	10 000	10 11 1000
1-25	10 000	10 11 1000
1-26	10 000	10 11 1000
1-27	10 000	10 11 1000
1-28	10 000	10 11 1000
1-29	10 000	10 11 1000
1-30	10 000	10 11 1000
1-31	10 000	10 11 1000
1-32	10 000	10 11 1000
1-33	10 000	10 11 1000
1-34	10 000	10 11 1000
1-35	10 000	10 11 1000
1-36	10 000	10 11 1000
1-37	10 000	10 11 1000
1-38	10 000	10 11 1000
1-39	10 000	10 11 1000
1-40	10 000	10 11 1000
1-41	10 000	10 11 1000
1-42	10 000	10 11 1000
1-43	10 000	10 11 1000
1-44	10 000	10 11 1000
1-45	10 000	10 11 1000
1-46	10 000	10 11 1000
1-47	10 000	10 11 1000
1-48	10 000	10 11 1000
1-49	10 000	10 11 1000
1-50	10 000	10 11 1000
1-51	10 000	10 11 1000
1-52	10 000	10 11 1000
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1-76	10 000	10 11 1000
1-77	10 000	10 11 1000
1-78	10 000	10 11 1000
1-79	10 000	10 11 1000
1-80	10 000	10 11 1000
1-81	10 000	10 11 1000
1-82	10 000	10 11 1000
1-83	10 000	10 11 1000
1-84	10 000	10 11 1000
1-85	10 000	10 11 1000
1-86	10 000	10 11 1000
1-87	10 000	10 11 1000
1-88	10 000	10 11 1000
1-89	10 000	10 11 1000

CRANKCASE ASSEMBLY

C2-311-03

UNIT 1

02-311A - Crankcase Assembly

Acceptability of the crankcase assembly is documented in the following
Sequence Control Charts (SCC):

SCC No.

Accession No.

1RT-M278
1RT-M277

B44 850918 853
B44 850918 835

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1COMPONENT Crankcase: Crankcase
Mounting HardwareUTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. 02-311DTASK DESCRIPTION NO. DR-13-02-311D-0SNPS GPL NO. 99-311CCLASSIFICATION TYPE ATASK DESCRIPTIONS

Design review is not required for this component based on review of the Comanche Peak DR/QR report (the crankcase mounting hardware used at Bellefonte is identical to that used at Comanche Peak) and the fact that there is no applicable site or industry experience in the EDG Component Tracking System.

There are no maintenance or modification recommendations for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Lutz PROGRAM MANAGER JC Kammerer

BF3657/1

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Crankcase:
Crankcase Gaskets
COMPONENT and Mounting Hardware UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-386B TASK DESCRIPTION NO. DR-13-02-386B-0
SNPS GPL NO. 99-386B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable site and industry experience.

A review of site and industry experience indicates that there have been some instances of bolting failures caused by undertorquing, which resulted in fatigue failures, or overtorquing, which resulted in shear failures. These failures are not attributed to design deficiencies of this component. The recommended torque values are appropriate, and the specified bolting and stud materials (SAE GR 5 and SAE GR 1120, respectively) are acceptable for their intended function of holding the covers onto the crankcase. Isolated failures can occur when the torque is not applied properly or a lesser grade material is substituted. Barring any deviations as mentioned above, the bolting is acceptable for use on the diesel engines.

There are no modification or maintenance recommendations for this component.

The following Quality inspection should be performed on all engines:

- Review the existing documentation or physically verify that the bolt torques are in accordance with the TDI manual.
 - Verify that no cracking exists, at the bolt holes of covers.
-

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-386B-0

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Fitzpatrick

PROGRAM MANAGER JC Kammerer

UNIT 1

02-386B - Crankcase Gaskets and Mounting Hardware

The inspections required are documented in the Sequence Control Charts used for the crankshaft inspection. See 02-310A.

TDI OWNERS GROUP
for
BELLEFONTE NUCLEAR PLANT - UNIT 1
CYLINDER BLOCK
COMPONENT PART NO. 02-315A

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the Bellefonte Nuclear Plant requires Design and Quality Revalidation reviews of the cylinder blocks to determine the adequacy of design for the intended use at Bellefonte. The blocks are manufactured by TDI and are supplied under their part number 02-315-03-AE. The cylinder block forms the framework of the liquid cooled engine and provides passage for coolant and support for the cylinder liners and cylinder heads.

II OBJECTIVE

The objective of this review was to evaluate the structural adequacy of the cylinder block for its intended use at Bellefonte.

III METHODOLOGY

In order to meet the stated objective, the following methods were used:

- Review of Bellefonte site, nuclear and non-nuclear experience (see Appendix C).
- Review of engine operating conditions at Bellefonte and identification of any differences from those at Comanche Peak.
- Performance of dimensional check and evaluation of cylinder liner/block interaction.
- Evaluation of steady state stresses, alternating stresses and stiffness in key portions of the cylinder block.
- Evaluation of crack growth rate for cylinder block landing and counterbore diameter by comparison with conservative Shoreham data and analysis.
- Review of liquid penetrant inspections of Bellefonte DSRV-16-4 A and B engine blocks.
- Review of metallurgical/microstructural analysis of cylinder block top material.
- Review of Quality Revalidation Checklist results for acceptability.

IV RESULTS AND CONCLUSIONS

A generic investigation of the structural adequacy of the TDI R-4 and RV-4 series diesel engine cylinder blocks for emergency standby service in nuclear power plants is summarized in Reference 1. The investigation considers the cause, extent, and consequences of cylinder block cracking, and the inspections required to assure sufficient margin of safety during continued operation under test and postulated accident conditions.

Evaluation of steady state stresses, alternating stresses and stiffness in key portions of the cylinder block was accomplished as part of the Shoreham strain gauge testing and the results were included in the cumulative damage and crack growth analyses. The cumulative damage algorithm is explained in Reference 1.

Diesel generators A and B have had limited operational experience. Engine hours accumulated to date consist of test hours performed by TDI at the factory.

The engine operating conditions at Bellefonte were compared to those at Comanche Peak and Shoreham. No significant differences were found that would affect the structural integrity assessment of the Bellefonte blocks.

Before placing Engines A and B in emergency standby service it is recommended that material microstructure evaluation for each cylinder block be performed. Without satisfactory material verification, there is no analytical basis for continued operation. It is also recommended that liner bore and mating block dimensions be checked in order to evaluate the interaction of the block and liner. These results are utilized in applying the cumulative damage methodology outlined in Figure 5-1 of Reference 1. For the purpose of analyzing the steady and alternating stresses present, the cylinder block material is assumed to be characteristic of typical Class 40 grey cast iron and liner/block bore interaction is assumed similar to that present at Shoreham. These assumptions must be verified prior to placing Engines A and B in emergency standby service.

The power output for this engine is 7000 kW at 100 percent load. Maximum output required for LOOP/LOCA is 7043 kW (Ref. 3). The duration of a LOOP/LOCA used in this analysis is 168 hours.

Strain gauge testing of the original Shoreham EDG 103 block, inspection data from before and after testing, and materials testing were used as a basis to predict adequate life for cylinder blocks. The apparent rate of propagation of cracks between stud holes in the original Shoreham EDG 103 block, when compared with the assumed Bellefonte LOOP/LOCA requirements, indicates that even if the Bellefonte blocks had ligament cracks they are predicted to withstand with sufficient margin a LOOP/LOCA event provided that block material is shown to be characteristic of typical Class 40 grey cast iron.

To date no inspection results for Engine A and B block tops have been reported. It is recommended that, prior to placing the engines in emergency standby service, the visual and NDE examinations consistent with those identified in Appendix B be performed on Engines A and B to determine whether or not block top cracks are present.

Application of the cumulative damage algorithm (Figure 5-1 of Reference 1) (with material evaluation completed and the block material shown to be characteristic of typical Class 40 grey cast iron, and satisfactory liner/block bore dimensions) shows that engine operation without inspection for 424 hours at 100 percent power level (or operation resulting in equivalent cumulative damage) would be possible with sufficient margin remaining for a LOOP/LOCA event (Reference 2).

Engine operation in excess of the above listed time periods without inspection could be justified if the fatigue damage index since the last inspection has not exceeded the allowable fatigue damage index before the last inspection. In the future, after additional engine operation without inspection has been accumulated, additional engine operation may be performed after removal of the cylinder heads and inspection of the block top for detectable ligament, stud-to-stud or stud-to-end cracks. If none are found then additional engine operation without inspection may be performed until the future fatigue damage index equals the allowable fatigue damage index accrued to the last inspection. This process may be repeated indefinitely throughout the life of the engine.

Optionally, in the future, after additional engine operation without inspection has been accumulated and the fatigue damage index for future operations exceeds the allowable fatigue damage index, continued engine operation without removal of cylinder heads and inspection of the block top will allow sufficient margin to withstand a LOOP/LOCA event provided periodic eddy current inspections are performed. The periodic eddy current inspections are described in Figure 5-1 of Reference 1.

There are no TERs associated with this component.

Results of Quality Revalidation Inspections performed to date have been reviewed and considered in the performance of this design review, and the results are consistent with the final conclusions of this report.

Based on the above review, subsequent completion and review of block top inspections, block material evaluations, and cylinder liner/block bore dimensional check as identified in Appendix B for Engines A and B, and implementation of routine inspections, it is concluded that the cylinder blocks are acceptable for their intended use at Bellefonte.

V. REFERENCES

1. Design Review of TDI-R4 Series Emergency Diesel Generator Cylinder Blocks and Liners. FaAA-84-9-11.
2. FaAA Support Package Number SP-84-9-11(1).
3. Letter from C.A. Chandley (Tennessee Valley Authority) to C.L. Ray (TDI Diesel Generator Owners Group) 11-20-84.

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Cylinder Block-Liners
and Water Manifold:
COMPONENT Cylinder Block UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-315A TASK DESCRIPTION NO. DR-13-02-315A-0
SNPS GPL NO. 03-315A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Review liquid penetrant inspections of Bellefonte DSRV-16-4 engine block tops and review engine operating experience.

Review engine operating conditions of Bellefonte and identify any differences from those at Comanche Peak.

Perform dimensional check on cylinder block and cylinder liners and evaluate liner/block interaction.

Evaluate steady state stresses, alternating stresses and stiffness in key portions of the cylinder block.

Evaluate crack growth rate for cylinder block landing and counterbore diameter by comparison with conservative Shoreham data and analysis.

Review metallurgical/microstructural analysis of cylinder block top material.

Review of Bellefonte site, nuclear and non-nuclear experiences (see Appendix C).

Review of Quality Revalidation Checklist results for acceptability.

Review information provided on TERs.

PRIMARY FUNCTION

To provide framework for engine components and to provide cooling water passages.

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-13-02-315A-0

ATTRIBUTE TO BE VERIFIED

That components have sufficient strength and stiffness to react major loads.

SPECIFIED STANDARDS

None.

REFERENCES

None.

DOCUMENTATION REQUIRED

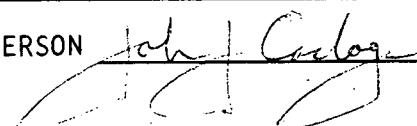
Manufacturer's drawings for DSR-48 and RV blocks, liners and studs, including all specifications for material, torques, valve train loads and gas cycles.

Engine operating history (time vs. load) for operation prior to block top inspection, and for total engine hours.

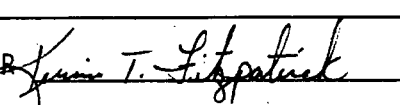
Anticipated engine operating profile (time vs. load) for fuel cycle, including pre-operational, qualification, and surveillance testing.

Engine factory test logs that report firing pressures and exhaust temperatures for each cylinder.

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Cylinder Block</u>	UTILITY	<u>Tennessee Valley Authority Bellefonte Nuclear Plant - Unit 1</u>
GPL NO.	<u>02-315A</u>	REV. NO.	<u>3</u>
SNPS GPL NO.	<u>03-315A</u>		

TASK DESCRIPTIONSEngine A

1. Assemble and review existing documentation.
2. Perform a dimensional check on the area around the cylinder liner for all cylinder block liner landings.
3. Perform a Liquid Penetrant or Magnetic Particle test on the cylinder block liner landing along the top landing surface, fillet radius, and vertical face adjacent to the landing surface. Four liner landings (3L, 4L, 5L, 6L, 3R, 4R, 5R, and 6R) should be inspected with the liners removed. If linear indications are found, increase inspection plan to all liner landings.
4. Perform a Liquid Penetrant or Magnetic Particle test on the cylinder head mating surface on top of the cylinder block. The area between stud hole and liner, and between adjacent cylinder stud hole should be inspected. The inspection plan should include cylinders 3L, 4L, 5L, 6L, 3R, 4R, 5R and 6R. If linear indications are found, increase inspection plan to all cylinders.
5. Perform an Eddy Current test on the cylinder head stud holes if required (i.e., linear indications found at stud hole extending into threads).
6. Remove a sample from each cylinder block by drilling and cutting. The sample shall be tetrahedral in shape with a one inch square base and a height of 5/8 inch. Attachment B shows the location where the sample should be taken.

Engine BSame as Engine A

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 8
13-02-315A

ATTRIBUTES TO BE VERIFIED

Engine A

1. Quality status of Component Document Package
2. Dimensions of the cylinder block liner landing area
- 3-5. Surface integrity of the cylinder block liner landing
6. Samples taken from the cylinder block are in accordance with TER# 99-016.

Engine B

Same as Engine A

ACCEPTANCE CRITERIA

Engine A

1. Satisfactory Document Package
2. See attachments C, D and E. Liner dimensions must be in accordance with any one of these drawings.
- 3-4. See Attachment A
- 5-6. Review of inspection report by the Design Group

Engine B

Same as Engine A

REFERENCES

Engine A

1. QCI No. 52
2. Approved Site NDE Procedures, TER# 99-050
- 3-4. TER#s 99-004, 99-018, 99-036
5. FaAA Procedure NDE 11.8
6. TER# 99-016, 99-031

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 8
13-02-315A

REFERENCES (continued)

Engine B

Same as Engine A

DOCUMENTATION REQUIRED

Engine A

1. Document Summary Sheet
- 2-6. Inspection Report

Engine B

Same as Engine A
GROUP CHAIRPERSON

PROGRAM MANAGER

COMPONENT REVIEW

Engine A

1. No EDGCTS site experience documents are in evidence.
- 2-6. No inspection reports have been received which fulfill these requirements.

Engine B

Same as Engine A.

RESULTS AND CONCLUSION

Engine A

The Quality Revalidation effort with respect to this component, as outlined above is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine B

Same as Engine A

GROUP CHAIRPERSON

PROGRAM MANAGER

ACCEPTANCE CRITERIA

A. Area to be inspected

1. Top of Block
2. Liner counterbore

B. Reference Standard ASTM E125

C. Evaluation of indications

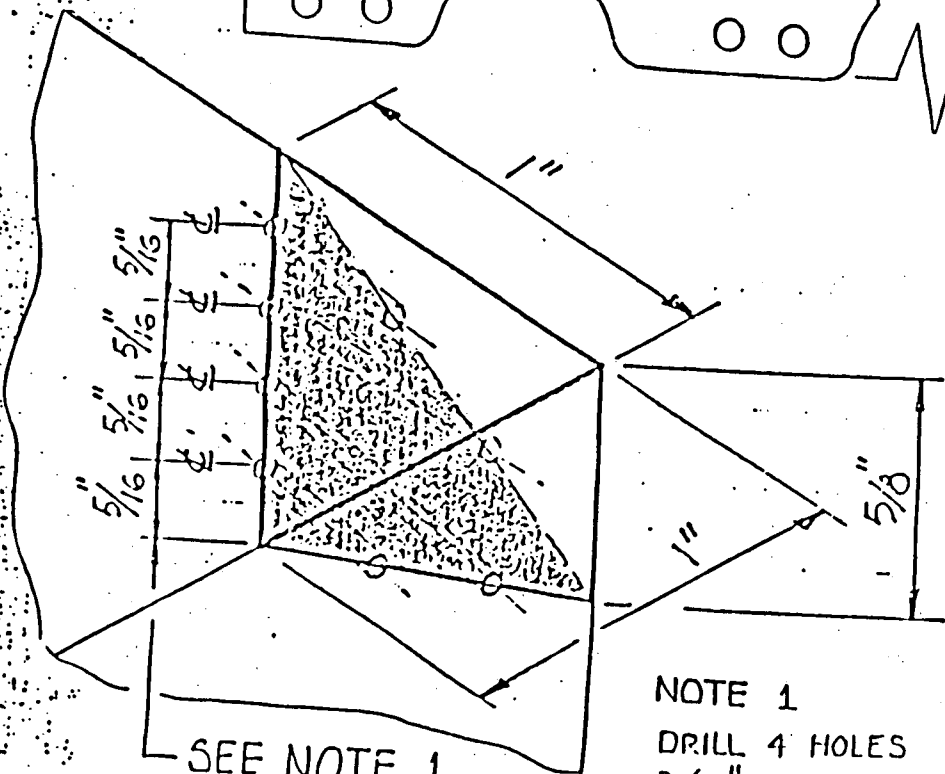
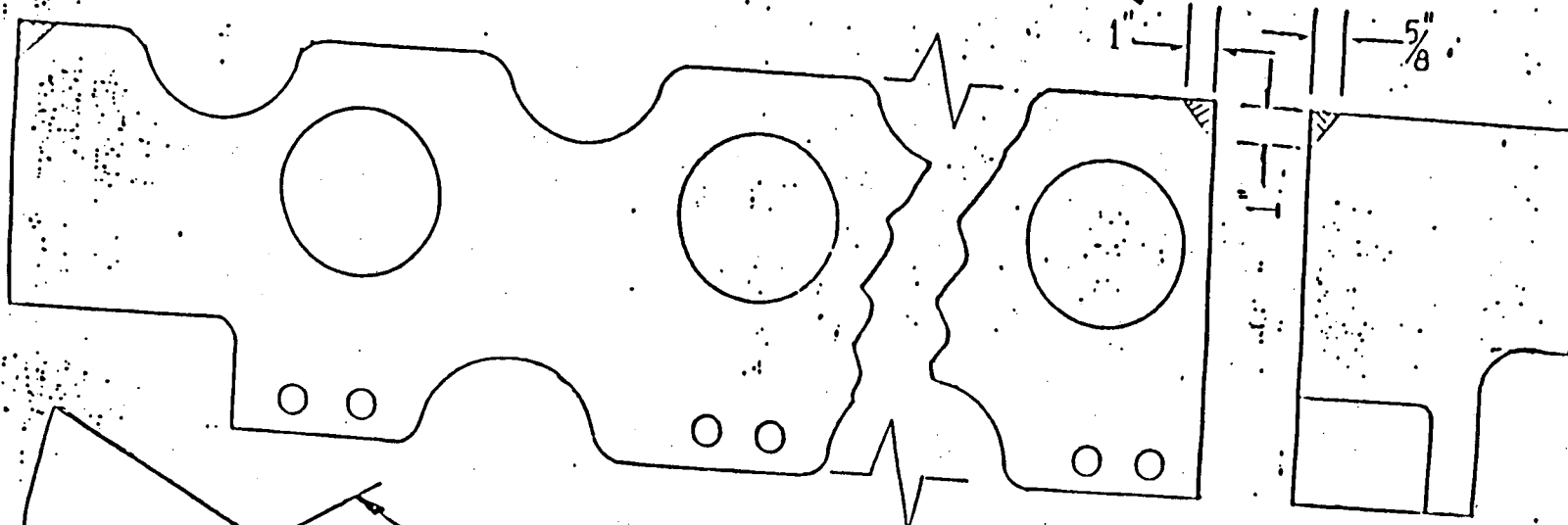
1. Relevant indications are:
 - a. Hot tears and cracks, linear indications that exceed ASTM E125 Class I-2
 - b. Shrink that exceeds ASTM E125 Class II-3
 - c. Inclusions that exceed ASTM E125 Class III-3
 - d. Porosity that exceeds ASTM E125 Class V-1
2. All indications exceeding the specification listed above shall be documented and submitted to the Design Group.
3. Indications that do not exceed the ASTM E125 reference regardless of size and quantity are acceptable.

D. Non-Relevant Indication

1. The indications referenced below shall be considered non-relevant.
 - a. Magnetic writing
 - b. Linear grain boundaries (carbon, ferrite, or graphite induced)
 - c. Rounded grain boundaries (carbon, ferrite, or graphite induced)

TYP. EITHER END

SEE ISOMETRIC DETAIL A-A



NOTE 1

DRILL 4 HOLES
3/32" DIA. 45°

CUT OUT PIECE

SEE NOTE 1

ISOMETRIC DETAIL A-A
(DARKENED AREA INDICATES

Attachment B

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B5 of 8
13-02-315A

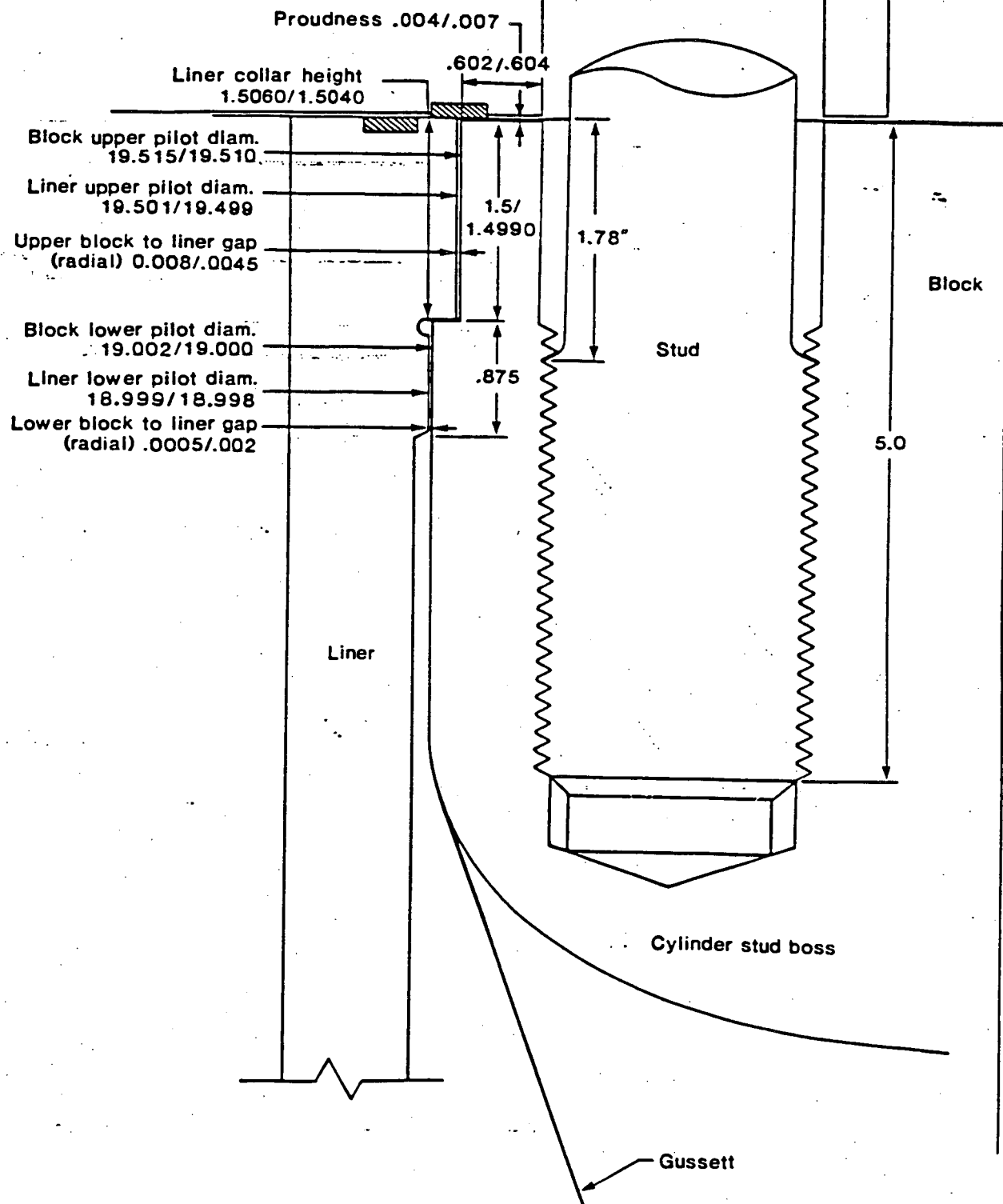


Figure 1-6. Block and liner interface (7/31/68 TDI dimensions).
Typical for SNPS EDG101/102 and original EDG103.

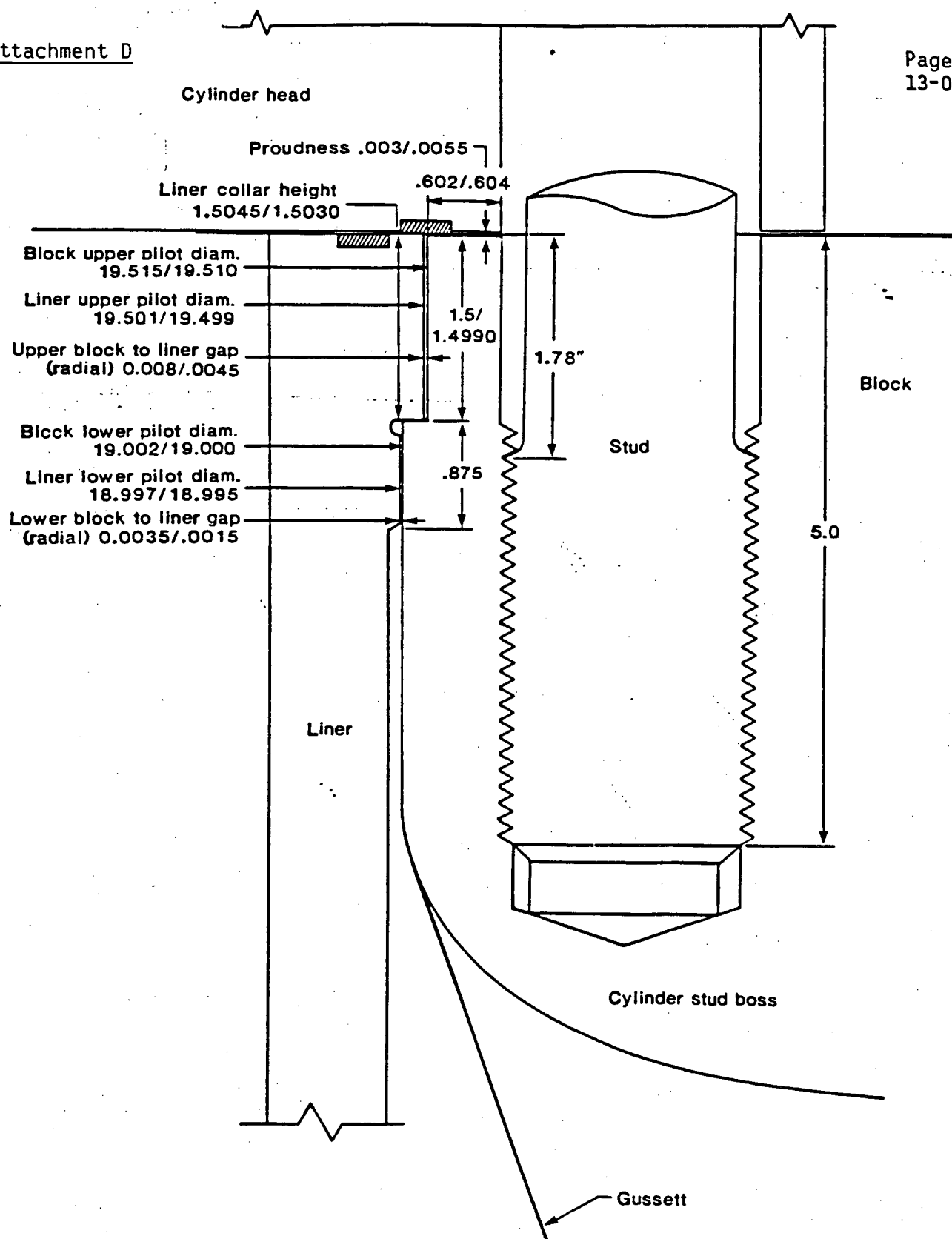


Figure 1-7. Block and liner interface (1/19/78 TDI dimensions).

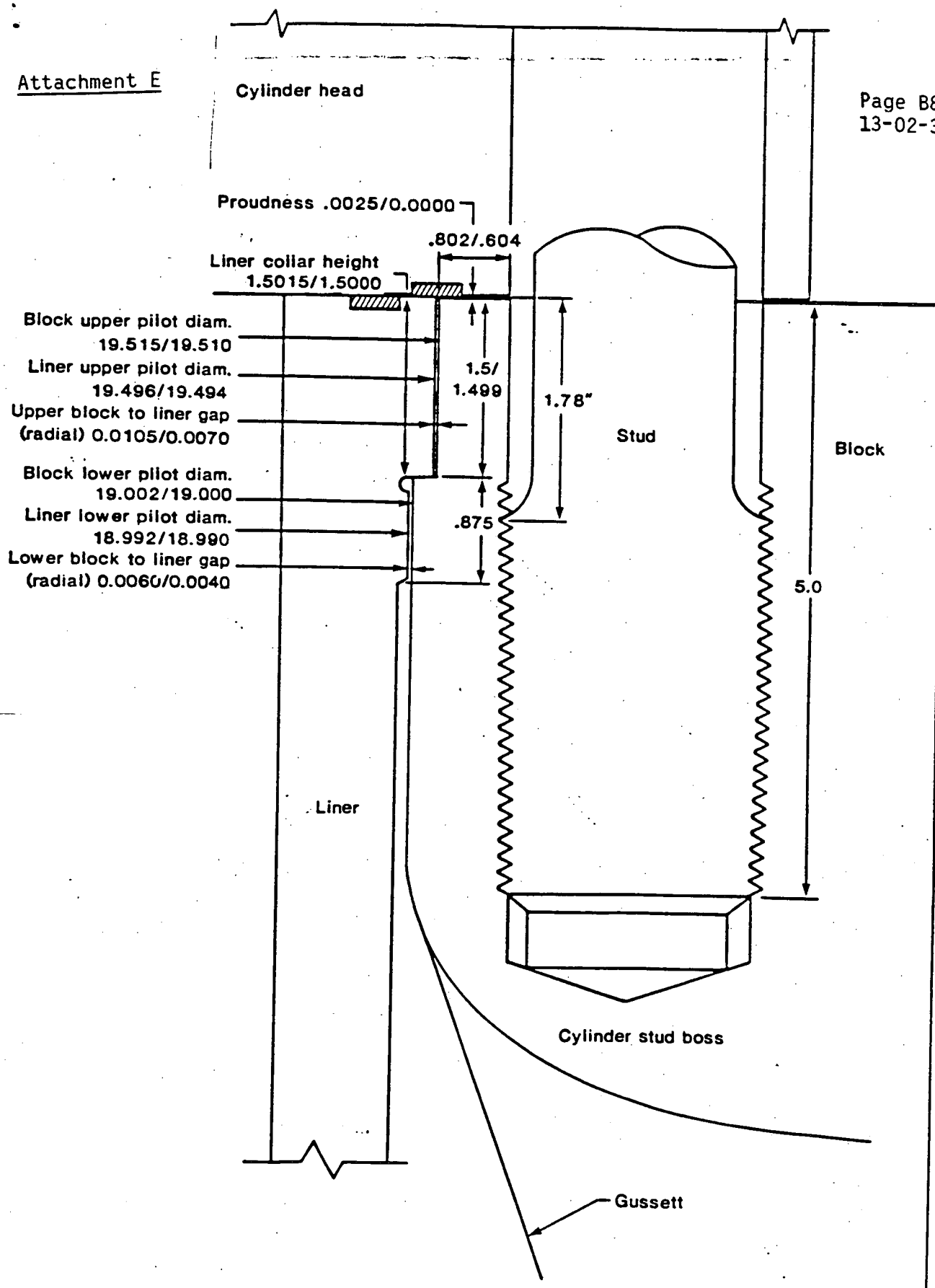


Figure 1-8. Block and liner interface (10/24/83 TDI dimensions).

EDG COMPONENT TRACKING SYSTEM: BELLEFONTE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-315A

Effective Printout Date: 11/13/84

COMPONENT TYPE: Cylinder Block

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
<u>BELLEFONTE</u>		
None		
<u>NUCLEAR</u>		
Cylinder block repair because of corrosion.	SIM 247	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Gasket groove of 7R cylinder was cracked.	Service Report TPC Nuclear Plant No. 3 Maanshan Dec. 9, 1983 (File No. T-45)	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
<u>NON-NUCLEAR</u>		
The forward outboard cylinder block of the starboard main engine of the vessel cracked from entry of water from the cooling system into the air intake system of the engine.	Letter 4/21/83 J. Blain to W. Busch; Complaint C.A. No. H-83-2420 filed U.S. District Ct. 52, p.4.; U.S. Salv. Assoc. Rpt. 52-15573, 7/1/82; Amer. Bur. Ship. Rpt. HA-81-2539, 12/16/81; Salv. Assoc. Rpt. CH0830, 4/1/82.	No impact on Bellefonte. Reference intercooler report.
Block cylinder bores were found egg shaped.	Hunton & Williams to C. Seaman 12/29/83; Memo M. Zbinden to R. Ward 1/16/81.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE STATUS

Extensive cracking of cylinder block.

Hunton & Williams to C. Seaman 12/29/83; Memo M. Zbinden to R. Ward 3/13/81.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Final cam tappet could not be placed into position because of deficient cylinder block.

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to File 4/29/81.

No impact on Bellefonte. Isolated initial assembly problem.

Cylinder blocks ordered because previous ones fretted, distorted, and cracked. Head stud holes not machined properly per TDI's spec.

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to File 4/9/81; M. Zbinden to R. Ward 3/13/81.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

TDI blocks on malaspiner class vessels are structurally stronger although rated less than half of Columbia's HP.

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to R. Lind 6/17/81.

No impact on Bellefonte.

Allegations made that cylinder block has experienced creep and cylinder block is heated in the center during operation and room temperature at the ends.

Hunton & Williams to C. Seaman 12/29/83; G. Trussell to D. Thompson 10/27/81.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Engine derating will lessen thermal stresses of cylinder block.

SES 123-01, 4/83 pp. 4-6, 4-7

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Observed deformation of cylinder liner block. Counterbore lip of cylinder block observed to have circumferential cracking.

SES 123-01, 4/83, pp. 3-14, 3-28, 6-3.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>VOGTLE STATUS</u>
Reformation of counterbore lip of cylinder liner block caused by metallic fatigue.	Engine Rebuild Report for Alaska 3/31/81, pp. I, I-10.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Block deformation because of cracks, metallic fatigue creep, overload of counterbore lip, close proximity of cooling water holes, close proximity of head retaining studs, and thread termination for studs level with counterbore depth is causing high stress concentration area.	Engine Rebuild Report for Alaska 3/31/81, pp. I-9, V, V-10, VI, VIII and Summary pp. 26, 27.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Engine crankshaft out of alignment; possibly from engine block misalignment.	Engine Rebuild Report for Alaska 3/31/81, pp. V-10, V-12, VI.	Reference crankshaft report on Bellefonte. No impact on Bellefonte.
Reported cracks between heads and liner bores.	Memo from E. Sigrist (TDI) to G.E. Trussell (TDI) dated 11/8/82 (File No. T-10) City of Homestead, Fla.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Reported cracks between the head stud holes and liner bores.	Letter from R. Pratt (TDI) to John Smith, (City of Homestead, Fla.) dated 6/17/82 (File No. T-2) City of Homestead, Fla.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Engine block cracked from improper placing and tightening of head gaskets (April 1979).	Memo from E. Sigrist (TDI) to G.E. Trussell (TDI) dated 11/8/82 (File No. T-10) City of Homestead, Fla.	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE STATUS

Several cracks were discovered running from the cylinder cover bolt holes into liner. Cause of cracks not determined.

Letter from R.C. Grindeland (BIEHL) to C. Mathews (TDI) 3/16/81 (File No. T-14)

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Distortion in upper deck and small cracks in cylinder block. New blocks have heavier external walls and interior bulkheads.

Report by George G. Sharp, Inc. "Overview of Reports, Analysis and Recommendations Re-Propulsion Engines M/V Columbia," July 26, 1983.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Cylinder block fractures caused by the combination of diametral and vertical thermal expansion of the liner, cyclic stress from combustion pressure, both radially from the liner and vertically through the head studs, and torque down stress of the studs themselves. Recommendations, cylinder head, studs machined to remove stud load stress, cracks repaired by Metalok technique and diameter of the upper liner collar reduced by 0.005 inches.

Letter from M. Lowrey (TDI) to H. Blanding (American Bureau of Shipping) dated 12/30/83 (File No. T-30). Letter from M. Lowrey (TDI) to H. Taylor (American Bureau of Shipping) dated 10/28/83 (File No. T-30). Minutes of meeting between TDI and USS-GLF on 12/20, 21, 1983 (File No. T-30). Letter from R. Bertz (USS-GLF) to A. Barich (TDI) dated 4/7/83 (File No. T-30). Letter from R. Bertz (USS-GLF) to M. Lowrey (TDI) dated 7/14/83 (File No. T-30). Minutes of meeting between TDI and the USS-GLF dated 6/17/83 (File No. T-30).

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>BELLEFONTE STATUS</u>
Cracks in the engine block at a point between the cylinder head hold-down studs and the cylinder liner bore. These cracks were repaired in Unit 18, but the same type of block cracks have reappeared in both Units 18 and 19 at several stud locations on each.	Letter from A. Muxo (City of Homestead) to C.S. Mathews and R.J. Bazzini (TDI) dated 5/31/82 (File No. T-10). Letter from A. Muxo (City of Homestead) to C.S. Mathews dated 12/13/82 (File No. T-10). Letter from J.A. Smith (City of Homestead) to G.E. Trussell (TDI) 06/14/77 (File No. T-10). Comments by City of Homestead, Fla., on the observations of R.A. Pratt and G.E. Trussell tested in the Transamerica Delaval Survey Report, 8/10/82 (File T-10).	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.
Cylinder block cracking.	Minutes of meeting between USS Great Lakes Fleet Service Inc. and TDI dated 4/13/83 (File No. T-46). Telex from G. Trussell (TDI) to R. Bertz (USS-GLF) dated 4/8/83 (File No. T-46). Letter from R. Bertz (USS-GLF) to A. Barich (TDI) dated 4/7/83 (File No. T-46). Agenda TDI and USS-GLF dated 4/14/83 (File No. T-46). American Bureau of Shipping Report by D.W. Johnson Report No. DL5702 dated 3/22/83. (File No. T-46).	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

EXPERIENCEREFERENCE
DOCUMENTSBELLEFONTE STATUS

Cracks in engine block.
Florida.

Letter 5/13/82 from
City of Homestead, Fla.,
to TDI (Oakland and
New York) Units 18
and 19 (File T-64).

Inspection of block tops
at intervals governed by
inspection results and
accumulated operation will
confirm block reliability
at Bellefonte.

Piston failed and hit
block causing crack.
Could drill stop each leg
of crack, then stitch up
holes with a few
supporting stitches along
length of crack.

TDI letter to Metalok
International 5/12/81
(File No. T-50), Greg
Beshouri (TDI), D.
Venning (Metalok Int.
Assn. Ltd). Enterprise
Oak (Geoff King) to
Beshouri 5/28/81-2 (File
T-50). Photocopy of
preliminary report on
crack on left cylinder
(4th) by G.K. Rao (Bhel).
Memo dated 5/11/81 Bob
Bailey (Riyadh) to G.
King (Oakland)
(File T-50).

Isolated incident. Not
a design related problem.
No impact on Bellefonte.

Cracked block on Unit
No. 19.

Letter from John A.
Smith (City of
Homestead) to G.E.
Trussell (TDI)
6/17/77 (File No. T-55).

Inspection of block tops
at intervals governed by
inspection results and
accumulated operation will
confirm block reliability
at Bellefonte.

Eng. S/N 79002 exploded.
Cylinder block damaged.
Attributed to multiple
head gaskets (2).

Rafha Electricity Co.
and Suburbs, Saudi Co.
Ltd., Saudi Arabia
dated 7/12/81. No
addressee or transmittal
letter available.
No. 3 gen. (File No.
T-57).

Fracture attributed to
installation of three
rather than 2 head
gaskets. No impact on
Bellefonte.

EXPERIENCEREFERENCE
DOCUMENTSVOGTLE
STATUS

Cylinder block 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 water jacket or stud. Termination of stud threading at the same level, creep deformation, and fatigue. (M/V Columbia)

Engine Rebuild Report State of Alaska dated 03/31/81
Pg. iv.

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

Cylinder block repaired by Metalok.

Telex 5-28-81 G. King (TDI) to Desrumeaux/Wilder/Beshouri-Jizan 77036 TDI (File No. T-50)

Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at Bellefonte.

UNIT 1

02-315A - Cylinder Block

Acceptability of the cylinder block is documented in the following
Sequence Control Charts (SCC):

SCC No.

1RT-M180
1RT-M207
1RT-M142

Accession No.

B44 850918 820
B44 850904 819
B44 850904 808

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1Cylinder Block Liners &
Water Manifold - Cylinder
COMPONENT LinerUTILITY Tennessee Valley AuthorityGROUP PARTS LIST NO. 02-315CTASK DESCRIPTION NO. DR-13-02-315C-0SNPS GPL NO. 03-315CCLASSIFICATION TYPE ATASK DESCRIPTIONS

Design review is not required for this component based on review of the lead engine DR/QR reports (Shoreham/Comanche Peak) and the reported applicable industry experience. There is no site experience in the EDG Component Tracking System.

There are no modification recommendations for this component, however, the following is recommended as a maintenance item:

- Inspect the cylinder liners borescopically (visually if the cylinder head are off) at every refueling outage for signs of progressive wear.

At the present time, there are no inspection results for this component. The following Quality inspections as delineated in the CQRC are recommended:

- Verify liner dimensions including bore, length, height, O.D. and shoulder height for all cylinder liners.
- Visually inspect the outside pilot diameter where it contacts the cylinder block on all cylinders.
- Visually inspect all cylinder liners over the zone of piston travel.
- Determine the material of a spare liner.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page -2 of 2
DR-13-02-315C-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kevin T. Lefterich

PROGRAM MANAGER

DC Kammeyer

UNIT 1

02-315C - Cylinder Block Liners

Acceptability of the cylinder block liners is documented in the following Sequence Control Charts (SCC):

<u>SCC No.</u>	<u>Accession No.</u>
1RT-M163	B44 850904 810
1RT-M188	B44 850904 744
1RT-M204	B44 850904 806
1RT-M175	B44 850918 851
1RT-M139	B44 850904 746
1RT-M203	B44 850904 780
1RT-M166	B44 850904 814
1RT-M276	B44 850904 754
1RT-M300	B44 850904 737
1RT-M299	B44 850904 736

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT Jacket Water Manifold Piping
(Large Bore Scope Only) UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-315D TASK DESCRIPTION NO. DR-13-02-315D-0
SNPS GPL NO. 03-315D CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the EDG Component Tracking System indicated that there was no significant applicable industry or site experience.
- A review of the lead engine DR/QR reports (Shoreham/Comanche Peak).
- A comparison of the jacket water manifold piping for Bellefonte with Comanche Peak.

There are no maintenance or modification recommendations for this component.

Quality revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-315D-0

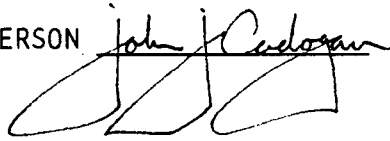
REFERENCES

Not required

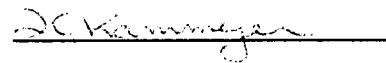
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT	<u>Cylinder Block Liners & Water Manifold: Studs</u>	UTILITY	<u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO.	<u>02-315E</u>	TASK DESCRIPTION NO.	<u>DR-13-02-315E-0</u>
SNPS GPL NO.	<u>03-315E</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review of this component is not required based on the review of the lead engine DR/QR report (Comanche Peak) and the applicable industry experience. There is no site experience for this component in the EDG Component Tracking System.

There are no maintenance recommendations for this component; however, the following change to the installation torque is recommended to lower the stresses in the cylinder block (Ref. 1):

- Lubricate the cylinder head stud blockside threads with engine oil.
- Torque the studs into the block to 80-120 ft-lbs. Use the necessary lockwashers (shims) to obtain a stud free length of $15'' \pm 1/16''$. (Caution: Do not use impact type tools to tighten the studs). The free length is measured from the block top to the end of the cylinder head stud. Care should be taken not to further tighten the headstuds during installation of the heads and torquing of the head stud nuts to 3600 ft-lbs.

The following Quality inspections should be performed regardless of the design that is implemented:

- Perform a visual inspection of the head studs for signs of distress (four heads; per engine)
 - Determine the material of four studs (material to be AISI 4140/4142) on one engine;
 - Determine the hardness of one stud (hardness to be 25-30 Rc) on one engine;
 - Verify that the studs are installed with a torque of 80-120 ft-lbs into the block per the above recommendations, all engines.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-315E-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

1. TDI Diesel Generator Owners Group letter (OGTP-296-0-156) cylinder head stud modification and revised installation procedure. File: MTS-4086 (Dated 9/24/84).
-

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Fitzpatrick PROGRAM MANAGER DC Hammer

UNIT 1

02-315E - Cylinder Block Studs

Acceptability of the cylinder block studs is documented in the following
Sequence Control Charts (SCC):

SCC No.

1RT-M140
1RT-M214

Accession No.

B44 850904 745
B44 850904 764

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Cylinder Block Liner &
Water Manifold -
COMPONENT Cylinder Head Nuts UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-315F TASK DESCRIPTION NO. DR-13-02-315F-0
SNPS GPL NO. 03-315F CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the following:

- A review of the Comanche Peak and Shoreham DR/QR reports which establish the acceptability of the cylinder head nuts for their intended purpose.
- A review of site, nuclear and non-nuclear industry experience in the EDG Component Tracking System indicates that there has been no design related failures associated with this component. The cylinder head nuts are identical on all the Owner's Group TDI Diesel Engines (TDI Part No. F-090-021).

The only adverse experience occurred at Shoreham and involved a cracked nut attributed to a forging lap during manufacturing, and did not impair engine operation.

There are no maintenance or modification recommendations for this component.

The following Quality revalidation inspections should be performed on both engines to ensure component quality:

- Visually examine all nuts for identification markings.
- Verify the proper installation and torquing of the nuts.
- Perform a visual inspection of the nuts for signs of forging laps.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-315F-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

Kevin T. Fitch

PROGRAM MANAGER

DC Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

Cylinder Block-Liners
and Water Manifold:
COMPONENT Seals and Gaskets UTILITY Tennessee Valley Authority
GROUP PARTS LIST NO. 02-315G TASK DESCRIPTION NO: DR-13-02-315G-0
SNPS GPL NO. 03-315G CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the applicable industry experience and the lead engine DR/QR reports (Shoreham/Comanche Peak). There is no reported site experience for this component in the EDG Component Tracking System.

A review of the applicable site documentation should be performed to verify that the proper cylinder liner seals (TDI P/N JF-019-000) have been installed in the diesel generators.

There are no maintenance or modification recommendations for this component.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

BF3660/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-315G-0

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Fitzpatrick PROGRAM MANAGER DC Kammerer

COMPONENT DESIGN REVIEW CHECKLIST
BELLEFONTE NUCLEAR PLANT - UNIT 1

COMPONENT <u>Cylinder Block</u> <u>Covers: Gaskets & Bolts</u>	UTILITY <u>Tennessee Valley Authority</u>
GROUP PARTS LIST NO <u>02-385B</u>	TASK DESCRIPTION NO. <u>DR-13-02-385B-0</u>
SNPS GPL NO. <u>03-385B</u>	CLASSIFICATION TYPE <u>C</u>

TASK DESCRIPTIONS

Design review for this component is not required based on a review of the lead engine DR/QR report (Comanche Peak) and the applicable site and industry experience.

There have been cases of fastener failures on the cylinder block covers, however these failures are not attributed to design deficiencies of this component. Based on the lead engine DR/QR report, the recommended torque value of 30 ft-lbs is appropriate and the specified bolting and stud materials (SAE GR 5 and SAE GR 1120, respectively) are acceptable for their intended function of holding the covers onto the cylinder block. Isolated failures can occur when the torque is not applied properly or a lesser grade material is substituted. Barring any deviations as mentioned above, the bolting is acceptable for use on the diesel engines.

There are no modification or maintenance recommendations for this component.

The following Quality inspections are recommended to be performed on one engine:

- Verify that the proper torque is applied and the specified material is installed. Plant personnel should review site documentation or perform the necessary inspection to make these determinations.
- Perform a visual inspection to verify that the gaskets are suitable for the environment.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-13-02-385B-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON Kevin T. Fitzpatrick

PROGRAM MANAGER J. Hamner

UNIT 1

02-385B - Cylinder Block Covers - Gaskets and Bolts

Acceptability of the cylinder block cover gaskets and bolting is documented in the following Sequence Control Charts (SCC):

SCC No.

1RT-M356

Accession No.

B44 850918 805

UNIT 1

02-315F - Cylinder Head Nuts

Acceptability of the cylinder head nuts is documented in the following
Sequence Control Charts (SCC):

SCC No.

1RT-M295
1RT-M296

Accession No.

B44 850918 838
B44 850904 783