

TDI DIESEL GENERATOR
DESIGN REVIEW
AND QUALITY REVALIDATION
REPORT


Prepared For

SOUTHERN CALIFORNIA EDISON
SAN ONOFRE NUCLEAR STATION - UNIT 1

By

TDI DIESEL GENERATOR OWNERS GROUP

Revision 2
April 1986



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

TDI
OWNERS GROUP

APPENDIX - II
GENERIC MAINTENANCE MATRIX

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 San Onofre 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.
MM19/20	Turbocharger	Turbo, Intake, Intrclr. & Exhaust	2
SE-014	Lube Oil Full Pressure Strainer	Lube Oil	2
S0-101	Fuel Oil Filters & Emergency Diesel Generator	Generator	4
S0-102	Generator - Generator Control	Generator	4
S0-103	Generator: Shaft and Bearings	Generator	4
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
00-621A	Fuel Oil Drip Tank Assembly	Fuel Oil Injection	4
00-621C	Fuel Oil Day Tank	Fuel Oil Injection	4
02-CFR	Turbocharger Thrust Bearing Drip Lube System	Turbo, Intake, Intrclr. & 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 - Tube & Fittings	Lube Oil	2
02-307D	Lube Oil Fittings Internal: Supports	Lube Oil	2

Index (continued)

Component Number	Component Description	Category	Volume No.
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 Liners & Water Manifold: 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	Water Manifold: 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
02-316B	Jacket Water Inlet Manifold: Coupling and Gaskets	Jacket Water	4

Index (continued)

Component Number	Component Description	Category	Volume No.
02-317A	Water Discharge Manifold: 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 Gear Case: Bolting	Idler Gear Assembly & Front Gear Case	3
02-340A	Connecting Rods: Connecting Rods & Bushings	Connecting Rods	3
02-340B	Connecting Rods: 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
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

Index (continued)

Component Number	Component Description	Category	Volume No.
02-355A	Idler Gear Assembly: Crank To Pump Gear	Idler Gear Assembly & Front Gear Case	3
02-355B	Idler Gear Assembly: Idler Gear Assembly	Idler Gear Assembly & Front Gear Case	3
02-359	Air Start Valve	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	Cylinder Heads & Valves	4
02-362A	Subcover	Camshaft & Valve Train	3
02-365A	Fuel Injection Pump	Fuel Oil Injection	4
02-365B	Fuel Injection Nozzle Assy.	Fuel Oil Injection	4
02-365C	Fuel Injection Equipment - Tube Assembly	Fuel Oil Injection	4
02-365D	Fuel Injection Equipment: Supports	Fuel Oil Injection	4
02-371A	Fuel Pump Control Shaft, Linkage Assembly & Bearings	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

Index (continued)

Component Number	Component Description	Category	Volume No.
02-380A	Exhaust Manifold - Piping	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
02-390F	Rocker Arms and Pushrods: Lifters	Camshaft & Valve Train	3
02-390G	Rocker Arms and Pushrods: Miscellaneous 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: Coupling (Flexible & Spider)	Overspeed Trip & Governor	3

Index (continued)

Component Number	Component Description	Category	Volume No.
02-410D	Vent Valve: Overspeed Trip	Overspeed Trip & Governor	3
02-411A	Governor Drive: Governor & Tachometer Drive Gear and Shaft	Overspeed Trip & Governor	3
02-411B	Governor Drive: Couplings, Pins & Keys	Overspeed Trip & Governor	3
02-413	Governor Linkage	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
02-420	Engine Driven Lube Oil Pump	Lube Oil	2
02-425A	Jacket Water Pump	Jacket Water	4
02-435A	Jacket Water Fittings: Pipe & Fittings	Jacket Water	4
02-437A	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, Strainer, Filters	Air Start & Barring Device	3
02-441C	Starting Air Manifold: Supports	Air Start & Barring Device	3
02-445	Engine Driven Fuel Oil Booster Pump	Fuel Oil In- jection	4
02-450B	Fuel Oil Header: Piping/Tubing	Fuel Oil In- jection	4

Index (continued)

Component Number	Component Description	Category	Volume No.
02-450D	Fuel Oil Header: Fuel Oil Tubing 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
02-467A	Generator Large Bore 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	Turbocharger - Bracket Air Butterfly Valve Assembly (With Actuator)	Turbo, Intake, Intrclr. & Exhaust	2
02-475C	Turbocharger Bracket - Air Intake Piping	Turbo, Intake, Intrclr. & Exhaust	2
02-475D	Turbocharger - Bracket - Bolting & Gaskets	Turbo, Intake, Intercooler & Exhaust	2
02-475E	Turbocharger Bracket Pipe Supports	Turbo, Intake, Intercooler & Exhaust	2
02-500A	Control Panel Assembly: Cabinet/System	Control Panel Assembly	4

Index (continued)

Component Number	Component Description	Category	Volume No.
02-500F	Control Panel Assembly Accumulator	Control Panel Assembly	4
02-500G	Control Panel Assembly 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 Components: Piping, Tubing, Fittings	Control Panel Assembly	4
02-500N	Control Panel Assembly: Terminal Boards/Switches/Wiring	Control Panel Assembly	4
02-515	Thermostatic Valve	Jacket Water	4
02-525B	Barring Device - Pneumatic: Regulator Valve/Shut Off Valve	Air Start & Barring Device	3
02-525D	Barring Device - Pneumatic: Mounting Bracket & Supports	Air Start & Barring Device	3
02-540A	Lube Oil Sump Tank with Strainer Assembly and Mounting Hardware	Lube Oil	2
02-540B	Lube Oil Sump Tank: Misc. Fittings, Gaskets, Bolting Material, Valves	Lube Oil	2
02-540C	Lube Oil Sump Tank: Mounting Hardware	Lube Oil	2
02-545	Lube Oil System: Auxiliary Lube Oil Pump	Lube Oil	2

Index (continued)

Component Number	Component Description	Category	Volume No.
02-550	Foundation Bolts	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 Conduit Assembly- Conduit, Fitting, Supports	Engine Instru- mentation & Wiring	3
02-688B	Engine & Aux. Module Wiring Material & Terminations	Engine Instru- mentation & Wiring	3
02-688C	Engine & Aux. Module Wiring Material: Boxes & Terminals	Engine Instru- mentation & Wiring	3
02-690	On Engine Alarm Sensors	Engine Instru- mentation & Wiring	3
02-691A	Off Engine Alarm Sensors Level & Pressure Switches	Engine Instru- mentation & Wiring	3
02-695A	Engine Shutdown Equipment: Tubing/Fittings & Supports	Engine Shut- down & Equip- ment	3

Index (continued)

Component Number	Component Description	Category	Volume No.
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: Gaskets	Jacket Water	4
02-700C	Jacket Water Standpipe:	Jacket Water	4
02-700F	Jacket Water Standpipe: Mat.	Jacket Water	4
02-717A	Aux Sub Base & Oil & Water Aux. Sub Base	Jacket Water	4
02-717B	Aux Sub Base & Oil & Water Jacket Water: Valves	Jacket Water	4
02-717C	Aux Sub-Base & Oil & Water Piping - Jacket Water - Pipe, Couplings, Fittings, Orifices & Strainers	Jacket Water	4
02-717D	Aux Sub Base & Oil & Water Piping Jacket Water: Gaskets & Bolting	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 and Bolting	Lube Oil	2
02-717J	Aux Sub Base & Oil & Water Piping-Fuel Oil Piping and Fittings	Fuel Oil Injection	4
02-717K	Aux Sub Base & Oil & Water Piping-Fuel Oil Valves	Fuel Oil Injection	4

Index (continued)

Component Number	Component Description	Category	Volume No.
02-717L	Aux Sub Base & Oil & Water Piping-Fuel Oil Gaskets and Bolting	Fuel Oil Injection	4
02-805B	Intake Air Filter	Turbo, Intake, Intercooler & Exhaust	2
02-805C	Flex Connections	Turbo, Intake, Intercooler & Exhaust	2
02-805D	Intake Air Silencer	Turbo, Intake, Intercooler & Exhaust	2
02-810A	Misc. Equipment - Heater, Water Standpipe	Jacket Water	4
02-810B	Jacket Water Heat Exchanger	Jacket Water	4
02-810C	Jacket Water Standby Heater	Jacket Water	4
02-820A	Misc. Equipment - Heater, Tank	Lube Oil	2
02-820B	Lube Oil Heat Exchanger	Lube Oil	2
02-820C	Full Flow Lube Oil Filter	Lube Oil	2
02-820D	Prelube Oil Pump	Lube Oil	2
02-820E	Oil Prelube Filter	Lube Oil	2
02-835E	Starting Air Tank	Air Start & Barring Device	3
02-835G	Misc. Equipment - Starting Air Tank Relief Valve	Air Start & Barring Device	3
02-835H	Skid Base - Starting Air Equipment	Air Start & Barring Device	3
041-127A	Intercooler	Turbo Intake, Intercooler & Exhaust	2

Index (continued)

Component Number	Component Description	Category	Volume No.
041-127B&C	Intercooler Piping & Piping Couplings, Gaskets & Bolting	Turbo Intake, Intercooler &	2

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Jacket Water Manifold -
Manifold Assembly with
Hardware, Coupling and Gaskets

COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-316A&B TASK DESCRIPTION NO. DR-09-02-316A&B-0

SNPS GPL NO. 99-316A&B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Because of the inaccessibility and lack of design information for the connecting jacket water skid piping, evaluation of the subject component could not be performed. However, a review of the San Onofre diesel generator's operating history and the EDG Component Tracking System indicates that there has been no reports, of significant problems with this component. It is recommended that, at the utilities earliest convenience, a non-destructive examination of the subject piping component be performed to ensure the integrity of pipe welds. Also, for seismic considerations, it is recommended that the inaccessible piping be inspected to ensure adequate seismic restraint.

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

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-316A&B-0

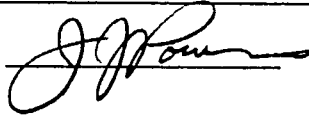
REFERENCES

Not required

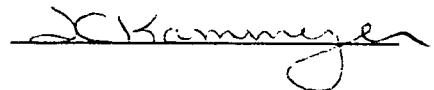
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Jacket Water Inlet Manifold: Coupling and Gaskets

COMPONENT PART NO.: 02-316B

See Component Part No.: 02-316A

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

WATER DISCHARGE MANIFOLD: JACKET WATER
DISCHARGE MANIFOLD, COUPLINGS AND SEALS
(LARGE BORE SCOPE ONLY)
COMPONENT PART NO. 02-317A&B

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the jacket water discharge manifold piping, couplings, and seals for the effects of normal operating and earthquake loadings.

The primary function of the manifold piping is to carry jacket water from the engine ports to the jacket water standpipe.

The primary function of the coupling and seals is to seal jacket water and accommodate thermal expansion.

The scope of piping embraced by this report includes the large bore (greater than 2-inch diameter) piping components as noted on the as-built information obtained during Impell field verification (Ref. 1), plus small bore piping, which was included because of the configuration.

Piping components are defined as piping spool pieces, elbows, tees, flanges, Dresser couplings, and the interconnecting welds. This scope is uniquely defined in terms of Transamerica Delaval, Inc. (TDI) part numbers in Reference 1.

II OBJECTIVE

The objective of this review was to verify the adequacy of the subject piping components for normal operating and earthquake loadings.

III METHODOLOGY

The evaluation of the piping components is performed in accordance with the philosophy and intent of ASME Code, Section III, for Class 3 Nuclear Piping. Towards this end, a criteria document, "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," was developed, which describes the background and provides the technique for evaluating the subject piping components. This criteria is presented in its entirety in Reference 2.

Quality Revalidation Checklist results were reviewed for acceptability.

The TDI Emergency Diesel Generator Component Tracking System was reviewed for the San Onofre site, nuclear, and non-nuclear industry experience.

IV RESULTS AND CONCLUSIONS

All piping stresses were within the design allowables specified by the ASME Section III Code.

The movements at the Dresser couplings (Style 65) are within the manufacturer's end movement requirements (Ref. 3). There are no service life constraints (Ref. 4) because these styles of couplings have no significant history of failure. Shelf life (Ref. 4) is unlimited as long as the gaskets remain packaged and protected from the elements (light, water, etc). The style 65 coupling gaskets are marginal with respect to manufacturer's service condition limits. Note, however, that a slightly marginal gasket would develop a leak, and the coupling would be replaced, as per Reference 5.

All pipe loads on the engine have been tabulated and issued for evaluation.

There are no TERs associated with this component.

Quality Revalidation Inspection results identified in Appendix B 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, it is concluded that the subject piping components, are adequate for their intended design function at San Onofre.

V REFERENCES

1. "Supporting Calculations for the Evaluation of San Onofre Diesel Generator Large Diameter Piping and Supports," Impell Report No. 02-0630-1283, Rev. 0, November, 1984.
2. "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre", Impell Report No. 02-0630-1282, Rev. 0, November, 1984. This is included in Appendix III of the final DR/QR report.
3. Dresser Pipe Couplings, Pipe Fittings, and Pipe Repair Products Catalog, No. 63.
4. Telephone Conversation between A. Palumbo (Impell) and M. Riley (Dresser Manufacturing Co.), dated June 5, 1984.
5. Letter from A. Palumbo (Impell) to J. Kammeyer, (SWEC), "Dresser Couplings - San Onofre," dated November 8, 1984.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Jacket Water Discharge
Manifold/Piping
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison Company
GROUP PARTS LIST NO. 02-317A&B TASK DESCRIPTION NO. DR-09-02-317A&B-0
SNPS GPL NO. 03-317A&B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Evaluate structural integrity of the jacket water discharge piping spool pieces and fittings for the effects of normal operating and earthquake loadings by (a) comparison to previous analyses, (b) review of previous qualification documentation, and/or (c) actual performance of stress evaluation in accordance with the intent and philosophy of ASME III Class 3 and Impell Design Criteria.

Review information provided on TERs.

PRIMARY FUNCTION

Carry jacket water from engine parts to jacket water standpipe.

ATTRIBUTE TO BE VERIFIED

Structural integrity of large bore (greater than 2-inch diameter) piping spool pieces and fittings to withstand the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

None

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-317A&B-0

REFERENCES

"Design Criteria for Diesel Generator Large Diameter Piping for San Onofre,"
Impell Report No. 02-0630-1282, Rev. 0, November 1984

DOCUMENTATION REQUIRED

Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to be "J. Raw", written over a horizontal line.

PROGRAM MANAGER

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

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Water Discharge Manifold: <u>J. W. Discharge Manifold</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-317A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-317A</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-317A

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

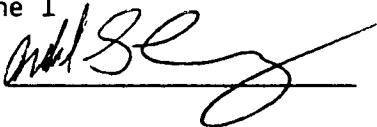
Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER


for JCK

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-317A

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Nita A. Salata

PROGRAM MANAGER

J. P. Power
for JCK

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Water Discharge Manifold: <u>Coupling and Seals</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-317B</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-317B</u>		

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Verify the type of Dresser coupling installed

Engine 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Type of coupling installed

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-317B

ACCEPTANCE CRITERIA (continued)

Engine 1 (continued)

2. Review of Inspection Report by Design Group.

Engine 2

Same as Engine 1

REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures, Dresser Manual, TDI Parts Manual

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

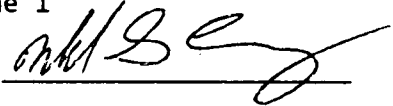
Engine 1

1. Document Summary Sheet
2. Inspection Report

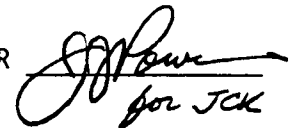
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER


for JCK

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
09-02-317B

COMPONENT REVIEW (continued)

Engine 1 (continued)

2. No Inspection Report has been received which fulfills this requirement.

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Nita A. Seleta

PROGRAM MANAGER

J. P. Low
for JCK

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

COMPONENT NO. 02-317A & B

Effective Printout Dates: 10/17/84

COMPONENT TYPE: Water Discharge Manifold: Jacket Water
Discharge Manifold, Couplings, and Seals

<u>EXPERIENCE</u>	<u>REFERENCE</u> <u>DOCUMENTS</u>	<u>SAN ONOFRE</u> <u>STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
During monthly surveillance testing the "A" diesel generator was shut down because of substantial coolant leakage in the No. 12 cylinder cooling jacket outlet. The cause was determined to be a failed gasket in the cooling water jacket outlet of the No. 12 cylinder.	LER Vermont Yankee, 271-8104810518	Appears to be an isolated failure and not industry wide. No effect on subject structural evaluation.
<u>NON-NUCLEAR</u>		
Capscrew breakage in the exhaust jumpers, between the cylinder heads and exhaust manifold.	Letter from J. A. Smith (City of Homestead) to G.E. Trussell (TDI) dated 06/14/77 (File No. T-10)	Not in Large Bore Piping Scope of work. No effect on subject evaluation.
Capscrew breakage in the exhaust jumpers, between the cylinder heads and exhaust manifold.	Letter from John Smith (City of Homestead) to G.E. Trussell (TDI) dated 05/14/77 (File No. T-55)	Not in Large Bore Piping Scope of work. No effect on subject evaluation.

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Water Discharge Manifold: Coupling & Seals

COMPONENT PART NO.: 02-317B

See Component Part No.: 02-317A

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Water Discharge
Manifold: Supports
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-317C TASK DESCRIPTION NO. DR-09-02-317C-0
SNPS GPL NO. 03-317C CLASSIFICATION TYPE B

TASK DESCRIPTIONS

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

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

Supports appear to be adequate provided that the analysis of the corresponding piping Component No. 02-317A&B does not mandate modifications. If the piping analysis warrants modification to the supports, these modifications will be addressed in the DR/QR report for Component No. 02-317A&B.

There are no maintenance 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-09-02-317C-0

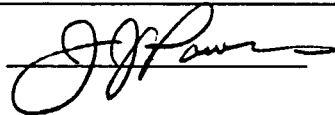
REFERENCES

Not required

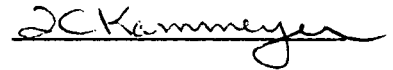
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Jacket Water Pump</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-425A</u>	TASK DESCRIPTION NO. <u>DR-09-02-425A-1</u>
SNPS GPL NO. <u>03-425A</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 site or industry experience, except that which was previously addressed in the lead engine report.
- A review of the lead engine DR/QR report for Comanche Peak.
- The San Onofre engine driven jacket water pump is similar in design to the Comanche Peak pump. The following differences exist: 1) The San Onofre pump is physically larger, 2) The San Onofre pump is driven through a gear vs. spline coupling, and 3) The San Onofre pump speed is 1640 vs. 1470 rpm.

The transient torsional crankshaft vibration report has been reviewed to compare the torsional vibrations experienced on the San Onofre engines to that expected during future operation. The frequency and severity of torsional vibrations during startup will be less for future service than has been experienced thus far. Any effects on the jacket water pump associated with future service should also be less severe. Therefore the Owners Group recommended quality inspections for this component, outlined below, should be conducted as noted to confirm the adequacy of the jacket water pump.

(Note: Any unsatisfactory inspection results should be subject to further engineering evaluation and a determination made as to the necessity of a decreased inspection interval.)

The following modifications and maintenance recommendations should be implemented:

- Since no impeller nut torque is given on the assembly drawing, the user will probably use the value of 550 ft-lb from page 8-5A of the instruction manual. This value results in tensile stresses in the relieved section of the shaft in excess of the 35,000 psi yield point

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 3
DR-09-02-425A-1

TASK DESCRIPTION (continued)

for AISI 303S material. This torque should be reduced to a value that will limit the tensile stress to $2/3$ of the yield. This is calculated at 150 ft-lb. Since the nut torque is not sufficient to drive the impeller onto the taper with sufficient interference to prevent relative motion between the impeller and the shaft, it is not critical to use a high torque value.

- A similar situation exists at the drive gear end of the pump shaft. The gear is retained on the shaft by a nut torqued to 375 ft-lb. This results in a tensile stress of 30,000 psi + in the shaft which is too high. It is also unnecessary because it does not prevent relative motion between the gear and the shaft. The torque should be reduced to 290 ft-lb and set as a "not to exceed value." To facilitate use of this limiting torque, a second hole should be drilled in the threaded end, 90 deg from the existing one, to minimize nut rotation required to insert the locking cotter pin.
- Because of differences in pumps at Comanche Peak and San Onofre these modifications are different from those required by the lead engine report (Reference "Emergency Diesel Generator Design Review Engine Driven Jacket Water Pump Calculation" for Southern California Edison).

The following Quality inspections have not been conducted to date and should be completed on one station engine at the next refueling outage: | 1

- Visually inspect pump gears for signs of pitting or galling.
- Liquid penetrant test on gear teeth and transition area.
- Visually inspect wear ring for galling or excessive wear.
- Determine pump shaft hardness.
- Determine pump shaft material.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 3 of 3
DR-09-02-425A-1

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

K.I. Litatuck

PROGRAM MANAGER

J.C. Kammerer

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Jacket Water Pump</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-425A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-425A</u>		

TASK DESCRIPTIONSEngine 1

1. Assemble and review existing documentation.
2. Determine the hardness of the pump shaft.
3. Determine the material of the pump shaft.
4. Perform a visual inspection of the pump shaft for signs of excessive galling wear or scoring. Document any questionable items with photographs.
5. Perform a visual inspection of the pump driven gears for signs of pitting or galling. Document any questionable items with photographs.
6. Perform a Liquid Penetrant test on the gear teeth and transition area (gear to shaft).
7. Perform a visual inspection on the wear ring for evidence of galling or excessive wear.

Engine 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIEDEngine 1

1. Quality status of Component Document Package
2. Hardness of the jacket water pump shaft
3. Material of the jacket water pump shaft

ATTRIBUTES TO BE VERIFIED (continued)

4. Lack of excessive galling wear or scoring on the pump shaft
5. Lack of pitting or galling on the pump driven gears
6. Surface integrity of the gear teeth and transition area
7. Lack of scoring, galling or reduction of cross-sectional area on wear ring

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Review of inspection report by the Design Group
3. Shaft material to be 303SS
- 4-7. Review of inspection report by the Design Group

Engine 2

Same as Engine 1

REFERENCES

Engine 1

1. QCI No. 52
- 2-7. Approved site NDE procedures

Engine 2

Same as Engine 1

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
09-02-425A

DOCUMENTATION REQUIRED

Engine 1

1. Document Summary Sheet
- 2-7. Inspection Report

Engine 2

Same as Engine 1

GROUP CHAIRPERSON *M. B. E.*

PROGRAM MANAGER *J. J. Power*
for JCK

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owners.
- 2-7. No inspection reports have been received which fulfill these requirements.

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON *Nita A. Salata*

PROGRAM MANAGER *J. J. Power*
for JCK

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Jacket Water Fittings-
Pipe and Fittings
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-435A TASK DESCRIPTION NO. DR-09-02-435A-1
SNPS GPL NO. 03-435A 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 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 loading.

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 0.
-

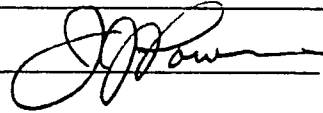
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-435A-1

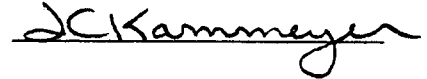
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBO WATER PIPING - PIPE AND FITTINGS
(LARGE BORE SCOPE ONLY)
COMPONENT PART NO. 02-437A

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the turbo water pipe and fittings for the effects of normal operating and earthquake loadings.

The primary function of the turbo water piping is to carry jacket water from the turbocharger to the jacket water discharge manifold.

The scope of piping embraced by this report includes the large bore (greater than 2-inch diameter) piping components as noted on the as-built information obtained during Impell field verification (Ref. 1).

Piping components are defined as piping spool pieces, elbows, tees, flanges, and the interconnecting welds. This scope is uniquely defined in terms of Transamerica Delaval, Inc. (TDI) part numbers in Reference 1.

II OBJECTIVE

The objective of this review was to verify the adequacy of the subject piping components for normal operating and earthquake loadings.

III METHODOLOGY

The evaluation of the piping components is performed in accordance with the philosophy and intent of the ASME Code Section III, for Class 3 Nuclear Piping. Towards this end, a criteria document was developed, "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," which describes the background and provides the techniques for evaluating the subject piping and supports. This criteria is presented in its entirety in Reference 2.

Quality Revalidation Checklist results were reviewed for acceptability.

The TDI Emergency Diesel Generator Component Tracking System was reviewed for the San Onofre site, nuclear, non-nuclear industry experience.

IV RESULTS AND CONCLUSIONS

All piping stresses were within the design allowables specified by the ASME Section III Code.

It is recommended that a rigid anchor be added on the 2½-inch diameter header (which runs along the centerline of the engine) at the location of the intersection with the two 1½-inch diameter branches. Further details on this addition are summarized in Reference 3.

All pipe loads on the turbocharger were tabulated and issued for evaluation.

Quality Revalidation Inspection results identified in Appendix B have been reviewed and considered in the performance of this design review and are consistent with the final conclusions of this report.

There are no TERs associated with this component.

Based on the above review, it is concluded that the subject piping components, with the addition mentioned above, are adequate for their intended design function at San Onofre.

V REFERENCE

1. "Supporting Calculations for the Evaluation of San Onofre Diesel Generator Large Diameter Piping and Supports," Impell Report No. 02-0630-1283, Rev. 0, November 1984.
2. "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," Impell Report No. 02-0630-1282, Rev. 0, November 1984. This is included in Appendix III of the final DR/QR report.
3. Letter from R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modifications for Validation of Impell's Design Review for Component No. 02-437A - San Onofre," dated November 8, 1984.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT	<u>Turbo Water Piping</u> <u>(Large Bore Scope Only)</u>	UTILITY	<u>Southern California Edison Company</u>
GROUP PARTS LIST NO.	<u>02-437</u>	TASK DESCRIPTION NO.	<u>DR-09-02-437-0</u>
SNPS GPL NO.	<u>03-437A</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Evaluate structural integrity of the turbo water piping spool pieces and fittings, for the effects of normal operating and earthquake loadings by (a) comparison to previous analyses, (b) review of previous qualification documentation, and/or (c) actual performance of stress evaluation in accordance with the intent and philosophy of ASME III Class 3 and Impell Design Criteria.

Review information provided on TERs.

PRIMARY FUNCTION

Carry jacket water from turbocharger to the jacket water discharge.

ATTRIBUTE TO BE VERIFIED

Structural integrity of large bore (greater than 2-inch diameter) piping spool pieces and fittings to withstand the effects of normal operating and earthquake loadings.

SPECIFIED STANDARDS

None

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-437A-0

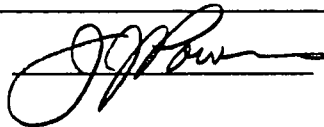
REFERENCES

"Design Criteria for Diesel Generator Large Diameter Piping for San Onofre,"
Impell Report No. 02-0630-1282, Rev. 0, November 1984

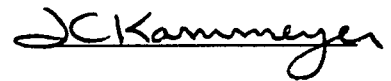
DOCUMENTATION REQUIRED

Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

GROUP CHAIRPERSON



PROGRAM MANAGER



See Component Report Tab No. 02-437A (SB) for applicable Appendix B.

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

COMPONENT NO. 02-437A

Effective Printout Date: 10/17/84

COMPONENT TYPE: Turbo Water Piping: Pipe And Fittings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
During monthly surveillance testing the "A" diesel generator was shut down because of substantial coolant leakage in the No. 12 cylinder cooling jacket outlet. The cause of the event was found to be a failed gasket in the cooling water jacket outlet of the No. 12 cylinder.	LER VT. Yankee 271-810518	Maintenance concern. Not related to the subject evaluation.
<u>NON-NUCLEAR</u>		
Cooling water piping between engine and turbo-charger breaks.	LTR 05/13/82 from City of Homestead, Fla., to TDI (Oakland and N.Y.) Units 18 and 19. (File #T-66)	Cooling water lines to turbocharger meet the ASME III rules for design and will perform their intended design function.

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBO WATER PIPING - PIPE AND FITTINGS

COMPONENT PART NO. 02-437A

(SMALL BORE SCOPE ONLY)

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the turbo water piping - pipe and fittings components to withstand the effects of normal operating and earthquake loadings. The primary function of this piping is to carry jacket cooling water from the jacket water inlet manifold to the turbocharger and from the turbocharger to the jacket water discharge manifold.

II OBJECTIVE

The objective of this review was evaluation of the small bore piping 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 objectives, the following methods were used:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the San Onofre 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 small bore piping, as defined by this Component Design Review, has been evaluated in accordance with Reference 1 and has been found acceptable with modifications.

There are no TERs associated with this component.

The Quality Revalidation Inspection results identified in Appendix B 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 and information contained in Reference 2, it is concluded that the small bore piping will perform its intended design function at San Onofre under all normal operating and earthquake loadings if the following recommended modifications are implemented as detailed in Reference 3:

- Engine 2, generator end, turbo water inlet supports should have 1/4-inch diameter U-bolts replaced with 3/8-inch diameter to increase lateral capacity.

NOTE: U-bolt on right bank is formed from 1/4-inch diameter all thread rod.

- The 1/4-inch tubing from the turbo jacket water outlet headers to the combustion air coolers on both engines must be provided with two-direction supports at 3 foot-6 inch maximum span intervals. Location of the supports should allow for flexibility by providing a 6-inch minimum offset around bends.

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, Rev. 0.
2. Stone & Webster Calculation No. 11600.60-NP(B)-0901-XH.
3. Memo No. 6425 from C. Malovrh (SWEC) to J. Kammeyer (SWEC) dated 10/19/84.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Turbo Water Piping - Pipe and Fittings	
COMPONENT <u>(Small Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-437A</u>	TASK DESCRIPTION NO. <u>DR-09-02-437A-1</u>
SNPS GPL NO. <u>03-437A</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

PRIMARY FUNCTION

The piping is to carry jacket cooling water from the jacket water inlet manifold to the turbocharger and from the turbocharger to the jacket water discharge manifold.

ATTRIBUTE TO BE VERIFIED

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

SPECIFIED STANDARDS

IEEE - 387

ANSI B31.1 (1973)

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 0.

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-437A-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

W. E. Littman
for J. Powers

PROGRAM MANAGER

J. Powers
for JCK

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Turbo Water Piping - Pipe and Fittings</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-437A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-437A</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-437A

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON 

PROGRAM MANAGER 
for JCK

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-437A

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

PERSON Nata A. Saleta

PROGRAM MANAGER J. How
for JCK

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

COMPONENT NO. !02-4 7A

Effective Printout Date 09/17/84

COMPONENT TYPE: Turbo Water Piping - Pipe and Fittings

<u>EXPERIENCE</u>	<u>REFERENCE</u> <u>DOCUMENTS</u>	<u>SAN ONOFRE</u> <u>STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Diesel shutdown due to a leaky gasket in the jacket water system. Gasket was replaced.	Vermont Yankee LER 271-810581	This is a maintenance item and does not affect the design of this component.
<u>NON-NUCLEAR</u>		
Cooling water piping between the engine and the turbocharger failed.	Letter from City of Homestead, Fla., to TDI dated 5/13/82	The design review for this component indicates that the cooling water lines will perform their intended function if the recommended modifications are made.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Thermostatic Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-515</u>	TASK DESCRIPTION NO. <u>DR-09-02-515-0</u>
SNPS GPL NO. <u>03-515</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

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

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

- Replacement of the power elements at 3 to 5 year intervals

There are no modifications recommended for this component.

The following inspections should be performed:

- Verify the body material to be cast steel
- Verify the exhaust ports are centerline horizontal and if not, vent lines should be installed. If the valve is installed up-side down, a special load spring supplied by the manufacturer should be installed.

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-09-02-515-0

SPECIFIED STANDARDS

Not required

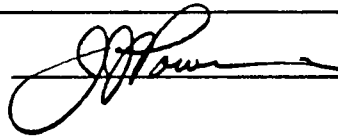
REFERENCES

Not required

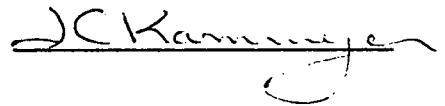
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT	<u>Jacket Water Standpipe Pipe, Fittings, Gaskets</u>	UTILITY	<u>Southern California Edison</u>
GROUP PARTS LIST NO.	<u>02-700A</u>	TASK DESCRIPTION NO.	<u>DR-09-00-700A-0</u>
SNPS GPL NO.	<u>00-700A</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

The jacket water standpipe pipe, fittings, and gaskets installed at San Onofre are supplied by Southern California Edison. Therefore, the associated piping is beyond the scope of the TDI Owners Group Design Review Program.

Southern California Edison supplied this piping and hence assumes responsibility for design adequacy.

A review of the air bubble removal system indicates adequate performance. The jacket water system high points have a continuous vent system to ensure that air binding does not occur.

Based on the above, the Design Review and Quality Revalidation for the jacket water standpipe piping is not required for San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-00-700A

REFERENCES

Not required

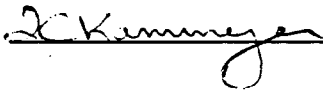
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Jacket Water Standpipe
Supports
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-700C TASK DESCRIPTION NO: DR-09-02-700C-1
SNPS GPL NO. 00-700C CLASSIFICATION TYPE B

TASK DESCRIPTIONS

The jacket water standpipe small bore piping/tubing supports installed at San Onofre are supplied by Southern California Edison. Therefore, the associated supports are beyond the scope of the TDI Owners Group Design Review Program.

Southern California Edison supplied these supports and hence assumes responsibility for design adequacy.

Based on the above, the Design Review and Quality Revalidation for the jacket water standpipe supports is not required on San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTES TO BE VERIFIED

Not required

SPECIFIED STANDARDS:

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

S01969/1

PROGRAM MANAGER

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

JACKET WATER STANDPIPE AND MISCELLANEOUS BOLTING MATERIALS
COMPONENT PART NO. 02-700F

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the jacket water standpipe and miscellaneous bolting materials. The standpipe is a slender cylindrical tank mounted on the auxiliary skid with the cylindrical axial vertical. The primary function is to serve as a water reservoir for the engine jacket water cooling system. For San Onofre, an expansion tank is furnished in addition to the standpipe. It provides an expansion volume and is mounted above the standpipe, producing a higher static pressure in the cooling system.

The standpipe has provisions for the jacket water standby heaters, which maintain temperature during engine standby. Provisions for temperature control, low water level alarm, etc., are incorporated in the standpipe. Jacket water standpipe assembly component part numbers are listed below:

<u>Name</u>	<u>Part Number</u>	<u>Manufacturer</u>
Standpipe	02-700-01-AG	TDI
Expansion Tank	02-700-01-AD	TDI
Bolting	GB-001-141	Various Vendors
	GB-001-121	Various Vendors
	GB-001-186	Various Vendors

II OBJECTIVE

The objective of this review was to revalidate the structural integrity of the jacket water standpipe and its associated supports and bolting under the action of normal operating, seismic and nozzle loads.

III METHODOLOGY

The following procedures were followed to verify the structural integrity of the jacket water standpipe:

- The Emergency Diesel Generator Component Tracking System was reviewed for San Onofre, nuclear and non-nuclear experience.
- The specification, drawings, and qualification analyses were reviewed to establish that all structural requirements had been met and that the input data for the analysis is current and accurate.

- The structural analysis code STRUDL was used to model the standpipe and evaluate the effects of nozzle loads and support displacements due to engine thermal expansion on support loads and stresses.
- A review of the Quality Revalidation Checklist results was performed for acceptability.

IV RESULTS AND CONCLUSIONS

Review of the Emergency Diesel Generator Component Tracking System indicates that there is no San Onofre or industry experience for this component.

Dimensions of the analytical models employed by Structural Dynamics Research Corporation (SDRC) (Ref. 1) were consistent with available TDI drawings (Ref. 2). Stresses indicated in the SDRC analysis for the standpipe, its supports, and associated bolting are well within acceptable allowables for weight and seismic loading. The SDRC summary report indicates that neither thermal nor nozzle loads were combined with weight and seismic inertia loads for qualification of the standpipe, its supports, or nozzles. A review of non-code jacket water standpipe design such as is utilized at San Onofre has indicated that single sided fillet welds have been used on large bore jacket water, engine driven pump suction and engine return nozzles. This results in high stresses at weld roots which may lead to cracking of weld joints. As such the following inspection is applicable to this component:

- Visually inspect jacket water standpipe, pump suction and engine return nozzle welds each routine engine run and every 100 hours during extended engine runs. Any visible cracking or minor jacket water leakage should result in rework of nozzle welds.

The SDRC seismic analysis indicated natural frequencies of the standpipe close to 15 Hz, which is a strong harmonic of engine operating vibration. The jacket water standpipe has been highlighted for special attention during the recommended engine vibration survey to ensure that resonances of the standpipe and associated hardware are avoided.

The expansion tank is a small vessel made from 12-inch pipe with heavier walls than the standpipe and is judged to be acceptable by comparison with the standpipe.

There are no TERs associated with this component.

Quality Revalidation Inspection results identified in Appendix B have been reviewed and considered in the performance of this design review and are consistent with the final conclusions of this report.

Based on the above review, it is concluded that the jacket water standpipe and miscellaneous bolting materials are adequate for their intended design function at San Onofre pending resolution of engine vibration loads.

V REFERENCE

1. Seismic Qualification Report, Delaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.
2. TDI Drawing Nos. 02-700-01-AG, 02-700-01-AE, 02-700-01-AF, 02-700-01-AD, 100881, R-3924.

1

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT	<u>Jacket Water Standpipe</u> <u>Misc. Bolting Materials</u>	UTILITY	<u>Southern California Edison</u>
COMPONENT PART NUMBER	<u>02-700F</u>	TASK DESCRIPTION NO.	<u>DR-09-02-700F-0</u>
SNPS GPL NO.	<u>00-700F</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Review structural integrity of the standpipe and bolting.

Review general design of the water jacket standpipe.

PRIMARY FUNCTION

Water reservoir and expansion tank for the engine jacket cooling system.

ATTRIBUTE TO BE VERIFIED

Structural integrity of the standpipe and mounting for normal operating loads plus earthquake effects.

SPECIFIED STANDARDS

None

REFERENCES

Specification E-73001, "Diesel Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition," through Rev. 6, dated 2/13/76.

Seismic Qualification Report, Delaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-700F-0

DOCUMENTATION REQUIRED

None

GROUP CHAIRPERSON

J. J. Lowe

PROGRAM MANAGER

J. C. Kammerer

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Jacket Water Stand Pipe-Miscellaneous Bolting Material</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-700F</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>00-700F</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-700F

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

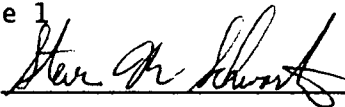
Engine 1

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

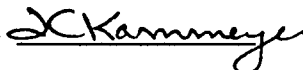
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-700F

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Nita A. Saleh

PROGRAM MANAGER

J. Kammerer

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

COMPONENT NO. 00-700F

Effective Printout Date 10/10/84

COMPONENT TYPE: Jacket Water Standpipe

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

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Aux. Sub Base, Oil and Water
COMPONENT Jacket Water Valves UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-717B TASK DESCRIPTION NO. DR-09-02-717B-0
SNPS GPL NO. 03-717B CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the EDG Component Tracking System for applicable industry experience and the lead engine DR/QR reports (Shoreham/Comanche Peak). Valves used at San Onofre are similar to those used on the lead engines.

The following maintenance from the lead engine reports should be followed:

- Monthly inspection for leakage at packing.

There are no modifications required for this component.

There is no quality revalidation 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-09-02-717B-0

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Aux. Sub-Base and Oil and
Water Piping: Jacket Water -
Pipe, Couplings, Fittings,
Orifices, and Strainers

COMPONENT	<u>Southern California Edison</u>
COMPONENT PART NUMBER	<u>02-717C</u>
SNPS GPL NO.	<u>03-717D</u>
UTILITY	<u>Southern California Edison</u>
TASK DESCRIPTION NO.	<u>DR-09-02-717C-0</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) and the applicable industry experience.

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 San Onofre has been assessed by a field walkdown.

The field walkdown was performed in accordance with the small bore piping criteria document (Ref. 1) and indicates that this component will maintain its functional capability for normal and earthquake loading provided that the supports are added/modified as indicated in DR/QR Report 02-717E.

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-09-02-717C-0

SPECIFIED STANDARDS

Not required

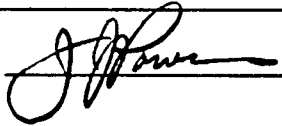
REFERENCES

"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 0.

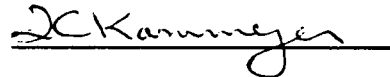
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to be "J. Power", written over a horizontal line.

PROGRAM MANAGER

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Aux. Sub Base & Oil & Water Piping - COMPONENT <u>J. W.: Gaskets & Bolting</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-717D</u>	REV. NO. <u>2</u>
SNPS GPL NO. <u>03-717F</u>	

TASK DESCRIPTIONS

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

- a) Component was reviewed on two lead engines with satisfactory results.
- b) Review of industry experience was performed in Shoreham Report. There is no significant negative industry experience for this component.

GROUP CHAIRPERSON

Nita A. Galea

PROGRAM MANAGER

J. J. Puma
for J. J. Puma

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

AUXILIARY SUB-BASE AND OIL AND WATER
PIPING - JACKET WATER: SUPPORTS
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-717E

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the auxiliary sub-base jacket water supports 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 San Onofre 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 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 TERs associated with this component.

The Quality Revalidation Inspection results identified in Appendix B 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 and information contained in Reference 2, it is concluded that the supports will perform their intended design function at San Onofre under all normal operating and earthquake loadings with the provision that the following recommended modifications are implemented as detailed in Reference 3:

Jacket Water Standpipe Fill Line

Modify the existing two-direction support approximately 3 feet up from the sump floor to a three-direction support on Engine 2.

In order to adequately support the piping of Component 02-717C it is recommended that the following supports be added:

Jacket Water Standpipe Fill Line

Add a three-direction support on the 16-inch long horizontal pipe run in the sump on Engine 1.

Jacket Water Keepwarm Pump Discharge Piping

Add a three-direction support in the 18-inch long riser adjacent to the keepwarm pump on both engines. On Engine 2, remove the spacer hanging from piping near the discharge check valve.

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 0.
2. Stone & Webster Calculation number 11600.60-NP(B)-0901-XH.
3. Memo No. 6425 from C. Malovrh/SWEC to J. Kammeyer/SWEC 10/19/84.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Auxiliary Sub Base Oil
and Water Piping -
Jacket Water Supports
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-717E TASK DESCRIPTION NO. DR-09-02-717E-1
SNPS GPL NO. 03-717G CLASSIFICATION TYPE B

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 loadings.

PRIMARY FUNCTION

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

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

ANSI B31.1 (1973)

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 0.

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-717E-1

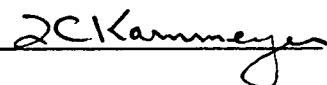
DOCUMENTATION REQUIRED

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



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Aux. Sub Base & Oil & Water Piping - Jacket Water: <u>Supports</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	<u>02-717E</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-717G</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

Engine 2

Same as Engine 1

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-717E

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

Engine 1

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

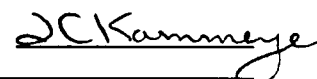
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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 2

Same as Engine 1

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
09-02-717E

RESULTS AND CONCLUSION

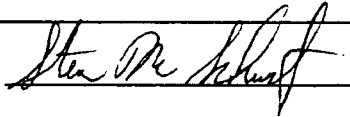
Engine 1

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.

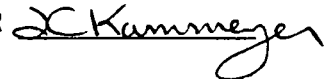
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT NO. 02-717-E

Effective Printout Date 09/17/84

COMPONENT TYPE: Auxiliary Sub-Base and Oil and Water
Piping-Jacket Water: Supports

<u>EXPERIENCE</u>	<u>REFERENCE</u> <u>DOCUMENTS</u>	<u>SAN ONOFRE</u> <u>STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
10CFR50.55E filed concerning pipe supports not built to ASME III Class NF as required.	Cleveland Electric DAR No. 117 02/17/83	DR/QR reviews provide assurance that components will perform their intended design functions during normal operating and earth- quake loading.
<u>NON-NUCLEAR</u>		
None		

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Misc. Equipment-Heater, <u>Jacket Water Standpipe</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating <u>Station - Unit 1</u>
GPL NO.	<u>02-810A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-800A</u>		

TASK DESCRIPTIONS

No further review of component 02-810A is required for the following reasons:

- a) There is no pertinent industry experience in evidence.
- b) Component was reviewed on lead engines (Shoreham). The following recommendations, made in the Shoreham DR/QR report should be followed by San Onofre.

Preventive maintenance included in the TDI manual should be performed. Inspections scheduled at 18-month intervals should consist of the following.

- ° Measure heater insulation resistance and replace heater if degradation of insulation resistance is noted.
- ° Thoroughly clean heater element of deposits and inspect for signs of deterioration.
- ° Check calibration and inspect condition of thermostat and recalibrate or replace thermostat when necessary.

GROUP CHAIRPERSON

Victor A. Salita

PROGRAM MANAGER

J. J. Power
for JCK

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Jacket Water Heat Exchanger UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-810B TASK DESCRIPTION NO. DR-09-02-810B-0
SNPS GPL NO. 10-103 CLASSIFICATION TYPE B

TASK DESCRIPTION

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

- A review of the component tracking system indicated that there was no significant applicable industry experience.
- On the diesel generators at San Onofre the jacket water heat exchangers are of the radiator type, rather than the shell and tube type as is the case for both lead engines. Radiators are, however, in general use on diesel engines throughout industry.
- Industry experience in the Component Tracking System includes cases of radiator leaks at San Onofre for engines other than TDI. Proper jacket water corrosion control and a normal station surveillance program should aid in minimizing this problem at San Onofre.

No unique maintenance or modifications are recommended 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-09-02-810B-0

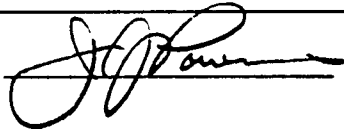
REFERENCES

Not required

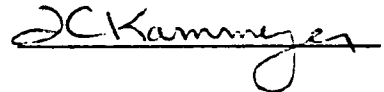
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>J.W. Standby Heater Pump</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-810C</u>	TASK DESCRIPTION NO. <u>DR-09-02-810C-0</u>
SNPS GPL NO. <u>10-107</u>	CLASSIFICATION TYPE <u>C</u>

TASK DESCRIPTIONS

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

- A review of the Component Tracking System indicated that there was no significant applicable industry experience.
- A review of the lead engine DR/QR report (Comanche Peak)
- This pump is similar to the pump used on the lead engine except this pump is larger.

No additional modifications or maintenance recommendations are made as a result of the lead engine DR/QR report for this component.

No Quality Revalidation is required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

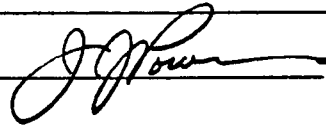
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-810C-0

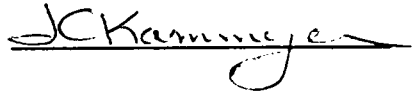
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Jacket Water Standby Heater Pump</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-810C</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>10-107</u>		

TASK DESCRIPTIONS

No further review of component 02-810C is required for the following reasons:

- a) Component was reviewed on two lead engines with satisfactory results.
- b) There is no industry experience for this component.
- c) Type C component - Failure has little bearing on the effective use or operation of D.G.

GROUP CHAIRPERSON

Victor A. Salata

PROGRAM MANAGER

J. Brown
for JAC

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Cylinder Heads</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-360A</u>	TASK DESCRIPTION NO. <u>DR-09-02-360A-0</u>
SNPS GPL NO. <u>03-360A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review is not required for this component based on review of the lead engine DR/QR reports (Shoreham/Comanche Peak), the Phase I report and the applicable industry experience in the EDG Component Tracking System.

All of the cylinder heads presently in use at San Onofre are Group I, as defined in the Phase I report. Although the Group I cylinder heads do not benefit from the manufacturing improvements implemented by TDI between October 1978 and September 1980, these cylinder heads have performed without problems at San Onofre over long operating periods.

There are no modification recommendations for this component, however, the following maintenance items are recommended:

- Blow-over the engine after each operation of the engine to ensure against harmful effects of water leaks. In the event water is detected as a result of a cylinder head leak, the cylinder head should be replaced.
- Visually inspect the fuel injection port on each cylinder head for water leaks during the normal monthly engine run. If water leakage is detected, the cylinder head should be replaced.

Quality inspections that have been performed to date have been reviewed. Cylinder head 6R from DG2 was replaced because of cracks in the Stellite valve seat. Two other heads that were inspected showed indications, but both of these cylinder heads (10L, DG1 & 10R, DG2) were dispositioned "accept as is" and put back on the engine. Because San Onofre has Group I cylinder heads, it is recommended that the following Quality inspections as delineated in the CQRC be performed on a 100% sample plan for both DG1 & DG2:

- Perform a liquid penetrant test of the valve seating surfaces.
 - Perform a magnetic particle test on the fire deck area excluding the valve seating area.
 - Determine the thickness of the fire deck area by performing an ultrasonic test at six locations on the deck.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-360A-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

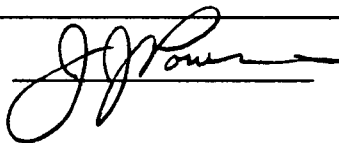
REFERENCES

Not required

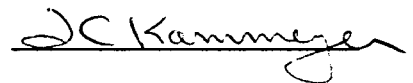
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Cylinder Head Valves - <u>Cylinder Head</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating <u>Station - Unit 1</u>
GPL NO.	<u>02-360A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-360A</u>		

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a Liquid Penetrant test of the valve seating surfaces.
3. Perform a Magnetic Particle test on the fire deck area excluding the valve seating area.
4. Determine the thickness of the fire deck area by performing an Ultrasonic test at six locations on the deck. (See Attachment A)

Engine 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
- 2-3. Surface integrity of the valve seating and fire deck area
4. Thickness of the fire deck area

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. No cracks allowed in the seating surface. Pin holes that do not exceed 1/32" diameter numbering 3 or less in one surface and not closer to each other than 1/8", are acceptable.
3. Acceptance criteria standard is ASTM E-125 for a Magnetic Particle test.
 - A) Relevant indications are:
 - 1) Hot tears and cracks, linear indications that exceed ASTM E-125, Class I-1.
 - 2) Shrink that exceeds ASTM E-125, Class II-1.
 - 3) Inclusions that exceed ASTM E-125, Class III-1.
 - 4) Porosity that exceeds ASTM E-125, Class V-1.
 - B) Any inclusion, shrink or porosity that exceeds ASTM E-125 is a reportable indication and shall be reported to the Design Group. In addition, linear indications exceeding 1/4" shall also be reviewed by the Design Group.
 - C) Indications that do not exceed the ASTM E-125 as described in 3A are acceptable.
4. All fire deck thickness readings to be recorded. Nominal fire deck thickness is 0.500"; Minimum thickness is 0.400".

Engine 2

Same as Engine 1

REFERENCES

Engine 1

1. QCI No. 52
- 2-4. Approved Site NDE Procedures, TER# 99-001, TER# 99-012

COMPONENT QUALITY REVALIDATION CHECKLIST

Page 3 of 5
09-02-360A

REFERENCES (continued)

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

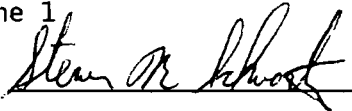
Engine 1

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

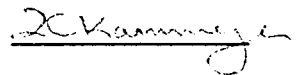
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
- 2-4. No inspection reports have been received which fulfill these requirements.

Note: a) A Magnetic Particle test was performed of cylinder head 10L with satisfactory results. This was reported by TER# 09-013.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
2. A Liquid Penetrant test was performed on the valve seating surfaces of cylinders 2, 6, and 10. Results were recorded by TER# 09-013.
3. No inspection report has been received which fulfills this requirement.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page 4 of 5
09-02-360A

4. An Ultrasonic test was performed on the fire deck area of cylinders 2, 6, and 10. This was reported by TER# 09-013.

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1.

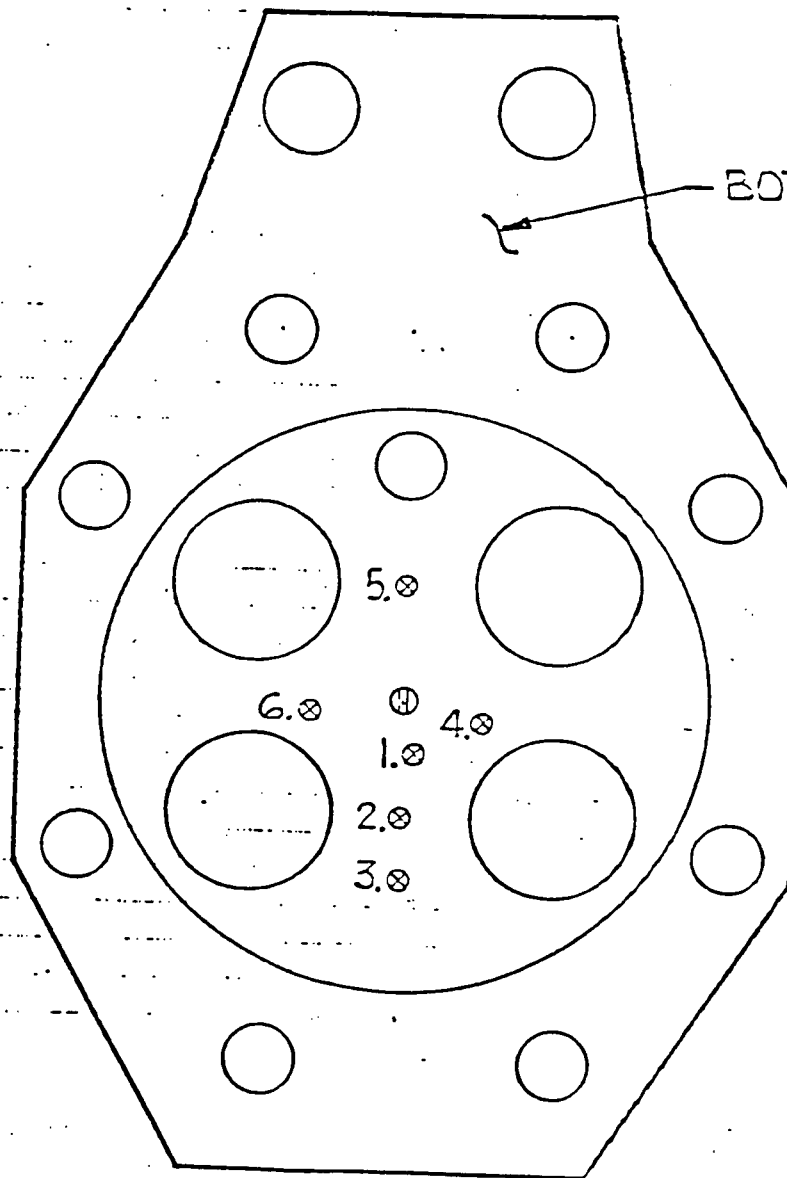
GROUP CHAIRPERSON

Nita A. Sabela

PROGRAM MANAGER

JC Kinnaman

ULTRASONIC TEST OF THE FIRE DECK



THIS SKETCH SHOWS THE SIX LOCATIONS WHERE A U.T. IS TO BE PERFORMED TO DETERMINE THE THICKNESS OF THE FIRE DECK.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Cylinder Head Valves: Intake and Exhaust Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-360B</u>	TASK DESCRIPTION NO. <u>DR-09-02-360B-0</u>
SNPS GPL NO. <u>03-360B</u>	CLASSIFICATION TYPE <u>B</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 cylinder head valves for their intended purpose.
- A review of nuclear and non-nuclear industry experience indicated that there had been no design related failures associated with this component. The cylinder head valves are identical on all the Owner's Group TDI diesel engines (TDI Part No. 03-360-02-0D).
- Stresses imposed by engine operation are less at San Onofre than at Comanche Peak or Shoreham because of a lower peak cylinder firing pressure and reduced BMEP at full load. Additionally, influential valve train components are identical to Comanche Peak.

The primary nuclear and non-nuclear industry experiences associated with this component have been chrome plate flaking, scuffing, and scoring, and exhaust gas blowby due to lack of concentricity of the valve and seat. Because of the small number of hours nuclear service diesels are expected to operate between inspections, this will not noticeably affect engine performance.

There are no modifications recommended for this component.

The following Quality Revalidation inspection recommendations are made to ensure proper component performance and quality and should be performed on both engines:

- Perform a visual inspection to verify adequate valve seating. There should be a uniform linear metallic ring on valve ring.
- Perform a visual examination of the valve and valve ring for scuffing and erosion on valve ring or valve seat area.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-360B-0

- Perform a dimensional check of the valve to valve guide clearance.
- Perform a visual examination of the top of the valve stems for scuffing and pitting.
- Perform a liquid penetrant test on the blended radius of the stem head for cracking.
- Determine the material of the valve and valve ring (Sample 16 valves).

The valve inspections outlined in the lead engine DR/QR reports also applies to the engines at San Onofre. The inspection should be performed for all new or reworked cylinder heads after an initial 500-600 hours of operation:

- Remove the subcover bonnet and inspect the interior for soot, which indicates valve blowby. Corrective action should be taken if this condition is found to exist.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

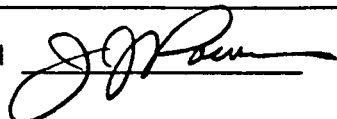
REFERENCES

Not required

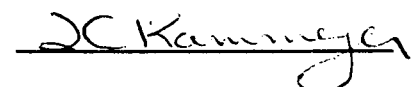
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



S01952/2

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Cylinder Head and Valves: Bolting and Gaskets</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-360C</u>	TASK DESCRIPTION NO. <u>DR-09-02-360C-0</u>
SNPS GPL NO. <u>03-360C</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) and the applicable industry experience in the EDG Component Tracking System.

A review of the San Onofre Parts Manual shows the field replacement set for cylinder head seals and gaskets as being TDI P/N 1A-4932. These are used to replace the seats and gaskets on one cylinder head. However, per Service Information Memo (SIM) 315, part number 1A-4932 should be replaced by part number 1A-6364. Part 1A-6364 is the replacement seal and gasket set that now includes E-60c Viton and cured E-60c Viton seals for those seals which were previously made of either Buna N, Ethylene Propylene, or silicon materials. The use of these newer seals will lead to increased service life of the sealed joints. Therefore, it is recommended that San Onofre replace the affected seals, when necessary, with those called out in SIM 315.

There are no maintenance recommendations for this component.

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

- Verify that the proper gaskets are installed in accordance with SIM 315;
- Perform a visual inspection of the head gaskets for signs of distress.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

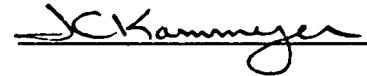
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Cylinder Head and Valves: Springs</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-360D</u>	TASK DESCRIPTION NO. <u>DR-09-02-350D-0</u>
SNPS GPL NO. <u>03-360D</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

- A review of Comanche Peak and Shoreham DR/QR Reports which establishes the acceptability of the valve spring for its intended purpose.
- A review of nuclear and non-nuclear industry experience listed on the Computer Tracking System indicates that there has been no design related failures associated with this component. The valve springs are identical on all the Owners Group TDI diesel engines (TDI Part No. 03-360-02-0M).

There have been several non-nuclear experiences where improperly shot peened springs were installed on some TDI engines. These springs failed during service and in some cases caused engine damage. The inspection recommended below will verify that the springs installed at San Onofre are not defective.

There are no maintenance or modification recommendations for this component.

The following Quality Revalidation inspection recommendation is made to ensure component quality:

- Visually inspect and document the color code of the valve springs. There should be no grey springs with brown stripes.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-360D-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

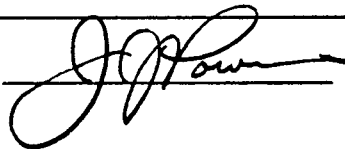
REFERENCES

Not required

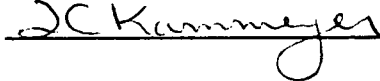
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Fuel Oil Drip Tank Assembly UTILITY Southern California Edison
GROUP PARTS LIST NO. 00-621A TASK DESCRIPTION NO. DR-09-00-621A-0
SNPS GPL NO. 99-621A CLASSIFICATION TYPE C

TASK DESCRIPTIONS

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

- There is no significant industry experience reported for the fuel oil drip tank in the EDG Component Tracking System.
- The fuel oil drip tanks used at San Onofre are similar to those used at Comanche Peak. The Comanche Peak tanks were reviewed in detail, Ref. 1, and found to have a relatively large margin of safety.

There have been no maintenance or modification recommendations made for this component in the lead engine review.

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-09-00-621A-0

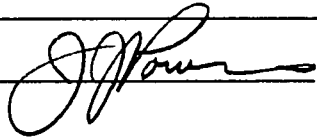
REFERENCES

- (1) Stone & Webster Calculation #11600.60 NM(B)-001-CZC-041 "Fuel Oil Drip Tank Assembly Structural Integrity Review and Seismic Qualification" (for Comanche Peak)

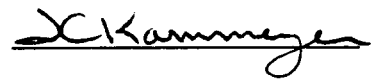
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Fuel Oil Day TankUTILITY Southern California EdisonGROUP PARTS LIST NO. 00-621CTASK DESCRIPTION NO. DR-09-00-621C-0SNPS GPL NO. 99-825ACLASSIFICATION TYPE A

TASK DESCRIPTIONS

A detailed design review of the fuel oil day tank is not necessary for San Onofre. The tank is TDI Part number 75041-117 and was manufactured by Iron and Steel Contracting Co. The tank was seismically analyzed in detail by SDRC., Ref. 3.

There are no experience items reported for this tank at San Onofre in the EDG Component Tracking System. There are no nuclear or non-nuclear experience items reported.

No special maintenance requirements were identified for this component in the lead engine design review (Grand Gulf).

Quality Revalidation is not deemed necessary 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-09-00-621C-0

REFERENCES

Specification E-73001, "Diesel Driven Electrical Generating sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition" Through Rev. 6, dated 2-13-1976.

Iron and Steel Contracting Co. Inc., S. San Francisco California, Drawing No. 27107, TDI Part No. 75041-117, "Fuel Oil Day Tanks."

Seismic Qualification Report, Dalaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, Submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.


DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Fuel Injection Pump</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-365A</u>	TASK DESCRIPTION NO. <u>DR-09-02-365A-0</u>
SNPS GPL NO. <u>03-365A</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

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

There are no modifications recommended for this component.

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

- It is recommended that the Owner inspect this component for leaks during the routine engine walk-around and that one pump be disassembled, inspected and tested during the refueling outage. Based on an evaluation of the results, a decision can be made regarding the need for inspection of the remainder of the pumps.

No Quality Revalidation is 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-09-02-365A-0

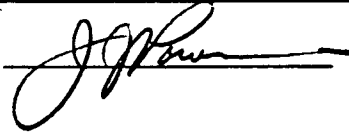
REFERENCES

Not required

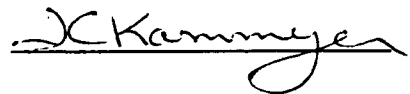
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Fuel Injection Nozzle Assy</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-365B</u>	TASK DESCRIPTION NO. <u>DR-09-02-365B-0</u>
SNPS GPL NO. <u>03-365B</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

- A review of the Component Tracking System indicated that there was no significant applicable industry experience.
- A review of the lead engine DR/QR Report (Comanche Peak).
- The component is similar in design to Comanche Peak, and both are manufactured by Bendix.

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

- Inspect for leaks during routine engine walkdown.
- Each assembly should be disassembled, inspected, cleaned and reassembled, pop tested and have the spray pattern checked at each refueling outage.
- TDI SIM Nos. 107 & 108 should be incorporated in the San Onofre maintenance procedures.

There are no modifications recommended for this component.

No Quality Revalidation is required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-365B-0

SPECIFIED STANDARDS

Not required

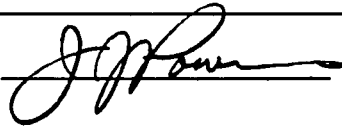
REFERENCES

Not required

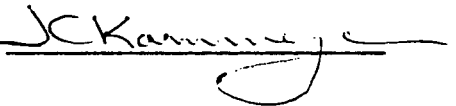
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT	<u>Fuel Injection Equipment</u> <u>Tube Assembly</u>	UTILITY	<u>Southern California Edison</u>
GROUP PARTS LIST NO.	<u>02-365C</u>	TASK DESCRIPTION NO.	<u>DR-09-02-365C-0</u>
SNPS GPL NO.	<u>03-365C</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Design review for this component is not required based on the review of the EDG Component Tracking System for applicable industry experience (Ref. 2), and the lead engine DR/QR Reports (Shoreham/Comanche Peak).

The fuel oil injection lines transfer fuel from the high pressure fuel injection pumps to the fuel injectors for the engine cylinders. The injection lines experience the extreme pulsating pressure of the plunger operated injection pumps. For TDI nuclear standby diesel generators, the pressure pulses are 3 ksi minimum pressure to 14.5 ksi maximum pressure. It was determined from fracture mechanics and fatigue analyses that flows on the inner surface of the tubing potentially cause fatigue failure of the tubing from pulsating fuel pressure (Ref. 1).

Industry experience (Ref. 2) indicates a number of fuel leakage incidents involving the high pressure fuel oil tube assemblies. Such incidents are related to either failures or loosening of attachment fittings during engine operation, or tube failures attributable to manufacturing flaws on the inner surface exceeding the critical limit.

All TDI fuel injection tubing is 1/2 in. SAE 1008 or SAE 1010 steel manufactured to identical specification and is found to be suitable for nuclear standby diesel generator service (Ref. 1) when manufacturing flows on the inner surfaces are below the critical limit.

The following maintenance recommendations for this component from the lead engine DR/QR Report for Shoreham site should be performed monthly while the engine is operating:

- Inspect compression fittings at both ends of each fuel injection line.

There are no modification recommendations for this component.

The following quality inspections as described on the Component Quality Review Checklist should be performed on all station engines:

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
QR-09-02-365C-0

- Perform a visual inspection on the fuel injection equipment for signs of leakage.
- All high pressure fuel lines are to be examined by an eddy current test (Ref. 3).

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

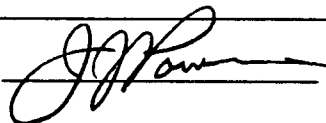
REFERENCES

1. Emergency Diesel General Fuel Oil Injection Tubing Qualification Analysis prepared for TDI Emergency Diesel Generator Owners Group April 1, 1984.
2. Emergency Diesel Generator Computer Tracking System - Industry Experience dated October 15, 1984.
3. Failure Analyses Assoc. NDE Procedure 11.10 "Eddy Current Inspection Procedure - High Pressure Fuel Lines - Carbon Steel."

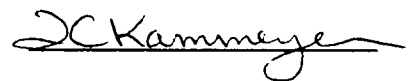
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Fuel Injection Equipment Supports	
COMPONENT <u>(Small Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-365D</u>	TASK DESCRIPTION NO. <u>DR-09-02-365D-1</u>
SNPS GPL NO. <u>03-365D</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 industry experience for this component in the EDG Component Tracking System.

There are no modification recommendations for this component.

A visual inspection of the support elastomer should be performed for signs of deterioration or degradation at each refueling outage. Any inserts found unsatisfactory should be replaced.

A field walkdown was performed in accordance with the small bore piping criteria document (Ref. 1) and indicates that this component will maintain its functional capability for normal and earthquake loading.

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-09-02-365D-1

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 0.

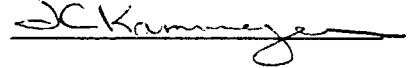
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to be "J. H. Power", written over a horizontal line.

PROGRAM MANAGER

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

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Fuel Pump Control Shaft, Linkage Assembly & Bearings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-371A&B</u>	TASK DESCRIPTION NO. <u>DR-09-02-371A&B-0</u>
SNPS GPL NO. <u>03-371A&B</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.
- A review of the lead engine DR/QR report (Comanche Peak).
- The components are similar in design to the components in the lead engine, but the shaft is larger in size (i.e., V-20 vs. V-16).

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

- Routine inspection and lubrication of the oil cups.

The following Quality inspections are recommended in order to ensure satisfactory operation and lubrication of the components:

- Visually inspect linkage and bearings for freedom of movement.
- Review site documentation to ensure that bearing lubrication procedures are in compliance with the TDI Manual.

Determination of control shaft hardness and linkage material are not considered necessary at this time pending satisfactory results of the above inspections and based on the satisfactory review and inspection of these components in the lead engine.

No modifications are required for these components.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-371A&B-0

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

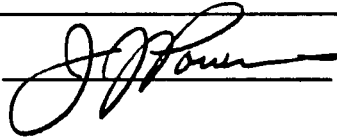
REFERENCES

Not required

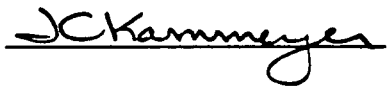
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Fuel Pump Linkage: Linkage Assembly and Bearing

COMPONENT PART NO.: 02-371B

See Component Part No.: 02-371A

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Fuel Pump Linkage:	
COMPONENT <u>Automatic Shutdown Cylinder</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-413B</u>	TASK DESCRIPTION NO. <u>DR-09-02-413B-2</u>
SNPS GPL NO. <u>03-413B</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTION:

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

- A review of the Component Tracking System indicated that there was no significant nuclear and non-nuclear industry experience.
- A review of the lead engine DR/QR Report (Comanche Peak).

There are no modifications or maintenance items recommended for this component.

No Quality Revalidation is 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-09-02-413B-2

REFERENCES:

Not required

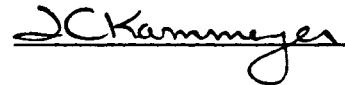
DOCUMENTATION REQUIRED:

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Engine Driven F.O. Booster Pump</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-445</u>	TASK DESCRIPTION NO. <u>DR-09-02-445-1</u>
SNPS GPL NO. <u>03-445</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.
- A review of the lead engine DR/QR report (Comanche Peak)

The transient torsional crankshaft vibration report has been reviewed to compare the torsional vibrations experienced on the San Onofre engines to that expected during future operation. The frequency and severity of torsional vibrations during startup will be less for future service than has been experienced thus far. Any effects on the engine driven fuel oil booster pump associated with future service should also be less severe. Therefore, the Owner's Group recommended inspection for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the engine driven fuel oil booster pump.

- Visually inspect pump gears on one station engine for signs of pitting or galling.

(Note: Any unsatisfactory inspection results should be subject to further engineering evaluation and a determination made as to the necessity of a decreased inspection interval.)

No additional modifications or maintenance recommendations are made as a result of 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-09-02-445-1

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

K.T. Fitzpatrick

PROGRAM MANAGER

J.C. Kammerer

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

FUEL OIL HEADERS - PIPING AND TUBING
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-450B

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the fuel oil headers - piping and tubing components to withstand the effects of normal operating and earthquake loadings. The primary function is to supply each cylinder with fuel oil, to provide for the recirculation of fuel oil through the injection pump, and to drain unused fuel back to the day tank.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the small bore piping/tubing 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 San Onofre 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 small bore piping and tubing, as defined by this Component Design Review, has been evaluated in accordance with Reference 1 and has been found acceptable with modification.

There are no TERs associated with this component.

The Quality Revalidation Inspection results identified in Appendix B 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 and information contained in Reference 2, it is concluded that the small bore piping and tubing will perform its intended design function at San Onofre under all normal operating and earthquake loadings if the following recommended modification is implemented as detailed in Reference 3:

- The fabricated cross on the fuel oil supply crossover header on the governor end of Engine 1 should be replaced with appropriate wrought fittings (socket welding or butt welding tee and reducers) to reduce high localized stress.

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 0.
2. Stone & Webster Calculation number 11600.60-NPB-0901-XH.
3. Memo No. 6425 from C. Malovrh (SWEC) to J. Kammeyer (SWEC) dated 10/19/84.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT	Fuel Oil Headers - Piping and Tubing (Small Bore Scope Only)	UTILITY	<u>Southern California Edison</u>
GROUP PARTS LIST NO.	<u>02-450B</u>	TASK DESCRIPTION NO.	<u>DR-09-02-450B-2</u>
SNPS GPL NO.	<u>03-450B</u>	CLASSIFICATION TYPE	<u>A</u>

TASK DESCRIPTIONS

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

PRIMARY FUNCTION

To supply each cylinder with fuel oil, to provide for the recirculation of fuel oil through the injection pump, and to drain unused fuel back to the day tank.

ATTRIBUTE TO BE VERIFIED

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

SPECIFIED STANDARDS

IEEE 387

ANSI B31.1 (1973)

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 0

COMPONENT DESIGN REVIEW CHECKLIST

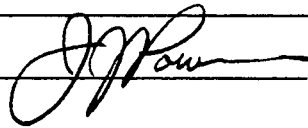
Page A2 of 2
DR-09-02-450B-2

DOCUMENTATION REQUIRED

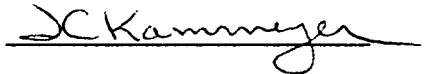
Delaval design documentation (specifications, calculations, drawings, etc.).

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



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Fuel Oil Header: <u>Piping and Tubing</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	<u>02-450B</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-450B</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-450B

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON 

PROGRAM MANAGER 
for JCK

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-450B

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Nator A. Saleh

PROGRAM MANAGER

J. J. [Signature]
for JCK

EDG COMPONENT TRACKING SYSTEM: SAN ONOFRE SITE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARYCOMPONENT NO. 02-450B

Effective Printout Date 09/17/84

COMPONENT TYPE: Fuel Oil Headers - Piping and Tubing

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Fuel oil leak occurred at the inlet to the fuel injection pump. Fitting replaced.	Zion 1 LER 295-76000 760621 NPRDS Hit 39	This is an isolated event. Eliminated fuel oil leakage.
Fuel line snapped at crossover connection.	Pilgrim 1 NPRDS 800903, Hit 3	Design review indicates that the present piping configuration precludes this occurrence at San Onofre.
Fuel oil line failure near left bank turbo at tee connection to main fuel oil header.	Grand Gulf LER No. 83-126, GGNS Diesel Generator Reliability Report dated 10/26/83, "Report on the Division I, II and III Diesel Generators." TDI memo from M. Herling to J. Kammeyer, dated 10/19/83, 10CFR21. Grand Gulf 75005/08, Grand Gulf Report No. 83-024 dated 10/22/83.	Design review indicates that the present piping configuration precludes this occurrence at San Onofre.

Appendix C

Page C2 of 3

EXPERIENCE

REFERENCE
DOCUMENTS

SAN ONOFRE
STATUS

Oil leak on the fuel oil supply manifold attributed to defective brazing.

Nine Mile 1
LER 220-82011,
820802

This is an isolated event. No defective welds have been found for this component at San Onofre.

Fuel oil line sheared at inlet to day storage tank. Break repaired and support modified.

Cooper
LER 298-77000,
770912

Piping involved is responsibility of architect/engineer and is not within the scope of the TDI effort.

Engine fuel oil line ruptured because of excessive vibration.

Grand Gulf
75005/08

The Design Review for this component concludes that this line is adequately supported to preclude this event.

Fuel line ruptured in the tubing at the branch tee. Support was added.

Grand Gulf
LER 83-126

The Design Review for this component concludes that this line is adequately supported to preclude this event.

Main fuel supply line separated at a swagelock fitting. Failure caused by high cycle caused by turbocharger vibration.

Grand Gulf
Report No. 83-024
on Division 1, 2, 3 D/G,
10CFR21 - TDI letter
to NRC dated 09/21/83

The Design Review for this component concludes that this line is adequately supported to preclude this event.

Fire caused by failure of swagelock connection caused by inadequate support.

TDI memo from
M. Herling to
J. Kammeyer
dated 10/19/83.

The Design Review for this component concludes that this line is adequately supported to preclude this event.

Diesel failed to reach rated speed as required. Diesel walkdown revealed fuel oil check valve not seating properly and loose tubing connection.

Farley 2
LER 346-81038,
810911.

This is a maintenance item and does not affect component design.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Potential problem with engine mounted fuel oil lines on engines S/N 74010/12. Line breaks may be caused by excessive vibration.	TDI letter to LILCO dated 10/27/83 (File #T-60)	Design review indicates that the present piping configuration precludes this occurrence at San Onofre.
Line between transfer pump and engine fuel oil header broke, possibly caused by excessive engine vibration.	10CFR21-TDI letter to NRC dated 09/21/83	The Design Review for this component concludes that this line is adequately supported to preclude this event.
Fuel oil header fitting leaked because of engine vibration loosening mechanical connections.	Vermont Yankee LER 271-76000, 760825 NPRDS Hit 200	The Design Review for this component concludes that this line is adequately supported to preclude this event.
Various flare and ferrule fittings loose from vibration.	Calvert Cliffs 1 LER 317-79074	This failure is probably caused by improper tightening of fittings during installation and has not occurred at San Onofre. Does not affect component design or integrity.
Several fittings of the fuel-oil-to-injection lines were leaking.	Calvert Cliffs 2 EPRI 110277	This is a maintenance item; does not affect component design.
Threaded nipple on suction side of injector had small crack.	Millstone 1 NPRDS 770201	TDI uses schedule 80 nipples for threaded pipe. These should preclude this event.
Fuel line ruptured in the joint of a branch tee at the main fuel oil header connection.	Grand Gulf LER 416-83126	Design review indicates that the present piping precludes this occurrence at San Onofre.
<u>NON-NUCLEAR</u>		
Swagelock elbow failed from excessive tightening.	TDI letter 08-02-84 to C. L. Ray. File No. T-70	This is a maintenance item and does not affect component design or integrity.
Fuel oil lines leaking. Lines replaced with heavier wall tubing.	Titan Navigation letter dated July 22, 1982	Design review indicates that the present piping precludes this occurrence at San Onofre.

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

FUEL OIL HEADER - FUEL OIL TUBING SUPPORTS
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-450D

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the fuel oil header 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 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 San Onofre 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 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 modification.

There are no TERs associated with this component.

The Quality Revalidation Inspection results identified in Appendix B 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 and information contained in Reference 2, it is concluded that the small bore piping/tubing supports will perform their intended design function at San Onofre under all normal operating and earthquake loadings if the following recommended modifications are implemented as detailed in Reference 3.

- Fuel oil return lines, both engines:

Modify one two-directional to a three-directional support approximately midspan of the lines running along the left side of the engine block at approximate elevation 23 feet.

Remaining U-bolts should be upgraded to 3/8-inch diameter and installed to provide lateral restraint while not restricting axial line growth.

All nuts should have suitable locking devices installed.

- Fuel oil return lines, Engine 2 only:

To maintain engine consistency, remove the lateral support on the riser directly below the pipe/tube interface on the generator end of the upper drain line (approximate elevation = 24 feet).

- Fuel oil return lines, Engine 1 only:

Add three-directional supports to the tube risers from the supply and circulation headers at approximately the access platform elevation. Remove spacers, tying risers together.

- Fuel oil supply header, both engines:

Modify one existing two-directional support approximately mid-engine on each fuel oil supply header to a three-directional support to provide axial restraint. Remaining two-directional restraints should be replaced or shimmed to provide proper sliding fit.

- Fuel oil crossover header, both engines:

Modify the two-directional support adjacent to the fuel oil supply crossover/riser connection tee to a three-directional restraint to restrict movements at the tee.

- Fuel oil crossover header, Engine 1 only:

The middle of the three supports (bent plate bolted to beam) located on the generator end, left side of the return line tie-in requires modification to increase section properties of plate and increase vertical stiffness.

U-bolts on governor end piping should be upgraded to 3/8-inch diameter and installed to provide lateral restraint while not restricting axial line growth. Nuts should have suitable locking devices installed.

- Fuel oil from pump to filter, both engines:

The support located on the 180-degree bend, also being utilized to support the drip header return line, should be modified to increase its capacity to carry lateral piping loads.

- Fuel oil drip header, both engines:

All welds connecting the drip header to the engine block should be removed and replaced with mechanical restraints. All but one restraint per header should be two-directional and installed in a manner that does not restrict axial thermal expansion/contraction. The remaining restraint should be three-directional and installed at approximately mid-engine.

- Fuel oil drip header, Engine 1 only:

The first support left of the drip tank, attached to the right bank intercooler, should have section properties of the existing vertical bar increased in the pipe's axial and lateral directions. The angle attachment to the intercooler requires reinforcement to accept applied moments. Modification to the support four feet to the left of this support is addressed above.

The U-bolt located on the sloped line near the left intercooler should be upgraded to 3/8-inch diameter and installed to provide lateral restraint while not restricting axial line growth. Nuts should be locked in place.

The nylon tube block attached to the right intercooler flange should be modified to ensure full bolt thread engagement.

- Fuel oil drip header, Engine 2 only:

The support attached to the right turbocharger support requires increased section properties and lateral stiffness to accept two-directional loads.

- Fuel oil nozzle holder to drain header, both engines:

The 1/4-inch tubes require the addition of clip type supports on Engine 1 cylinders 1L, 2L, 3L, 4L, 5L, 6L, 7L, 8L, 10L and 1R and on Engine 2 cylinders 9L, 10L, 6R, 8R and 9R, so that final installation is similar to Engine 2 cylinders 1L through 8L.

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 0.
2. Stone & Webster Calculation number 11600.60-NP(B)-0901-XH
3. Memo No. 6425 from C. Malovrh/SWEC to J. Kammeyer/SWEC dated 10/19/84.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Fuel Oil Header Supports
COMPONENT (Small Bore Scope Only)

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-450D

TASK DESCRIPTION NO. DR-09-02-450D-1

SNPS GPL NO. 03-450D

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 directions.

ATTRIBUTE TO BE VERIFIED

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

SPECIFIED STANDARDS

IEEE 387

ANSI B31.1 (1973)

REFERENCES

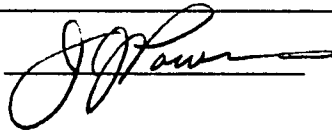
"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group" Report No. 11600.60-DC-02, Revision 0.

DOCUMENTATION REQUIRED

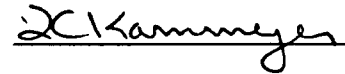
Delaval design documentation (specifications, calculations, drawings, etc.).

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



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Fuel Oil Header - Supports</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-450D</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-450D</u>		

TASK DESCRIPTIONS

Engine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-450D

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

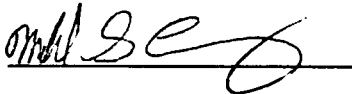
Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER


for Juk

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-450D

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Nita A. Saleta

PROGRAM MANAGER

J. J. Power
for JCK

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

COMPONENT NO. 02-450D

Effective Printout Date 09/17/84

COMPONENT TYPE: Fuel Oil Header - Supports

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None.		
<u>NUCLEAR</u>		
None.		
<u>NON-NUCLEAR</u>		
None.		

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Fuel Oil Filters & Strainers:
COMPONENT Filters UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-455A TASK DESCRIPTION NO. DR-09-02-455A-0
SNPS GPL NO. 03-455A CLASSIFICATION TYPE B

TASK DESCRIPTIONS

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

- A review of the component tracking system indicated that there was no significant applicable industry experience.
- A review of the lead engine DR/QR Report (Shoreham and Comanche Peak).

The following maintenance recommendations are applicable for this component:

- Filter element should be replaced at 20 psid rise above the clean differential pressure.
- The filter should be vented after maintenance or inspection of filter.
- Proper bowl bolt torques should be utilized during reassembly.

There are no modifications required for this component. No Quality Revalidation is 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-09-02-455A-0

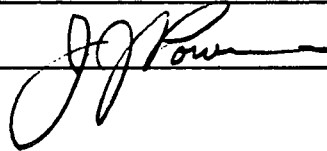
REFERENCES

Not required

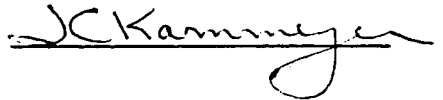
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Fuel Oil Filters & Strainers: Strainers</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-455B</u>	TASK DESCRIPTION NO. <u>DR-09-02-455B-0</u>
SNPS GPL NO. <u>03-455B</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

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

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

- Strainer elements should be cleaned at 5 psid.
- Bowl bolt torques of 120-150 in.-lbs should be utilized during reassembly of the strainer element.
- The strainer should be vented after inspection or maintenance.

There are no modifications recommended for this component.

No Quality Revalidation is required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-455B-0

SPECIFIED STANDARDS

Not required

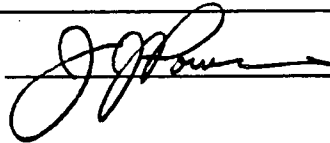
REFERENCES

Not required

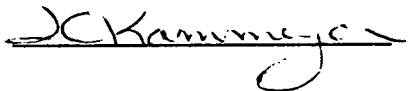
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Fuel Oil Filters and Strainers:

COMPONENT Mounting Hardware UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-455C TASK DESCRIPTION NO. DR-09-02-455C-0
SNPS GPL NO. 03-455C 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 and/or site experience.
- A review of the lead engine reports for Comanche Peak and Shoreham indicated substantial design margins.

There are no maintenance or modification recommendations in 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

Not required

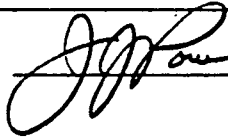
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-455C-0

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

AUXILIARY SUB-BASE & OIL AND WATER
PIPING FUEL OIL: PIPING AND FITTINGS
(SMALL BORE SCOPE ONLY)
COMPONENT PART NO. 02-717J

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the structural adequacy of the auxiliary sub-base fuel oil piping and fittings to withstand the effects of normal operating and earthquake loadings. The primary function of the piping is to carry fuel oil from the day tank supply line to the engine and auxiliary strainers via the auxiliary pump. Also, the piping carries fuel oil from the drip return tank to the drip return pump and from the drip return pump to the return piping. The primary function of the tubing is to carry fuel oil from the drip return crossover pipe to the drip tank.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the small bore piping and tubing 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 San Onofre 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 and tubing, 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 TERs associated with this component.

The Quality Revalidation Inspection results identified in Appendix B 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 and information contained in Reference 2, it is concluded that the small bore piping and tubing will perform its intended design function at San Onofre under all normal operating and earthquake loadings with the provision that the following recommended modifications be implemented as detailed in Reference 3:

Engine 1

Day Tank to the Fuel Oil Duplex Strainer Inlet

Add a three-direction support in the riser below the isolation valve to the duplex strainer inlet. Replace existing U-bolts with 3/8-inch diameter U-bolts. Install locking devices on threaded fasteners.

Fuel Oil Booster Pump to Fuel Oil Filter

Modify the two-direction support on the 30-inch long horizontal pipe run near the fuel oil filter to a three-direction support.

Piping From the Fuel Oil Recirculation Header to the Day Tank

Add a three-direction support within 12 inches downstream of the fuel oil booster pump bypass relief valve branch connection.

Modify the two-direction support located approximately 4 feet from the 1½ x 1½ inch reducer in the return line to a three-direction restraint.

Piping From the Fuel Oil Supply Header to the Day Tank

Reinstall the missing U-bolt on the horizontal near the 14-inch riser. Use 3/8-inch diameter U-bolt installed so as not to restrict axial movement. Install locking devices on threaded fasteners.

Add a two-directional restraint to the horizontal piping run in the area where it penetrates the skid structure near the connection to the plant piping similar to Engine 2.

Modify the two-direction support located approximately 4 feet from the 1½ by 1½-inch reducer in the return line to a three-direction restraint.

Fuel Waste Return Pump Suction and Discharge Piping

Add a two-direction support at the bottom of the 1½-inch pipe riser from the fuel oil waste tank.

Missing two-directional restraint approximately 3 feet from the 1 1/4 by 3/4-inch reducer near the fuel oil waste tank should be reinstalled.

Add a two-direction support in the pump suction piping horizontal run upstream of the shutoff valve approximately 6 inches from the elbow.

Add a two-direction support on the discharge piping within 12 inches downstream of the shutoff valve.

Stiffen 1/4-inch plate and increase U-bolt size for support located approximately 15 inches from tank discharge U-bolt to be 3/8-inch diameter and fitted so as not to restrict axial movement. Nuts should have locking devices installed.

Fuel Oil Waste Tank Drain Piping

The existing two-directional restraint in the sump should be modified by attaching it to the structure. The restraint at approximate el 22 feet should have 3/8-inch diameter U-bolts fitted so as not to restrict axial movement and additional weld to skid installed. Nuts should have locking devices installed.

Engine 2

Fuel Oil Waste Tank Drain Piping

Modify existing two-direction support to a three-direction support utilizing a structural attachment in lieu of the U-bolt attachment to another pipe.

Fuel Oil Booster Pump Discharge Piping

Add a three-direction support within 12 inches of the shutoff valve on the upstream side.

Fuel Waste Return Pump Suction and Discharge Piping

Add a two-direction support at the bottom of the 1 1/4-inch pipe riser from the fuel oil waste tank.

Add a three-direction support within 12 inches of the pump suction shutoff valve on the upstream side.

The existing U-bolt approximately 3 feet from the connection to the plant piping should be modified to 3/8-inch diameter and installed so as not to restrict axial movement. Threaded fasteners should have locking devices installed.

Piping From the Day Tank to the Fuel Oil Strainer

Add a two-direction support in the 2 foot - 9 inch horizontal run located approximately 4 feet from the trench piping flanged interface.

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 0.
2. Stone & Webster Calculation Number 11600.60-NP(B)-0901-XH.
3. Memo No. 6425 from C. Malovrh (SWEC) to J. Kammeyer (SWEC) dated 10/19/84.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Auxiliary Sub Base
Oil and Water Piping -
Fuel Oil: Piping and Fittings
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-717J TASK DESCRIPTION NO. DR-09-02-717J-1
SNPS GPL NO. 03-717M CLASSIFICATION TYPE A

TASK DESCRIPTIONS

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

PRIMARY FUNCTION

To provide/carry fuel oil from the day tank supply line to the engine and auxiliary strainers via the auxiliary pump. Also, the piping carries fuel oil from the drip return tank to the drip return pump, and from the drip return pump to the return piping. The primary function of the tubing is to provide/carry fuel oil from the drip return crossover pipe to the drip tank.

ATTRIBUTE TO BE VERIFIED

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

SPECIFIED STANDARDS

IEEE 387

ANSI B31.1 (1973)

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 0.


COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-717J-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



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Aux. Sub Base & Oil & Water Piping - Fuel Oil: Piping and Fittings	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	02-717J	REV. NO.	1
SNPS GPL NO.	03-717M		

TASK DESCRIPTIONSEngine 1

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 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIEDEngine 1

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

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIAEngine 1

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

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

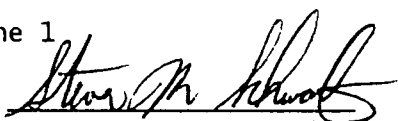
Engine 1

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

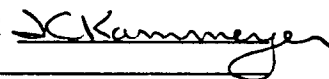
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
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
09-02-717J

COMPONENT REVIEW (continued)

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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 2

Same as Engine 1

GROUP CHAIRPERSON

Steve M. Schwartz

PROGRAM MANAGER

J. Kammerer

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

COMPONENT NO. 02-717J

Effective Printout Date 09/17/84

COMPONENT TYPE: Auxiliary Sub-Base Oil
and Water Piping-Fuel Oil:
Piping and Fittings

EXPERIENCEREFERENCE
DOCUMENTSSAN ONOFRE
STATUSSAN ONOFRE

None

NUCLEAR

Pin hole leak in crossover fuel line diluted lube oil to the No. 11 bearing causing the cap to warp. Diesel was replaced.

Quad Cities 1
LER 254-81022, 811107

All fuel piping is external and cannot contaminate lube oil. Therefore, experience is not applicable.

Diesel fuel oil and starting air piping was upgraded to conform to requirements of Reg. 1.26-B.

Sequoyah 1
LER 327-77000,
770106

Conclusions of this report indicate that these components will perform their intended design function during normal and earthquake loadings.

Diesel fire pump had small oil weep at a coupling to tubing weld on the engine's cylinder injection return line.

Nine Mile 1,
LER 220-81007,
810202

San Onofre does not use welds on injection return line. Fittings used exclusively.

Diesel did not reach speed and voltage within 15 second requirement because of air entrainment in fuel line.

Turkey Point 3
LER 250-77000,
770331

Not possible at San Onofre since fuel oil day tank is located above engine to prevent air entrainment.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
A leak was discovered in a fuel line fitting; failure caused by vibration.	Trojan LER 344-79006, 790415	The expected result of the future vibration evaluation should prove this not to be a problem.
A small fuel oil leak was discovered and corrected.	Peach Bottom 2, EPRI 112277 DG-E2	Maintenance item has no impact on component design or integrity.
Cleveland Electric filed a 10CFR50.55E after field inspection revealed violations of ASME III.	DAR No. 89, 10CFR50.55E 3/5/82	Results of this report indicate that the piping components will perform their intended design functions during normal operating and earthquake loadings.
Fuel line fitting leak. Replaced fittings and line.	Catawba Report "Extended Operation Tests and Inspections of Diesel Generators" 4/5/84 Pg 7-2 (File No. T-53)	Maintenance item, does not affect component design or integrity.
Fuel oil line breaks and fire at Grand Gulf.	10CFR50.55E, 10CFR21 DAR No. 145, 10/3/83, TDI Notification to NRC, 9/21/83	Results of this report indicate that the piping components will perform their intended design functions during normal operating and earthquake loadings.

NON-NUCLEAR

None

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Aux. Sub Base and Oil and Water Piping: COMPONENT <u>Fuel Oil Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-717K</u>	TASK DESCRIPTION NO. <u>DR-09-02-717K-1</u>
SNPS GPL NO. <u>03-717N</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

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

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

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

- Inspect and clean valves at each plant refueling outage.

There are no modifications required for this component.

No Quality Revalidation is required for this component, however, an inspection should be performed to verify the relief valves have been installed in a vertical position per the manufacturer's recommendations.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-717K-1

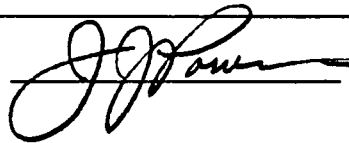
REFERENCES

Not required

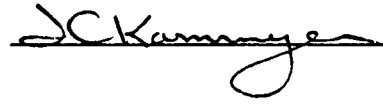
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Auxiliary Sub-Base & Oil
and Water Piping - Fuel Oil:
COMPONENT Gaskets and Bolting UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-717L TASK DESCRIPTION NO. DR-09-02-717L-0
SNPS GPL NO. 03-717P CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Design review for this component is not required based on the review of applicable industry experience in the EDG Component Tracking System, and the lead engine DR/QR reports (Shoreham/Comanche Peak).

As part of the suggested daily engine maintenance, the auxiliary piping should be walked down to verify the leak tightness of the fuel oil piping flanges.

There are no 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


COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-717L-0

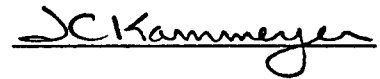
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Generator UTILITY Southern California Edison
GROUP PARTS LIST NO. S0-101 TASK DESCRIPTION NO. DR-09-S0-101-1
SNPS GPL NO. 03-650A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

At the request of Southern California Edison, design review and quality inspections were not performed on the generator at San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

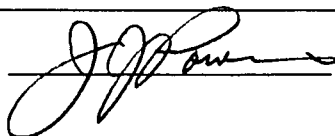
REFERENCES

Not required

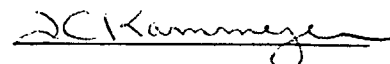
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Generator:	
COMPONENT <u>Generator Controls</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>SO-102</u>	TASK DESCRIPTION NO. <u>DR-09-SO-102-0</u>
SNPS GPL NO. <u>03-650B</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

At the request of Southern California Edison, design review and quality inspections were not performed on the Generator Controls at San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

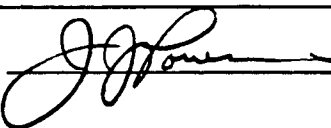
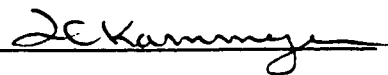
Not required

REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON <u></u>	PROGRAM MANAGER <u></u>
--	--

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Generator - Shaft and BearingUTILITY Southern California EdisonGROUP PARTS LIST NO. S0-103TASK DESCRIPTION NO. DR-09-S0-103-0SNPS GPL NO. 03-650CCLASSIFICATION TYPE A

TASK DESCRIPTIONS

At the request of Southern California Edison, a Design Review was not performed for this component at San Onofre.

A review of the Component Tracking System indicated no adverse industry experience associated with this component.

Quality Revalidation was 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 

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Control Panel Assembly	
COMPONENT <u>Cabinet/System</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-500A</u>	TASK DESCRIPTION NO. <u>DR-09-02-500A-0</u>
SNPS GPL NO. <u>03-500A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

The application of the electropneumatic control system used on San Onofre to start, stop, operate, protect, and monitor the diesel is essentially identical to Comanche Peak design.

The logic design used on San Onofre to disable the Group II trip functions during initial diesel startup and bypass all the Group I and Group II trips during an emergency condition is identical to Comanche Peak design.

San Onofre differs from Comanche Peak in that the controls to lock out the diesel for maintenance are simpler than those on Comanche Peak, but are identical to Shoreham controls.

Nuclear and non-nuclear industry experience listed does not show any significant or generic problems associated with the type of electropneumatic system used on San Onofre.

There are no maintenance or modification recommendations required for the control panel assembly cabinet/system.

A quality revalidation of the control panel assembly cabinet/system is not deemed necessary.

Based on the above, a design review of the control panel assembly cabinet/system is not required for San Onofre.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-500A-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

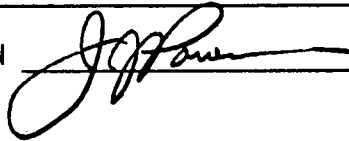
REFERENCES

Not required

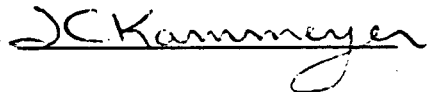
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT <u>Control Panel Assembly - Accumulator</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-500F</u>	TASK DESCRIPTION NO. <u>DR-09-02-500F-0</u>
SNPS GPL NO. <u>03-500H</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

The accumulators used on San Onofre are identical to those used on both Shoreham and Comanche Peak with regard to manufacturer and application.

There is no industry experience listed in the EDG Component Tracking System for this component.

There are no maintenance or modification recommendations required for the accumulators.

Quality Revalidation of the accumulators is not deemed necessary.

Based on the above, a design review for the accumulators is not required for San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-500F-0

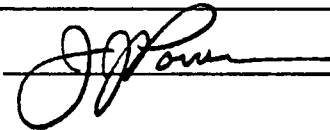
REFERENCES

Not required

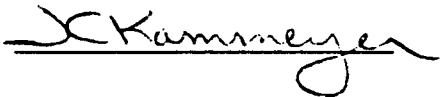
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

COMPONENT Control Panel Assembly Valves UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-500G TASK DESCRIPTION NO. DR-09-02-500G-0

SNPS GPL NO. 03-500G CLASSIFICATION TYPE A

TASK DESCRIPTIONS

The control panel valves used at San Onofre are identical in valve application and manufacturer to those at Comanche Peak, with the exception of Check Valve F-573-347. San Onofre uses a Nupro check valve, F-573-347, to prevent backflow while venting on a trip condition, whereas Comanche Peak uses a California Controls check valve, F-573-127, for this function. The Nupro check valve is to operate in the compressed air system at 60 psi and is adequate for its intended service.

The nuclear and non-nuclear industry experience listed does not show any significant experience relating to the control panel valves.

To minimize fouling of the control panel valves, the valves, including the fine mesh screen in the check valve, should be inspected and cleaned during each refueling outage. This recommended maintenance interval should be reassessed depending upon the degree of system fouling.

There are no recommended modifications for the control panel valves.

A quality revalidation of the control panel valves is not deemed necessary.

Based on the above, a design review for the control panel valves is not required for San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-500G-0

REFERENCES

Not required

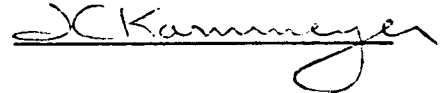
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

A handwritten signature in black ink, appearing to read "J. J. Power", 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 DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Control Panel Assembly -	
COMPONENT <u>Pressure Switches</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-500H</u>	TASK DESCRIPTION NO. <u>DR-09-02-500H-0</u>
SNPS GPL NO. <u>03-500H</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

The pressure switches used on San Onofre are identical to those used on Comanche Peak with regard to manufacturer and application.

The nuclear industry experience listed in the Component Tracking System does not show any generic or significant problems with the pressure switches.

There are no maintenance or modification recommendations required for the pressure switches.

Quality Revalidation of the pressure switches is not deemed necessary.

Based on the above, a design review for pressure switches 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-09-02-500H-0

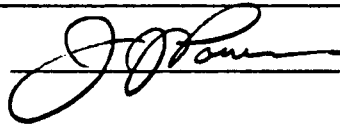
REFERENCES

Not required

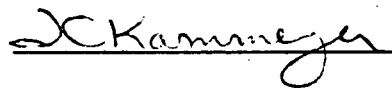
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Control Panel Assembly
COMPONENT Control Relays

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-500J

TASK DESCRIPTION NO.: DR-05-02-500J-0

SNPS GPL NO. 03-500J

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

The application of the control relays used on San Onofre, to start/stop the diesel generator and to monitor its integrity, is similar to Grand Gulf. San Onofre differs from Grand Gulf in that an Allen-Bradley relay is used for field-flashing at San Onofre while Grand Gulf uses a Humphrey solenoid. Also, San Onofre lists a Moore constant differential relay (TDI Part No. F-579-054) which functions as an airflow controller. Since this relay is a pneumatic device, it is not part of the scope for electrical control relays.

Nuclear Industry experience listed showed that most of the experience items are not applicable to relay type, service condition, or are otherwise unrelated to TDI design, and therefore are not applicable to this component.

There are no maintenance or modification recommendations required for the control panel assembly control relays.

Quality Revalidation of the control panel assembly control relays is not deemed necessary.

Based on the above, a design review for the control relays is not required for San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-05-02-500J-0

SPECIFIED STANDARDS

Not required

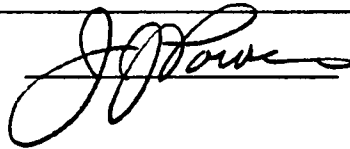
REFERENCES

Not required

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Control Panel Assembly:	
COMPONENT <u>Solenoid Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-500K</u>	TASK DESCRIPTION NO. <u>DR-09-02-500K-0</u>
SNPS GPL NO. <u>03-500K</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

The control panel assembly solenoid valves used at San Onofre are identical to those used at Shoreham with regard to manufacturer and application.

The San Onofre site control panel assembly solenoid valves (P/N F-586-061) are identical to those at Shoreham with respect to their application for the shutdown system activate, stop, maintenance lockout, and shutdown deactivate functions. At San Onofre, the solenoid valves are located on a three-station Humphrey manifold assembly (P/N F-568-045) for the above functions. Two additional shutdown deactivate solenoid valves (P/N F-586-024) are located on individual bases.

The Circle Seal Control solenoid valves, used as pilot valves for the California Controls Co. "Start Air Admission Valves" (TDI P/N KR-001-000) in the starting air systems on San Onofre, are similar to Shoreham design.

There are no maintenance or modification recommendations required for this component.

Quality revalidation for this component is not deemed necessary.

There is no non-nuclear industry experience listed in the EDG Component Tracking System for this component. The nuclear industry experiences have been reviewed with regard to San Onofre, and no generic or significant problems are apparent.

Based on the above information, a design review is not required for this component at San Onofre.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-500K-0

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

REFERENCES

Not required

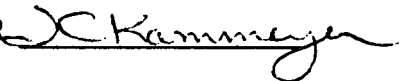
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Control Panel Components - COMPONENT <u>Piping, Tubing, Fittings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-500M</u>	TASK DESCRIPTION NO. <u>DR-09-02-500M-0</u>
SNPS GPL NO. <u>03-500M</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Detailed design review of control panel piping, tubing and fittings is not required for San Onofre. Review of the two lead TDI engines has revealed no inherent design flaws in these components. Typically the engine control panel is seismically qualified by shake table tests, and these tests have provided adequate qualification for all service conditions. The control panel used at San Onofre was shake table tested at Wyle Labs. Industry experience items reported in the EDG Component Tracking System relate to minor maintenance problems.

No maintenance or modification requirements are applicable to this component.
No quality revalidation is required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

None

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-500M-0

REFERENCES

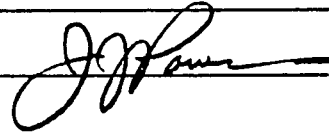
Specification E-73001," Diesel Driven Electrical Generating sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition" through Rev 6, dated 2-13-1976.

Seismic Qualification Report, Delaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.

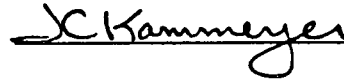
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

Control Panel Assembly - COMPONENT <u>Piping, Tubing & Fittings</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO. <u>02-500M</u>	REV. NO. <u>1</u>	
SNPS GPL NO. <u>03-500M</u>		

TASK DESCRIPTIONS

No further review of component 02-500M is required for the following reasons:

- a) Component was reviewed on two lead engines with satisfactory results.
- b) There is no significant negative industry experience for this component.

GROUP CHAIRPERSON

Victor A. Saleto

PROGRAM MANAGER

J. J. Brown
for JCK

COMPONENT QUALITY REVALIDATION CHECKLIST

Control Panel Assembly Terminal Boards/ COMPONENT <u>Switches, Wiring</u>	Southern California Edison San Onofre Nuclear Generating UTILITY <u>Station - Unit 1</u>
GPL NO. <u>02-500N</u>	REV. NO. <u>2</u>
SNPS GPL NO. <u>03-500N</u>	

TASK DESCRIPTIONS

No further review of component 02-500N is required for the following reasons:

- a) Component was reviewed on two lead engines with satisfactory results.
- b) There is no significant industry experience other than expected routine maintenance experience.

GROUP CHAIRPERSON

Nutor A. Saletta

PROGRAM MANAGER

J. J. How
for JCK

TDI OWNERS GROUP
for
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1
FOUNDATION BOLTS
COMPONENT PART NO. 02-550

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews of the foundation bolts of the engine, generator, barring device, auxiliary base, cooling water pipe supports, starting air base, starting air tanks, and engine sump drain pipe. The primary function of the foundation bolts is to fasten the above components to the concrete floor. There are twenty-six 2-inch engine foundation bolts (TDI Part No. 1A-6005, 6006), twelve 1½-inch generator foundation bolts (Part No. 00-550-02-AD), four ¾-inch barring device foundation bolts (Part No. 00-550-02-AB), seven 1-inch starting air base foundation bolts (Part No. 00-550-02-AE), four 1-inch cooling water pipe support foundation bolts (Part No. 00-550-02-AA), twenty-four 1½-inch starting air tank foundation bolts (Part No. 00-550-02-AM) and thirty-two 1-inch auxiliary base foundation bolts (Part No. 00-550-01-AC) including eight lube oil cooler and ten engine sump drain pipe supports. All studs are embedded hold-down bolts, supplied by TDI and designed per TDI requirements.

II OBJECTIVE

The objective of this review was to evaluate the structural adequacy of the foundation bolts for the effects of normal operating and seismic loadings.

III METHODOLOGY

The TDI Emergency Diesel Generator Component Tracking System was reviewed for experience with foundation bolts at San Onofre and in nuclear and non-nuclear industries. See Appendix C for results.

TDI supplied seismic reports (Ref. 3 and 4) were reviewed. Additional consideration for thermal expansion, concrete bonding capacity and partial shear cone failure was given to the critical components. The peak torque transient measured during startup was also reviewed for possible fatigue effect on engine foundation bolts. The torque value to produce the required preload (Ref. 5) for the foundation bolts was also reviewed.

Quality Revalidation Checklist results were reviewed for acceptability.

IV RESULTS AND CONCLUSIONS

The review of TDI supplied drawings and instruction manuals (Ref. 2 and 5) revealed the following material specifications and torque values:

<u>Location</u>	<u>Material</u>	<u>Torque</u>
Engine Foundation	ASTM A193 Grade 7 hot rolled heat treated 25-32 Rockwell 'C' or AISI 4140 heat treated cold drawn steel	3800 ft-lb
Generator Foundation	ASTM A 36 H.R.S. or AISI 4140 annealed with bend	480 ft-lb
Auxiliary Base Foundation	ASTM A 36 H.R.S. or AISI 4140 cold drawn or AISI 4140 annealed with bend	245 ft-lb
Barring Device Foundation	ASTM A36 H.R.S. or AISI 4140 cold drawn steel with bend or AISI 4140 annealed with bend	100 ft-lb

The review of the engine foundation bolts found the most significant concern to be generator bolts under seismic loads and major electrical transient torque (e.g. short circuits out-of-phase, generator motoring, etc). These bolts were concluded to be unacceptable in Reference 3 and a recommendation for higher strength bolts was made. Based on the review of current drawings, the material of these bolts has not been changed as recommended, but the size of the bolt was found to be $1\frac{1}{4}$ inches instead of the 1-inch bolt that was analyzed in Reference 3.

Since the major electrical transient torque is not a normal event, and the bolt stresses were calculated for 1-inch bolts while the drawing shows $1\frac{1}{4}$ inch bolts, the bolt stresses were recalculated (Ref. 6). It was found that with the correct size of bolt and appropriate calculation approach, the bolt stresses are within the allowables per Reference 1.

It was determined that the specified torque of 480 ft-lb (Ref. 5) produces a bolt preload that is smaller than the maximum calculated bolt load. However, generator #1 has experienced two major electrical transient events, and subsequent inspections indicated that the foundation was not adversely effected. Therefore, the existing bolt torque appears to be adequate. In order to assure continued reliability, it is recommended that the foundation bolts for both engines be torqued to 600 ft-lbs at the next refueling outage.

Foundation bolts for other components were also reviewed and found adequate. . The nozzle loads and engine vibration effects were negligible.

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

Based on the above review, it is concluded that the foundation bolts are adequate for their intended use at San Onofre.

V REFERENCES

1. Technical Specification of the Diesel-driven Electrical Generating Sets for San Onofre Nuclear Generating Station Unit 1, Southern California Edison Co. Spec. E-73001.
2. "Foundation Drawing DSRV-20" TDI drawing R-3925, Rev. H and R-3928, Rev H.
3. "Seismic Qualification Report," Structural Dynamic Research Corporation Project No. 7416, Oct. 1976.
4. "Report of Seismic Analysis of 7500 KVA, 450 RPM- Synchronous Generator," Portec, Inc. Electric Products Division.
5. Instruction Manuals for San Onofre Nuclear Generating Station, Volumes I & II.
6. Stone and Webster Engineering Corporation Calculation No. 11600.60-NM(B)-004-CZC-029, Rev. 0.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Foundation Bolts - Anchors, COMPONENT <u>Bolts, Misc. Hardware</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-550</u>	TASK DESCRIPTION NO. <u>DR-09-02-550-0</u>
SNPS GPL NO. <u>03-550</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

- Review structural adequacy of the foundation bolts for the engine and generator due to the effects of normal operating and seismic loads.
 - Review information in applicable TERs.
 - Review existing seismic qualification.
 - Review generator short circuit bolt loads.
-

PRIMARY FUNCTION

The foundation bolts provide the structural connection between the engine, generator and other off-engine mounted equipment and their concrete foundations.

ATTRIBUTE TO BE VERIFIED

- Verify seismic qualification and structural adequacy of the engine and generator foundation bolts.
 - Verify adequacy of specified bolt torques.
-

SPECIFIED STANDARDS

None

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2
DR-09-02-550-0

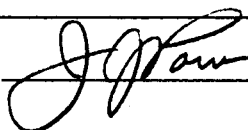
REFERENCES

1. Seismic Qualification Report, Delaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416
2. Specification E-73001, "Diesel Driven Electrical Generating sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition" through Rev 6 dated 2-13-1976

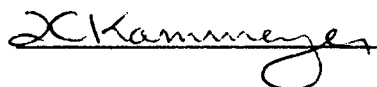
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Foundation Bolts - Anchors, Bolts, Miscellaneous <u>Hardware</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	<u>02-550</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-550</u>		

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.

Engine 2

Same as Engine 1

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package

Engine 2

Same as Engine 1

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package

Engine 2

Same as Engine 1

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3
09-02-550

REFERENCES

Engine 1

1. QCI No. 52

Engine 2

Same as Engine 1

DOCUMENTATION REQUIRED

Engine 1

1. Document Summary Sheet

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

Steve A. Schwartz

PROGRAM MANAGER

JC Kammerer

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.

Engine 2

Same as Engine 1

RESULTS AND CONCLUSION

Engine 1

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.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3
09-02-550

RESULTS AND CONCLUSION (continued)

Engine 2

Same as Engine 1

GROUP CHAIRPERSON Nitor A. Saleta

PROGRAM MANAGER JC Kammerer

EDG COMPONENT TRACKING SYSTEM: SAN ONOFRE, NUCLEAR
AND NON-NUCLEAR INDUSTRY EXPERIENCE SUMMARY

COMPONENT NO. 02-550

Effective Printout Date 10/31/84

COMPONENT TYPE: Foundation Bolts

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Engine internal components damaged. Engine mounting screw found loose, which may not have allowed uniform expansion.	Arkansas 2, LER 368-78016, 781109	This would primarily relate to the engine foundation bolts, and loose bolts could produce uneven expansion. If there had been such uneven expansion of the engine because of loose foundation bolts at San Onofre, grout would have been found damaged, but no adverse experience has been reported at San Onofre.
<u>NON-NUCLEAR</u>		
Several engine bolts sheared off because of an excessive gap between the engine skid and foundation pads.	Rafha/ Saudi Arabia, Telex from Bailey (TDI) to G. King (TDI) dated 4/15/81 (File no. T-42)	No adverse experience has been reported for San Onofre. The San Onofre engines have had sufficient operating time such that this problem would have already occurred if it were going to.

EXPERIENCE

Engine flexed on foundation causing engine cover bolts to break. Caused by gap between skid and chock plates. TDI hand ground chock plates to achieve full face contact with the skid.

REFERENCE
DOCUMENTS

Rafha/Saudi Arabia,
Telex from Bailey
(TDI) to Delaval HQ
(File no. T-49)

SAN ONOFRE
STATUS

No adverse experience has been reported for San Onofre. The San Onofre engines have had sufficient operating time such that this problem would have already occurred if it were going to.

COMPONENT DESIGN REVIEW CHECKLIST
SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

Auxiliary Sub Base and Oil
and Water Piping:
COMPONENT Auxiliary Sub Base UTILITY Southern California Edison
GROUP PARTS LIST NO. 02-717A TASK DESCRIPTION NO. DR-09-02-717A-0
SNPS GPL NO. 03-717A 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 no significant applicable industry experience.
- A detailed dynamic analysis was performed by SDRC to seismically qualify the skid (Ref. 2).

There are no maintenance recommendations from the lead engine beyond those recommended in the TDI Instruction Manual.

Quality Revalidation is not required for this component.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

None

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2
DR-09-02-717A-0

REFERENCES

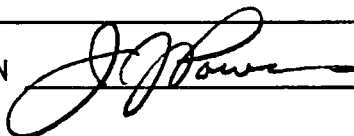
Specification E-73001, "Diesel Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition," through Rev. 6 dated 02/13/76.

Seismic Qualification Report, Delaval DSRV-20 Diesel Generator Unit, for San Onofre Nuclear Station Unit No. 1, Southern California Edison Company, Submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.

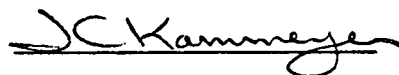
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI
OWNERS GROUP

GENERIC MAINTENANCE MATRIX

APPENDIX - II

OVERVIEW AND DEFINITIONS

OPERATING AND STANDBY SURVEILLANCE
PARAMETERS

PART A

TDI OWNERS GROUP

GENERIC MAINTENANCE AND SURVEILLANCE PROGRAM

APPENDIX - II

I INTRODUCTION

The purpose of this appendix is to provide the TDI Owners with a set of maintenance and surveillance recommendations for diesel generator components which have been developed by TDI and/or the Owners Group as a result of the overall Owners Group Program and including subsequent testing and inspections performed following the review conducted by the original program. This appendix is intended to enhance the existing TDI Instruction Manual, Volume I and Volume III, which will maintain the qualification of the diesel generators for the life of the plant.

II METHODOLOGY

During the implementation of the Owners Group Program Plan, the Owners Group Technical Staff reviewed many sources of information regarding the maintenance and surveillance for the diesel generator components identified in this appendix. These sources included TDI Instruction Manuals, Service Information Memos (SIMS), and TDI correspondence on specific components. The basis of this matrix is formed by the following:

- Owners Group Technical Staff review of TDI Instruction Manuals, SIMS, and TDI correspondence on specific components.
- Technical Staff input regarding the adequacy of recommendations found in sources mentioned above.
- Additional maintenance recommendations identified during the DR/QR review.
- Results of subsequent testing and surveillance (i.e., Shoreham EDG103 750-hour endurance run and subsequent engine teardown) performed following the review conducted during the original program.
- Additional review by the Owners Group representatives.

It should be noted that this revision in some cases modifies the original program results based on this additional information and review.

III RESULTS AND CONCLUSIONS

Proper maintenance is important in ensuring long, reliable and satisfactory service of the emergency diesel generators. Maintenance work, in order to be effective, must be carried out thoroughly and regularly. It

is for these reasons that a detailed schedule of maintenance service has been laid out by the Owners Group for the TDI Diesel Generators. This schedule should be followed as closely as the operating conditions will permit. This maintenance service as specified supersedes previous general maintenance requirements, but is separate and does not supersede Quality Revalidation and/or modifications previously recommended. The schedule details specific components requiring maintenance on a regular basis. This schedule separates the maintenance activities into frequencies as set forth in the subsequent list of definitions.

Inspections, as outlined in this maintenance schedule, are to be performed and parts refurbished or replaced as required by the program or deemed necessary by the inspection. Any adverse findings shall be investigated and corrective action, including amended inspection frequencies, shall be implemented unless sufficient justification is present to do otherwise.

This generic matrix, Parts A, B, C together with Part D entitled "Site-Specific Maintenance Matrix" and the sources defined in Section II form the TDI Maintenance Program. Note that component numbers used in the generic matrix are for Texas Utilities' Comanche Peak Steam Electric Station - Unit 1. Part E provides a cross reference to identify corresponding components for other engines. Also note that a blank in the cross reference signifies that a component is not on a particular engine and thus that Owner would not perform that maintenance item.

Tables 1 and 2 of Part A provide engine operating and standby surveillance parameters and frequencies. It is recommended that the utility address these tables in its operating and monitoring programs. Table 1 addresses operating parameters and is not duplicated in the maintenance schedules; these parameters are to be recorded and/or checked during the monthly testing and any other period of operation. Table 2 addresses the standby parameters that occur on a daily frequency and are not duplicated in the maintenance schedules.

IV. DEFINITION OF TERMS

1. Overhaul Frequency

- a) A complete engine teardown and inspection will be performed every 10 years. The utility has the flexibility to inspect one engine/reactor unit at the EOC prior to 10 years and the other engine at the EOC following 10 years. Alternately for PWR units, the inspection may be performed coincident with the 10-year reactor vessel in-service inspection. This will permit both engines for each unit to be disassembled in parallel since one engine will not have to remain in service with the reactor vessel off loaded. (For reactor units having three engines, the inspections are to be carried out as above with the third engine to be inspected at the second EOC following 10 years). The 10-year interval will typically be taken from issuance of the Low Power Operating license or from subsequent teardown and inspection for plants already in operation.

b) A one time inspection will be performed at the EOC closest to 5 years. For a unit, one engine may be inspected at the EOC prior to 5 years and the other at the EOC after 5 years to minimize plant outage length. (For reactor units having three engines, the inspections are to be carried out as above with the third engine to be inspected at the second EOC following 5 years). This inspection will generally involve the same components as the 10-year teardown; however, only a sample of items for some components will be inspected as set forth in the maintenance schedule. During this 5-year inspection any significant adverse findings of a particular component will result in an inspection of all such components of that engine to determine any adverse trends. Favorable findings will result in reassembly of the engine for service.

2. Daily Frequency - To be performed once per day.
3. Monthly Frequency - To be performed once in a month; normally during, before, or after test run per plant Technical Specifications.
4. EOC - (End of Cycle) - To be performed once during outage for refueling.
5. Alternate EOC - To be performed once every other outage for refueling.
6. Five Years - To be performed once at the EOC occurring nearest to the end of a recurring 5-year period.
7. As Required - To be performed as often as good maintenance, site procedures, manufacturer's recommendations, or experience dictate as determined by site personnel.
8. Maintenance - Monitoring and/or surveillance on a periodic frequency to assure the component will perform its intended function in a safe reliable manner.
9. Accessible - Any item on which the required function can be performed without disassembly of an engine component. Removal of defined access cover is not considered disassembly.
10. Appropriate NDE - Nondestructive examination selected by site personnel that is most suitable to obtain the information sought by an individual inspection item; choice of NDE shall be made to assure that the technique will detect indications consistent with the acceptance criteria.

TABLE 1

Diesel Engine Operating Surveillance Parameters and Frequency

<u>Component</u>	<u>Frequency</u>
1) Lube Oil Inlet Pressure to Engine	Log hourly
2) Lube Oil Filter Differential Pressure	Log hourly
3) Lube Oil Temperature (engine inlet and outlet)	Log hourly
4) Lube Oil Sump Level	Log hourly
5) Turbocharger Oil Pressure	Log hourly
6) Fuel Oil Filter Differential Pressure	Log hourly
7) Fuel Oil to Engine Pressure	Log hourly
8) Fuel Oil Day Tank Level	Check hourly
9) Jacket Water Pressure (engine inlet)	Log hourly
10) Jacket Water Temperature (in, out)	Log hourly
11) Engine Cylinder Temperature Exhaust - All (If temperature in any one cylinder exceeds 1050°, refer to MP-022/023 Item 7.)	Log hourly
12) Manifold Air Temperature (RB, LB for DSRV Engines)	Log hourly
13) Manifold Air Pressure (RB, LB for DSRV Engines)	Log hourly
14) Starting Air Pressure (RB, LB for DSRV Engines)	Check hourly
15) Crankcase Vacuum	Log hourly
16) Engine Speed	Log hourly
17) Hour Meter	Log hourly

TABLE 1 (Cont'd)

Diesel Engine Operating Surveillance Parameters and Frequency

<u>Component</u>	<u>Frequency</u>
18) Kilowatt Load	Log hourly
19) Visual Inspection for Leaks, etc.	Check hourly

TABLE 2

Diesel Engine Standby Surveillance Parameters and Frequency

<u>Component</u>	<u>Frequency</u>
1) Lube Oil Temperature (in, out)	Log daily
2) Lube Oil Sump Level	Log daily
3) Check Operation of Lube Oil Keep-Warm Pump Motor	Daily
4) Monitor Lube Oil Keep-Warm Strainer and/or Filter Differential Pressure	Daily
5) Perform a visual inspection for leakage of the Lube Oil Heat Exchanger. Verify that no leakage through the leak-off ports of the lantern ring is present.	Daily
6) Fuel Oil Day Tank Level	Log daily
7) Jacket Water Temperature (in, out)	Log daily
8) Perform a visual inspection for leakage at packing for Jacket Water Heat Exchanger whenever the engine is in the emergency STANDBY mode. Verify that no leakage through the leak-off ports of the lantern ring is present.	Daily
9) Governor Oil Level	Daily
10) Verify proper oil level of generator pedestal bearing	Daily
11) Starting Air Pressure	Log daily
12) Drain air receiver float traps and/or drain Starting Air Storage Tank and monitor the quantity of moisture produced. If quantity of moisture is excessive, correct immediately.	Daily

TABLE 2 (Cont'd)

Diesel Engine Standby Surveillance Parameters and Frequency

<u>Component</u>	<u>Frequency</u>
13) Check Operation of Compressor Air Traps	Daily
14) Test Annunciators	Before Engine Operation
15) Check Alarm Clear	Before Engine Operation
16) Inspect for Leaks	Daily
17) Visually inspect intercooler for external leaks including intake manifold drain connection.	Daily

TDI
OWNERS GROUP

APPENDIX - II
GENERIC MAINTENANCE MATRIX

PART B
PHASE I COMPONENTS

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
MP-022/23	Turbocharger	1. Measure vibration and check with baseline data.		X				To be accomplished during 24-hour test run.
		2. Inspect impeller/diffuser and clean if necessary.				X		
		3. Measure rotor end play (axial clearance) to identify trends of increasing clearance i.e., thrust bearing degradation.		X				Review thrust bearing axial clearances after inspection to determine if a trend exists. Any trend toward increasing axial clearance could signify thrust bearing degradation.
		4. Perform visual and blue check inspections of the thrust bearing.				X		Note: Thrust bearing inspection should also be performed after experiencing each 40 non-prelubed (automatic) fast starts. In addition, a one time inspection should be completed after the first 100 engine starts.
		5. Disassemble, inspect, and refurbish.				X		Note: During reassembly ensure that capscrews are properly installed with the recommended torque. If QR inspection was performed prior to accumulating significant hours (i.e., the number of hours accumulated during plant preoperational testing, approximately 100 hours), the turbochargers should be reinspected at the next EOC.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		6. The nozzle ring components and inlet guide vanes should be visually inspected for missing parts or parts showing distress. If such conditions are noted, the entire ring assembly should be replaced.				X		Also perform a visual inspection on one turbo-charger per nuclear unit at each EOC. Note: Discontinue inspection with appropriate redesign.
		7. Monitor inlet temperature to ensure gas temperature does not exceed manufacturer's recommendation of 1200°F if exhaust temperature for any cylinder exceeds 1050°F (Refr: Table 1).						Monitoring may be performed using permanent in-line thermocouple, strap-on thermocouple, heat gun, or other suitable means that has been appropriately tested and calibrated per plant procedures. Note: Also perform monitoring any time the engine operates in an unbalanced condition.
02-305A	Base Assembly	1. Perform a visual inspection of the base. The inspection should include the areas adjacent to the nut pockets of each bearing saddle and be conducted after a thorough wipe down of the surfaces, using good lighting.					X	Note: Any cracks detected must be investigated further before the engine is allowed to return to service. The mating surfaces of the base and cap shall be thoroughly cleaned with solvent before any reassembly. Perform on EO basis for 3 cycles, then overhaul provided there are satisfactory results. Note: 3 EOC inspections may be eliminated by performing a metal analysis to confirm consistent to class 40 grey iron requirements; performing analysis does not eliminate need for overhaul inspections.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-305C	Main Bearing Caps - Studs and Nuts	<p>1. The mating surfaces at the bearing cap/saddle interface should be inspected when disassembled to ensure the absence of surface imperfections that might prevent tight boltup.</p> <p>Note: Upon removal of bearing caps, clean mating surfaces with a solvent prior to reassembly of the caps to the base.</p>						
02-310A	Crankshaft	See site specific recommendations						
02-315A	Cylinder Block	See site specific recommendations						
02-315C	Cylinder Liners	<p>1. Perform a visual inspection of liners for progressive wear.</p>						To be performed for first 2 EOCs following piston removal; then discontinue until next piston removal. Boroscopic inspection is acceptable if heads are not removed. Complete TDI Inspection and Maintenance Record Form No. 315-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6.
02-340A/B	Connecting Rods, Bushings and Bearing Shells (Generic)	<p>1. Inspect and measure all connecting rod bearing shells to verify lube oil maintenance, which affects wear rate.</p>					X	Complete TDI Inspection and Maintenance Record Form No. 340-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6, Appendix III for clearance values. Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-340 A/B DSRV's only	Connecting Rods, Bushings and Bearing Shells	2. Inspect and measure the connecting rods. Note: Perform inspection and measure four connecting rods for DSRVs and two for DSRs at random at one time 5-year inspection.					X	Complete TDI Inspection Maintenance Record Form No. 340-2-1, -2 as applicable, TDI Instruction Manual, Volume I, Section 6.
		3. Perform an x-ray examination on all replacement bearing shells to acceptance criteria developed by Owners Group Technical Staff.						This is to be performed prior to installation of any replacement bearing shells as required.
		4. All connecting rod bolts, nuts, and washers should be visually inspected, and damaged parts should be replaced. The bolts should be MT inspected to verify the continued absence of cracking. No detectable cracks should be allowed at the root of the threads.					X	Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.
		5. During any disassembly that exposes the inside diameter of a rod-eye (piston pin) bushing, the surface of the bushing should be LP inspected to verify the continued absence of linear indications in the heavily-loaded zone width ± 15 degrees of the bottom dead-center position.						Perform inspection, as required and on items accessible, consistent with Item 2 of this component.
		6. Measure the clearance between the link pin and link rod. This clearance should be zero i.e., no measurable clearance when the specified bolt torque of 1,050 ft-lbs is applied.						To be performed once for each connecting rod.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		7. At the overhaul, visually inspect the rack teeth surfaces for signs of fretting and at one time 5-year inspection for rods disassembled.					X	
		8. Inspect mating surfaces to verify that the minimum manufacturers' recommended percent contact surface is available.						To be performed once for new and/or replacement parts.
		9. If connecting rod bolt stretch was measured ultrasonically during reassembly following the preservice inspection, the lengths of the two pairs of bolts above the connecting rod should be remeasured ultrasonically before the link rod box is disassembled. If ultrasonic measurement was not previously used, begin use at next inspection that accesses the connecting rods. Measure bolt stretch before disassembly.					X	Also to be performed at any time the connecting rod is disassembled. Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.
		10. All connecting rod bolts should be visually inspected for thread damage (galling) and the two pairs of connecting rod bolts above the crankpin should be MT inspected to verify the absence of cracking. All washers used with the bolts should be examined visually for signs of galling or cracking and replaced if damaged.					X	Also to be performed at any time the connecting rod is disassembled. Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.
		11. A visual inspection should be performed of all external surfaces of the link rod box to verify the absence of any signs of service-included distress.					X	Also to be performed at any time the connecting rod is disassembled. Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		12. All of the bolt holes in the link rod box should be inspected for thread damage (galling) or other signs of abnormalities. Bolt holes subject to the highest stresses (the pair immediately above the crankpin) should be examined with an appropriate non-destructive method to verify the absence of cracking. Any indications should be recorded for evaluation and corrective action.					X	Also to be performed at any time the connecting rod is disassembled. Perform inspection at 5 years, on items accessible, consistent with Item 2 of this component.
02-341A	Pistons	1. Inspect and measure skirt and piston pin. This item assumes that AE skirts are installed. For other types, see site-specific recommendations.					X	Complete TDI Inspection and Maintenance Report Form No. 341-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6. Use Volume 1, Section 8, Appendix III for clearance values. To be performed at 5-year interval on sampling basis consistent with Component 02-340A/B-Connecting Rods.
02-360A	Cylinder Head	1. Visually inspect cylinder heads (all cylinders). Note: Inspection by boroscope is acceptable.					X	Complete TDI Inspection and Maintenance Record Form No. 360-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6 - one sheet for each head. To be performed at 5-year interval on sampling basis consistent with Component 02-340 A/B - Connecting Rods.
		2. Record cold compression pressures and maximum firing pressures.			X			If so indicated - remove cylinder heads, grind valves, and reseal. Refr: TDI Instruction Manual, Volume I, Section 6.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-365C	Fuel Injection Tubing	3. Blow-over the engine at least 4 hours but not more than 8 hours after engine shutdown. The cylinder cocks should be open for detection of water leakage into the cylinders. A second air roll should be performed in the same manner approximately 24 hours after engine shutdown. In addition, the engine should be air rolled shortly before any planned start.						In the event water is detected, the cylinder head should be replaced or returned to the vendor for repair. Delete post-run air roll requirements for engines with Group II heads after one cycle with positive inspection results.
		4. Visually inspect the area around the fuel injection port on each cylinder head during the normal monthly run for signs of leakage.	X					If water leakage is detected, the head(s) should be replaced.
		1. Check tubing for leaks at compression fittings.		X				All fuel oil leak inspections to be performed while the engine is running or whenever the compression fittings have been disturbed.
		2. Visually inspect tubing lengths for fuel oil leaks or cracks if tubing is unshrouded. If shrouded, fuel oil leakage can be detected at the leak-off ports in the base nuts, which are provided for this purpose.		X				Fitting inspection for leaks to be performed at engine operation following shutdown. Subsequent inspections to be performed periodically as indicated. Unshrouded tubing, used as replacement, should be fully inspected consistent with FaAA NDE Procedure 11.10 prior to bending.

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-390C	Push Rods	<p>1. Each push rod of the forged-head design should be inspected by liquid penetrant prior to installation or, if installed, at each overhaul. This should be repeated, until it has been determined by 750 hours of operation at the load level used for surveillance testing that the push rod will not develop service-induced cracks. Push rods confirmed in this way need be examined only visually at subsequent overhauls. Push rods of the forged-head design exhibiting cracks larger than 0.25 inch should be replaced, preferably with push rods of the friction-welded design. Each forged-head rod should also be visually inspected one time to confirm that the head was fully inserted in the tube prior to welding.</p> <p>2. Each push rod of the friction-welded design should be inspected initially by liquid penetrant. If this initial inspection was not performed prior to placing the push rods in service, it should be performed at the first overhaul. If the friction-welded push rod has been previously inspected by liquid penetrant, then visual examination will suffice for future inspections. All friction-welded push rods with cracks should be replaced, preferably with push rods of the same design.</p>					X	<p>Refr: PNL-5600</p> <p>If initial inspection was not performed, perform on sampling basis at 5-year inspection consistent with Component 340A/B - Connecting Rods.</p>

GENERIC MAINTENANCE MATRIX - PHASE I

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-390G	Rocker Arm Capscrews, Drive Studs (Pop Rivets)	<ol style="list-style-type: none"> 1. Verify capscrew torque values during QR inspection. If not performed at QR, verify at next EOC, then as required at reassembly. 2. Verify that rocker arm drive studs are intact and tight during QR inspection or EOC1, then as required at reassembly. 						Use TDI Instruction Manual, Volume I, Section 8, Appendix IV for proper torque values.
02-425A	Jacket Water Pump - Gear	<ol style="list-style-type: none"> 1. Visually inspect jacket water pump gear for chipped or broken teeth, excessive wear, pitting or other abnormal conditions. 2. Check the key to keyway interface for a tight fit on both the pump shaft to impeller and the spline to pump shaft during pump reassembly. At next teardown, verify impeller is one piece, (i.e., without a bore insert). If it is not a one piece impeller, replace. 3. It is recommended that the castle nut that drives the external spline on its taper have minimum and maximum torque values of 120 ft-lbs and 660 ft-lbs respectively for DSRVs and a maximum torque value of 77 ft-lbs for DSRs. 				X		Any abnormal situations or indications of progressive pitting should be reported for an engineering evaluation. For engines with less than 750 hours, also inspect by EOC2.
							X	This along with the drive fit of the impeller onto the shaft will preclude past problems where relative motion between shaft and impeller caused fretting and upset of the keyway sides.

TDI
OWNERS GROUP

APPENDIX - II
GENERIC MAINTENANCE MATRIX

PART C
PHASE II COMPONENTS

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
F-068	Intercoolers	1. Record the following temperatures during the monthly surveillance test of the engine: exhaust from cylinders and jacket cooling water supply. Compare these results with similar data from previous month to establish whether the trend is sufficient to warrant further action.	X					
		2. Inspect shell and tube sides, and clean as required.						Inspect at EOC1 and EOC3 to verify Item 1 results are valid.
		3. Verify intake manifold drain connection is open and clean.	X					Note: Refer to TDI SIM to be issued subsequent to March 1986.
		4. Perform leakage test of water side boundary for gross degradation.				X		
CP-101A	Emergency Generator	1. Check operation of brushes and slip rings by visual examination during operation.	X					
		2. Inspect all accessible parts of the generator, and clean as required.			X			
		3. Megger rotor and stator.			X			
		4. Verify that space heaters are on with engine shutdown.	X					
		5. Measure vibration and check against baseline data.			X			
CP-101B	Emergency Generator Pedestal Bearing	1. Drain, flush, refill bearing housing.			X			
		2. Measure bearing housing insulation resistance.			X			

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
CP-102	Emergency Generator Control Panel	3. Disassemble and inspect bearing and check clearances.					X	
		1. Inspect panel for cleanliness and clean as required.		X				
		2. Check terminal boards for loose wiring.		X				
		3. Visually check condition of wire insulation for degradation.		X				
		4. Clean and inspect relay contacts.		X				
		5. Check meter calibrations.						To be performed per appropriate site intervals for similar equipment.
		6. Bridge rectifier assembly.						Note: Inspections may be deleted after modifications as prescribed in DR/QR Report.
		a. Inspect the temperature sensitive label placed on the most visible face of the hexagonal body of the diodes. The label shall be inspected before and after each running of the engine.	X					If the label permanently blackens, the maximum temperature of the diode has been exceeded, requiring an electrical inspection of the diode and an inspection of the mounting threads of the heat sink and diode. Replace the diode and the heat sink as needed and assure that proper mounting tightness of 300 in-lbs and proper thread condition is maintained.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		b. Inspect glyptol applied to the side of the lugs and mounting bolt for the lugs which attach to the bottom of the diode and SCR heatsinks for signs of relative motion.		X				Retighten any loose connections, remove old glyptol, and reapply if connections are retightened.
		7. Adjustment potentiometers - inspect glyptol applied to the the side of the adjustment screws for each of the five adjustment potentiometers on the printed circuit board of the voltage regulator for signs of relative motion.		X				If adjustments are needed, remove glyptol, and reapply when the adjustment procedure is complete.
		8. Printed circuit boards - check for cleanliness and proper mounting of components.		X				Report any abnormal conditions to engineering for evaluation.
		9. Implement a procedure to monitor generator voltage at start. A manual reset of the exciter must be performed in the event of a failed start.						This recommendation is required until such time that modifications are made to the time delay relay latching logic in the generator control.
00-420	Lube Oil Pressure Regulating Valve	1. Disassemble and clean.					X	If valve sticks repeatedly, more frequent cleaning may be necessary. If valve plugging becomes a problem, the dimensions of the valves internal parts should be checked to ensure proper clearance.
		2. During initial startup after a major reassembly of lube oil piping, abnormal lube oil pressure excursions should be investigated and remedial action taken until excursions subside.						

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
00-442A	Starting Air Distributor Assembly	1. Visually inspect the poppet valve spool ends and timing cam of the starting air distributor.					X	Evaluate the degree of wear to determine whether existing condition would have an adverse effect on timing and the specified ability to start the engine.
		2. Ensure that the starting air manifold vent is open and unobstructed by noting the escape of air during engine startup.	X					Note: Inspect at EOC1 for sites that did not perform QR Inspection after plant pre-operational testing.
02-307B	Lube Oil Tubing and Fittings - Internal	1. Check accessible tubing for dents or crimps after performing maintenance in that area.						To be performed as required.
02-310B	Main Bearings Shells	1. Inspect and measure thickness of all main bearing shells. Inspection shall evaluate bearing wear and evidence of harmful crankshaft misalignment. If results show evidence of misalignment, TDI recommendations for crankshaft realignment should be implemented.					X	Note: Perform inspection on bearings 5 & 7 for DSRVs and mains between 5 & 6, and 6 & 7 for DSRs on one engine/station at EOC2. At one time 5-year inspection, inspect bearings 3 through 8 inclusive. Complete TDI Inspection and Maintenance Record Form No. 310-2-1 as applicable, TDI Instruction Manual, Volume I, Section 6 - one sheet for each main bearing. Use Volume I, Appendix III for clearance values. Also inspect when removed consistent with inspections required for Component 02-310A.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-310C	Thrust Bearing Ring	<p>1. Measure thrust bearing ring clearance by "bump check" method to be performed in conjunction with crankshaft web deflection measurements. The following information should be recorded:</p> <ul style="list-style-type: none"> ◦ Date of inspection ◦ Hours of engine operation ◦ Hours of engine operation since last bearing replacement ◦ Bearing clearance 		X				<p>Complete applicable sections of TDI Inspection and Maintenance Record Form No. 310-1-1 TDI Instruction Manual, Volume I, Section 6.</p> <p>Note: If the clearance is greater than the maximum allowed in the TDI Instruction Manual, at least one bearing must be replaced. Bearings should also be replaced if they are cracked or gouged.</p>
		2. Visually inspect thrust bearing ring for signs of wear or degradation.					X	To be performed at 10-year interval only (i.e., not at one time 5-year inspection).
02-311A	Crankcase Assembly	<p>1. Perform a visual inspection of the vertical portion of the crankcase arch wall to the nut pocket area for indications of cracking.</p>					X	The first inspection after 185 hours of at or near full load operation may be used to justify the discontinuation of such inspection until an overhaul. For engines with less than 185 hours operation at or near full load, inspect at each EOC until exceeds 185 hours.
		2. Remove alternate left side doors and examine the inside of the engine for any abnormal conditions. Check with a good light for evidence of babbit flakes.		X				If excessive water, sludge or any indication of bearing failure is present, drain crankcase, determine cause, and take necessary corrective action.
		3. Check internals of block and base for leaks.		X				

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-317A&B	Water Discharge Manifold - Jacket Water Discharge Piping, Couplings and Seals	1. Visually inspect for leaks.	X					
02-341B	Piston Rings	1. Inspect and measure piston replacement rings.						Complete TDI Inspection and Maintenance Record Form No. 341-2-1 as applicable, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values. To be performed as required.
02-341C	Piston Pin Assembly	<p>1. Visually inspect for chrome plate damage. Replace pins which show chipped or blistered chrome.</p> <p>Note: All new or replacement pins should be LP or MP inspected before installation in Owners Group engines.</p> <p>2. Inspect end plugs and reroll or replace any that are loose.</p>					X	<p>Also to be performed one time at the 5-year inspection on sampling basis consistent with Component 340A/B - Connecting Rods.</p> <p>Note: MT may cause FE particulate accumulation.</p>
02-345A	Intake and Exhaust Tappet Assembly	1. Visually inspect intake and exhaust tappet assembly condition, and verify that cam rollers are free to rotate and that there is no noticeable clearance between the cam rollers and the roller pins. Do this by manually checking for excessive motion and visually observing for abnormalities on the mating surfaces.					X	<p>Note: This inspection is also to be performed one time at 5-year interval on sampling basis consistent with Component 340A/B - Connecting Rods.</p> <p>Complete TDI Inspection and Maintenance Report Form No. 345-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6. Refr: TDI Instruction Manual, Volume I, Maintenance Schedule. Perform an additional inspection by EOC2 on exposed or accessible assemblies. Also perform one time at 5 years consistent with Component 02-340 A/B Item 2.</p>

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-345B	Fuel Tappet Assembly	1. Visually inspect fuel tappet assembly condition, and verify that cam rollers are free to rotate and that there is no noticeable clearance between the cam rollers and the roller pins. Do this by manually checking for excessive motion and visually observing for abnormalities on the mating surfaces.					X	Complete TDI Inspection and Maintenance Report Form No. 345-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6. Also perform one time at 5 years consistent with Component 02-340 A/B Item 2. Perform an additional inspection by EOC2 on exposed or accessible assemblies.
02-350A	Cam Shaft Assembly	1. Perform a visual inspection of all cam lobe surfaces for signs of cracking, pitting, or spalling.					X	Any signs of cracking, pitting, or spalling shall be followed by a detailed analysis to evaluate the expected life based on the size and extent of surface distress. Any corrective measures shall be implemented as indicated by this analysis. Signs of spalling shall result in immediate replacement of the cam. Perform an additional inspection by EOC2 on exposed or accessible assemblies. Refr: TDI Instruction Manual, Volume I, Maintenance Schedule. Also to be performed one time at 5 years consistent with Component 02-340 A/B.
02-350B	Cam Shaft Bearings	1. Inspect and measure cam shaft bearing shells.					X	Complete TDI Inspection and Maintenance Record Form No. 350-1-1 as applicable, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III for clearance values.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-350C	Cam Gear	<ol style="list-style-type: none"> 1. Visually inspect cam gear for chipped or broken teeth, pitting, excessive wear, or other abnormal conditions. At this inspection, the gear is in immediate proximity to the spray nozzle which should also be visually inspected. 2. Measure gear backlash. Note: If cam gear hub is removed, it is recommended that the nut be relocked at the position corresponding to the torque of 70±20 ft-lbs. Insertion of the cotter pin must be accomplished at a torque > 50 ft lbs and < 90 ft -lbs. If this is not possible, another bolt, nut or washer should be used. 				X		<p>Also at one time 5-year inspection for Component 02-340A/B measure clearances per TDI on one bearing housing/camshaft.</p> <p>For engines with less than 750 hours, also inspect at EOC2.</p>
02-355A	Crank to Lube Oil Pump Gear	<ol style="list-style-type: none"> 1. Visually inspect crankshaft to lube oil pump gear for chipped or broken teeth, excessive wear, or progressive pitting or other abnormal conditions. 				X		<p>Complete applicable sections of TDI Inspection and Maintenance Record Form No. 355-1-1, TDI Instruction Manual, Volume I, Section 8, Appendix III-1 for clearance values.</p> <p>Note: Refer to TDI SIM to be issued subsequent to March 1986. Also to be performed one time at 5 years consistent with Component 02-340 A/B.</p> <p>Any abnormal situations or indications of progressive pitting should be reported for an engineering evaluation. For engines with less than 750 hours, also inspect by EOC2.</p>

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		2. Measure gear backlash.					X	Complete applicable sections of TDI Inspection and Maintenance Record Form No. 355-1-1, TDI Instruction Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III-1 for clearance values.
02-355B	Idler Gear Assembly	1. Visually inspect idler gears for chipped or broken teeth, excessive wear pitting, or other abnormal conditions.				X		Any abnormal indications should be reported for an engineering evaluation. For engines with less than 750 hours, also inspect at EOC2.
		2. Measure gear backlash. Note: If idler gear hub is removed, it is recommended that the nut be relocked at the position corresponding to the torque of 70±20 ft-lbs. Insertion of the cotter pin must be accomplished at a torque > 50 ft-lbs and < 90 ft-lbs. If this is not possible, another bolt, nut, or washer should be used.					X	Complete applicable sections of TDI Inspection and Maintenance Record Form No. 355-1-1, TDI Manual, Volume I, Section 6. Use Volume I, Section 8, Appendix III-1 for clearance values.
02-359	Air Start Valves	1. Remove, clean, and inspect air start valves. (Replace copper valve-to-head gasket).			X			Ensure valve installation includes retorque requirements. Refr.: TDI SIM 360.
		2. Inspect the piston, cap, guide, and housing sliding surfaces to evaluate wear or corrosion.			X			
02-360B	Cylinder Head - Intake and Exhaust Valves	1. Visually inspect intake and exhaust valves, keepers, stems and seats for wire drawing, pitting, distortion, concentricity, and any abnormal condition.					X	Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		2. Visually inspect subcovers for evidence of valve guide blowby (soot).						This is a one-time-only inspection, to be performed after 500 or 600 hours of operation after rebuild of a cylinder head.
		3. Measure intake and exhaust valves head thickness.					X	Complete applicable sections of TDI Inspection and Maintenance Records Form 360-2-1, TDI Instruction Manual, Volume I, Section 6-one sheet for each cylinder. Use Section 8, Appendix III for clearance values. (Items 2 & 3). Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.
		4. Measure intake and exhaust valves - valve-to-guide clearances.					X	Complete applicable sections of TDI Inspection and Maintenance Record Form 360-2-1, TDI Instruction Manual, Volume I, Section 5-one sheet for each cylinder. Use TDI SIM 336, Rev. 1 for clearance values (acceptance criteria). Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.
02-362A	Cylinder Head Covers - Subcover Assembly	1. Perform a liquid penetrant examination of the rocker arm pedestals top and vertical machined surfaces (connector push-rod side only).					X	Also to be performed one time at 5 years on a sampling basis consistent with Component 340A/B. Subcovers with pedestal cracks that extend through the counter bore web down to the threads should be replaced. Refr: DR/QR Report #02-362A.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-365A	Fuel Injection Pumps	1. Tear down one pump for inspection.			X			Use representative pump to determine need to overhaul other pumps. Complete fuel injection pump inspection in accordance with TDI Instruction and Maintenance Manual, Volume I, Section 6. Based on inspection results and operating parameters. Complete TDI Instruction and Maintenance Record Form No. 365-1-1 as applicable, for the pump disassembled.
		2. Visually check pressure bleed screw for erosion on disassembled pump.			X			
02-365B	Fuel Injection Nozzles	1. Remove, inspect, and clean tips.			X			Ensure that a new copper gasket is used upon reinstallation of nozzle into head. Perform retorquing requirement per TDI. Complete TDI Inspection and Maintenance Record Form 365-2-1 as applicable, Instruction Manual, Volume I, Section 6. Note: 135° fuel oil tips may be used if inspection results indicate a need for additional action to improve lubrication and reduce coke buildup.
		2. Check nozzle pop pressure.			X			
		3. Check spray pattern.			X			

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-365D	Fuel Oil Injection Lines: Supports	1. Visually inspect support elastomer inserts for deterioration or degradation.		X				Any inserts found to be unsatisfactory shall be replaced with new inserts prior to reassembly of fuel oil lines. This inspection can be performed prior to reassembly of the fuel oil lines in conjunction with the cylinder liner inspection.
02-371A	Fuel Pump Control Shaft	1. Check and lubricate as required.						
02-371B	Fuel Pump Linkage Assembly and Bearings	1. Grease swivel link or otherwise lubricate all fuel oil pump assemblies.		X				
02-380A	Exhaust Manifold	1. Perform a visual examination of accessible pipe welds and corresponding heat-affected zones.			X			To be performed at EOC1 and alternate EOCs thereafter.
02-385A	Crankcase Relief Valve	1. Clean flame arrestors.			X			
		2. Inspect seat and disc.			X			
02-387A	Crankcase Vacuum Fan	1. Inspect fan and clean as necessary.			X			
		2. Check bearing for roughness.			X			
02-390E	Rocker Arm Bushings	1. Visually inspect and measure intake rocker arm bushings.					X	Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.
		2. Visually inspect and measure exhaust rocker arm bushings.					X	Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.
		3. Visually inspect and measure intermediate rocker arm bushings.					X	Also to be performed one time at 5 years on sampling basis consistent with Component 340A/B.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-390F	Hydraulic Valve Lifters	1. Check and adjust valve lash.		X				
		2. Reinstall and adjust lifters.					X	Also to be performed one time at EOC2 and at 5 years on a sampling basis consistent with Component 340A/B. Note: Ensure lifters are installed with the fill holes up. Verify condition of lifters by comparison of lifter leak-down rate (actual) to specifications noted on TDI Maintenance Manual. Refr: TDI Maintenance Manual, Section 6-B-5.
02-410A	Overspeed Trip Governor	1. Check trip set point - adjust as required.			X			Modify the surveillance testing procedure to include verification that the overspeed trip is correctly set to an overspeed trip setting of 517 ± 5 rpm. Ensure that the electric governor setting is properly returned to 450 rpm and the mechanical backup governor returned to the manufacturer's specified interval following the overspeed test. The test is to be performed with no load on the engine by increasing the normal governor speed setting(s) until a trip occurs. After several inspection periods, the history of the required adjustments should be reviewed to evaluate and possibly modify the testing interval. Also perform at EOC2.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
								Note: After setting the overspeed governor, the adjustment screw settings should be marked with Torque Seal or other positive means to reveal any unintended changes in the set positions.
02-410B	Overspeed Trip Governor and Accessory Drive	1. Remove plugs from housing and check for magnetic particles.			X			
		2. Check shafts for excessive radial and axial movement.			X			
		3. Visually inspect accessory drive gear for excessive wear.			X			
02-410C	Overspeed Trip Drive Couplings	1. Remove the present L-110 Lovejoy couplings in compliance with SIM 363.						To be completed by the first refueling outage.
		2. Verify that coupling is tight on shaft.			X			
		3. Replace the Lovejoy coupling spiders or test coupling elastomer for hardness.			X			Replace elastomer if hardness is greater than 90 Shore A.
02-410D	Overspeed Trip Vent Valve	1. Disassemble and replace "O" rings or replace valve.			X			
02-411A	Governor Drive - Governor and Tachometer Drive Gear and Shaft	1. Visually inspect drive gear and shaft for signs of wear.					X	Also inspect one time at EOC nearest 5 years. For engine with less than 750 hours, also inspect at EOC2.
02-411B (excluding San Onofre - See Site Specific for San Onofre)	Governor Drive - Couplings, Pins and Keys	1. Check that coupling is tight on shaft.			X			If the coupling is found to be loose, it should be removed, all mating surfaces cleaned, and the unit reassembled using Loctite 609 on the mating surfaces.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-413A	Governor Linkage	2. Replace the elastomeric insert in the Koppers coupling.		X				Note: To be performed as necessary after tightening governor linkage hardware to design torque specifications.
		1. Install positive locking hardware to the lever arm clamp bolt heads and shaft roll pins.						
02-413A	Governor Linkage (DSRVs only)	2. Inspect for loose parts on the linkage assembly.	X					
		3. Lubricate cross shaft bearings as required.						
		4. Grease the rod end fittings, or lubricate oil wicks, especially those at the ends of the cross shaft.		X				
02-413B	Fuel Pump Linkage: Automatic Shutdown Cylinder	1. Check cylinder for extension and return.	X					To be accomplished when placing unit in maintenance modes.
		2. Check tailrod vent for air leakage.		X				To be accomplished during controls system check.
02-415A	Woodward Governor	1. Drain, flush, refill, and vent actuator oil system with new oil from a clean container ensuring the appropriate cleanliness procedures are followed. If contaminated oil is noted, increase frequency.			X			Note: Ensure the hydraulic actuator is properly vented.
		2. Disassemble, clean, and refurbish the actuator.					X	
		3. Verify all governor control knob settings are in appropriate positions.	X					Note: Mechanical governor setting to be 470 rpm.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		4. Evaluate electric governor settings to verify overshoot of the 450 rpm set speed is within plant-specific guidelines and to avoid critical speeds during start or when unloaded.		X				An evaluation of the governor settings is to be performed during surveillance testing once under joint mechanical and electrical governor control.
02-415B	Governor Booster Servomotor	1. Clean, inspect, and replace "O" rings and gaskets.					X	
02-415C	Governor Heat Exchanger	1. Clean and inspect.					X	
02-435A	Jacket Water Fittings - Pipe and Fittings (Small Bore Scope Only)	1. Visually inspect for leaks.	X					
02-437	Turbo Water Piping-Pipe and Fittings	1. Visually inspect for leaks.	X					
02-441B	Air Filter to Starting Air Distributor	1. Replace filter elements. If filter in a metal screen, cleaning with solvent is acceptable in lieu of replacement.		X				This can be modified so that the filter is to be changed at a maximum pressure drop of 25 psi for engines equipped with pressure monitoring devices.
	Air Start Admission Valve Strainer	2. Clean and inspect strainer.		X				If the strainer is excessively dirty, the frequency of cleaning and inspecting should be increased.
	Air Start Block Valves	3. Clean and refurbish valves - replace "O" rings and clean the screened fitting. Ensure leak tightness after reassembly.					X	
		4. Inspect for tightness of fittings and bolts and apply locking compound as required during reassembly of components.						
		5. Replace "O" rings of the shuttle valve.					X	

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-455A	Fuel Oil Filter	1. Record filter differential pressure.	X					Change filter elements when filter differential pressure reaches 20 psid rise above the clean differential pressure. Purge entrapped air from the filter canister using the vent valve provided, and divert some fuel oil into the newly replaced cartridge. After air has been purged, close vent valve and return handle to previous operating position.
		2. Inspect canister gaskets and replace as required.						To be performed during change out of filter elements.
		3. Inspect tubing and mechanical connections for tightness and/or leaks.	X					Refr: TDI Instruction Manual, Volume I.
02-455B	Fuel Oil Strainers	1. Record strainer differential pressure or monitor supervisory alarm as applicable.	X					If greater than 5 psid-shift, clean element. Bolt torques of 120-150 in-lbs should be utilized during reassembly.
		2. Purge air from stand-by strainers.						As required.
02-467A	Turbocharger Lube Oil Fitting: Pipe, Tubing, Fittings, and Flexible Coupling (Small Bore Scope Only)	1. Visually inspect for leaks.	X					
02-475A,C	Turbocharger: Bracket Bolting and Gaskets	1. At each engine shutdown for the first three engine shutdowns of operation after turbo installation, these screws should be visually 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, future						

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		<p>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.</p> <p>Note: To avoid damage to bracket to engine, and/or bracket to turbo, the proper torques as delineated above should be utilized for each respective bracket bolting application.</p>						
02-475B	Air Butterfly Valve	1. Lubricate valve shaft via grease fittings.			X			If oil cups are used, lubricate shaft monthly.
		2. Check valve disc for freedom of movement.			X			Check by visually observing valve/actuator operation. If oil cups are used, this should be completed monthly.
		3. Verify that associated locking devices (jam nuts and lock washers) are tight.			X			
02-500A	Engine Control Cabinet	1. Inspect interior of cabinet for cleanliness, and clean as required.			X			
		2. Visually check wiring for insulation degradation.			X			
		3. Visually check instrument tubing for leaks.			X			
		4. Functionally check cabinet heater and calibration of thermostat.			X			

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		5. Replace "O" rings, gaskets, and filter in pressure regulator as required.						
		6. Inspect filter surface for matter to determine if problems may exist downstream.		X				
		7. Monitor control system air pressure or supervisory alarm as applicable.	X					
02-500C	Circuit Breakers and Contact Blocks	1. Check all terminals - clean and tighten.		X				Accomplished during panel cleaning and inspection.
		2. Visually check wiring insulation for degradation.		X				Accomplished during panel cleaning and inspection.
		3. Trip check circuit breakers.						To be performed at appropriate site intervals for similar equipment.
02-500G	Control Panel Valves	1. Inspect control panel valves for leaks.		X				
		2. Replace or refurbish pneumatic logic board.				X		
02-500J	Control Panel Assembly: Relays	1. Inspect contacts and clean as required.		X				
		2. Visually check condition of wiring and tightness of terminations.		X				
02-500N	Control Panel Switches Terminal Boards and Wiring	1. Clean terminal boards and switch contacts.		X				
		2. Visually check wire insulation and terminals for tightness and degradation.		X				
		3. Inspect for arcing and overheating.		X				

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-525B	Barring Device Control Valve and Press Regulator	1. Replace control valve "O" rings and lube shaft. 2. Replace press regulator elastomeric parts.						As required. As required.
02-525C	Barring Device Air Filter	1. Replace filter element. 2. Drain barring device air filter.						As required. As required.
02-525D	Barring Device - Mounting Bracket/Supports	1. Replace old cotter pin with new cotter pin after each reassembly.						To be performed after each reassembly.
02-540A	Lube Oil Sump Tank	1. Check lubricating oil with a viscosimeter for fuel oil dilution. Send a sample of oil to laboratory for analysis. 2. Drain lubricating oil system and clean sump tank. Refill with new oil. To be performed based on sample analysis.	X					Refr: TDI Instruction Manual, Volume I, Maintenance Schedule, Items 1, 2. Note: When replacing engine oil use HD oil that meets or exceeds series 3 standards. The base stock should be more resistant to thermal degradation and coke formation. The additive package should provide high detergent dispersant properties with high alkalinity and a high level of antiwear additive such as zinc dithiophosphate. Total Base Number (TBN) should be 12 to 15 for use with #2 fuel, oil and a sulfated ash content of 1.5% to 2.0% is preferred. An engine oil with such properties, Mobilguard 412 or equivalent product may be used to insure improved lubrication. Do not mix lube oil brands or types. When changing lube oil replace the entire charge. Replace as required.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		3. Visually inspect lube oil sump tank level switch floats. Check switch set points.						To be performed per appropriate site intervals for similar equipment.
		4. Perform a spectro-chemical engine oil analysis to assist the bearing monitoring program. To further expand or clarify chemical analysis, ferrographic analysis may be utilized. Particular attention shall be paid to copper level and particulate size, which could signify thrust bearing degradation. Particular attention shall be given to percent moisture content.	X					Note: Sample to be drawn upstream of lube oil filter. Items 1 and 4 can be performed using the same sample.
02-550	Foundation Bolts	1. Visually inspect foundation for breaks in the bond between the sole plates and grout.		X				
		2. Check foundation bolts for correct torque. Retorque as necessary, then recheck crankshaft web deflections.					X	Use TDI Instruction Manual, Volume I, Section 8, Appendix IV for proper torque values.
		3. Generator foundation bolts are to be retorqued after a generator short circuit if the bolts were initially torqued to 480 ft-lbs. If initial bolt torque was 600 ft-lbs, no retorque is required.						
02-6300	Thermocouples	1. Check that thermocouple indicates ambient engine temperature when the engine is cold.		X				An inconsistent reading traced to thermocouple trouble should result in replacement of the thermocouple.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		2. Clean and inspect thermocouples and thermocouple shields as required.						Indications of fatigue should result in re- placement of the thermo- couple and/or thermo- couple shield.
		3. Pyrometer wiring - check that terminations are tight.						To be accomplished dur- ing control panel check- out and initial operation inspections.
02-695B	Engine Control Air Pressure Regulator	1. Inspect and clean engine control air pressure regulator when pressure gauge indicates abnormal pressure reduction during normal engine shutdown.						Note: This recommenda- tion should be reassessed depending on the degree of system fouling.
		2. Replace elastomeric parts and gaskets in the pressure regulator.						As required.
02-695C	Engine Control Pneumatic Trip Switches	1. Check switch set points per appropriate site interval.						Pressure switches and temperature switches.
		2. Replace elastomeric parts.						As required.
02-700B	Jacket Water Standpipe: Valves	1. Replace elastomeric parts in valves.						As required.
02-700F	Jacket Water Standpipe and Miscellaneous Bolting	1. Visually check jacket water standpipe, pump suction and engine return nozzle welds during each routine engine run and every 100 hours during extended engine runs.						Any visible cracking or minor jacket water leakage should result in rework of cracked nozzle welds.
		2. Check treatment (ph, etc. as applicable) of jacket water and correct as recommended by chemical supplier.		X				Also to be performed after adding makeup water.
02-717B	Auxiliary Sub-Base and Oil & Water Piping - Jacket Water: Valves	1. Inspect the valves for packing leakage.		X				Replace packing as necessary.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-717C	Auxiliary Sub-Base and Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings Orifices, Y-Strainers (Small Bore Scope Only)	1. Visually inspect for leaks.	X					
02-717F	Auxiliary Sub-Base Lube Oil Pipe and Fittings	1. Visually inspect pipe and joints for leakage. 2. Clean and inspect lube oil keep-warm pump suction strainer as required.	X					Complete when lube oil tank is drained.
02-717G/K	Auxiliary Sub-Base Lube Oil/ Fuel Oil Valves	1. Disassemble, inspect, and refurbish off engine lube oil and fuel oil valves as required. 2. Check relief valve lift pressure. Disassemble and clean if necessary.					X	
02-805B	Intake Air Filters	1. Inspect air intake/oil bath filters every 3 to 6 months.						Replace with change oil if necessary. If sampling is utilized, change based on analysis results.
02-805D	Flex Connection (Exhaust)	1. Visually inspect for evidence of cuts, holes, or dents. 2. Visually check for evidence of exhaust leakage.		X			X	
02-810C	Jacket Water Heat Exchanger	1. To avoid corrosion and fouling, jacket water heat exchanger and associated service water piping should be flushed on a periodic basis (continuous service flow is sufficient). Alternatively, service water chemistry control can be used to maintain heat exchanger performance and integrity.						

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		2. Record heat exchanger parameters.	X					Use for trend data.
		3. Evaluate heat exchanger performance data.		X				
		4. Inspect tubes and tube sheet for fouling and erosion - remove entrance and exit channel covers as required by trend data or at overhaul. Also review consistent with inspections of other plant heat exchangers utilizing similar water chemistry.					X	Refr: TDI Instruction Manual, Volume I, Maintenance Schedule.
		5. Inspect and clean lantern ring as required. Verify leak-off holes are not plugged.						Replace or rework lantern ring as necessary to ensure concentricity prior to reinstallation.
		6. Replace packing rings as required.						Replace packing when packing becomes hard or leakage at the packing is noted and cannot be stopped by tightening.
02-810D	Thermostatic Valves	1. Replace thermal power elements as required.						
		2. Visually inspect valve bonnet for evidence of leakage.	X					To be accomplished during monthly test run. Ensure that any replacement valves have cast steel valve bodies.
02-810E	Jacket Water Heaters	1. Check calibration and inspect thermostat.						To be performed at appropriate plant interval for similar equipment. Replace heater if degradation of insulation resistance is noted.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-820A	Lube Oil Sump Tank Heaters	1. Inspect and clean heater elements as required by trend data.						Replace heater if degradation of insulation resistance is noted.
		2. Check calibration and inspect condition of thermostat.						To be performed at appropriate site intervals for similar equipment.
02-820C	Lube Oil Keep-Warm Pump	1. Check mechanical seal and piping connection for leakage.	X					
		2. Verify pump discharge pressure is within manufacturer's specification.		X				Use for trend data.
02-820D	Lube Oil Keep-Warm Strainer	1. Clean or replace strainer element when the differential pressure change at the lube oil keep-warm strainer is 20 psid or for those plants not having this capability, clean or replace when differential pressure of keep warm filter is 20 psid.						
02-820E	Lube Oil Keep-Warm Filter	1. Record filter differential pressure.	X					
		2. Change filter elements as required.						To be performed when the filter differential pressure reaches 20 psid. For sites not equipped with differential pressure gauge, inspect monthly and clean as necessary.
02-820F	Full Flow Lube Oil Filters	1. Record filter differential pressure.	X					Use for trend data. Refr: TDI Instruction Manual, Volume I, Maintenance Schedule.
		2. Replace filter cartridges and perform a visual inspection to determine nature of the material caught in the filter.						To be performed when the filter differential pressure reaches 20 psid.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		3. Lube oil filter gauge - calibration check.						To be performed at appropriate site intervals for similar equipment.
02-820G	Lube Oil Heat Exchanger	1. Record heat exchanger parameters.	X					Use for trend data.
		2. Evaluate heat exchanger performance data.		X				
		3. Inspect tubes and tube sheet.					X	Refr: TDI Instruction Manual, Volume I, Maintenance Schedule.
		4. Inspect and clean lantern ring as required. Verify leak-off holes are not plugged.						Replace or rework lantern ring as necessary to ensure concentricity.
		5. Replace packing rings at the floating tube sheet during reassembly.						When packing becomes hard or leakage at the packing is noted and cannot be stopped by tightening.
02-820H	Full Pressure Lube Oil Strainer	1. Monitor differential pressure of strainer and/or filter.	X					Use for trend data.
		2. Clean or replace strainer element when the differential pressure change at the lube oil strainer is 20 psid. For those plants not having this capability, clean or replace when differential pressure of full pressure filter is 20 psid.						To be performed when the differential pressure across the strainer is 20 psid. Refr. TDI Instruction Manual, Volume I, Maintenance Schedule.
		3. Lube oil strainer pressure gauge - calibration check.						To be performed per appropriate site intervals for similar equipment.

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-835B	Diesel Starting Air Compressors	1. Check oil pressure and oil level if compressor is so equipped.	X					
		2. Overall visual inspection.	X					
		3. Clean fins on intercoolers and aftercoolers.		X				
		4. Inspect intake filter element if equipped and replace as necessary.		X				
		5. Change compressor oil at each EOC, or if monthly sampling is performed change as required based on results.		X				
		6. Check belt tension.		X				
		7. Check pulley clamp bolts and set screws tight.		X				
		8. Inspect filter felts on unloader system.		X				Replace as required, if so equipped.
02-835I	Air Dryers and Moisture Traps	1. Inspect and service moisture traps.		X				
		2. Check proper operation of dryer.	X					Replace desiccant charge or refrigerant as required.
02-835J	Starting Air Storage Tank	1. Disassemble and clean the float trap if installed.		X				

GENERIC MAINTENANCE MATRIX - PHASE II

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
		2. Starting air tank pressure gauges - calibration check.						To be performed per appropriate site intervals for similar equipment.
		3. Starting air tank pressure switches - calibration check.						To be performed per appropriate site intervals for similar equipment.
	Piping System (For items not previously covered)	1. Conduct a detailed vis- ual and audible inspec- tion of all fuel, air, oil, and water piping and valves for leakage.	X					Tighten, repair, or replace as required. Refr: TOI Instruction Manual, Volume I, Maintenance Schedule.

TDI
OWNERS GROUP

APPENDIX-II
SITE SPECIFIC MAINTENANCE MATRIX

PART D

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
(San Onofre)	Gear Train	1. All accessible gears should be inspected to verify satisfactory condition at next EOC. Inspect remaining gears at overhaul.					X	Refr: PNL-5600.

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-310A (San Onofre)	Crankshaft	1. Measure and record crankshaft web deflections (hot and cold).		X				Complete TDI Inspection and Maintenance Record Form No. 310-1-1, TDI Instruction Manual, Volume I, Section 6. Refr: TDI Instruction Manual, Volume I, Maintenance Schedule.
		2. The two 1.5 inch deep dowel holes and the fillets in main journal No. 12 of the DG1 engine should be inspected at the earliest reasonable time using fluorescent PT or eddy current as appropriate.						If cracks are found, also perform for DG2. Any cracks found in either engine should be evaluated.
		3. Inspect the oil holes in main journals Nos. 4 through 11 and the 1.5 inch deep dowel holes in No. 12 at the first EOC using fluorescent PT or eddy current as appropriate. Favorable results from this inspection will permit subsequent inspections to be limited to journals Nos. 8 through 12.		X				
		4. Inspect the fillets of main journals Nos. 4 through 12, together with the oil holes using fluorescent PT or eddy current as appropriate.					X	
		5. Inspect the oil holes and fillets of three crankpin journals using fluorescent PT or eddy current as appropriate.					X	

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
6.	Measure diameter of crank-pin journals.						X	Complete TDI Inspection and Maintenance Record Form No. 310-3-1, TDI Instruction Manual, Volume I, Section 6. Also perform inspection once at 5 years, on items accessible, consistent with this component and Component 02-340A/B
	Note: Should modifications be made to the engine to alter the torsional characteristics, the need for these inspections should be reviewed and revised as appropriate. Refr: PNL-5600.							
7.	Analyze the trends of cylinder pressure and temperature measurements to detect imbalances.				X			

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-315A (San Onofre)	Cylinder Block	<ol style="list-style-type: none"> 1. Perform a visual inspection of the block top under intense light to detect any obvious evidence of cracking. Areas between adjacent cylinder heads should be included in this inspection. 2. For blocks with known or assumed ligament cracks, perform an LP or eddy current inspection of block tops for stud-to-stud cracks between cylinder heads and the block edge and the block edge and studs at the block ends. 3. Additional inspections to be performed per DR/QR Report 02-315A. 	X					Perform monthly during surveillance run. Also perform during any period of continuous operation on a daily basis. Refr: DR/QR Report 02-315A.

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-3308 (San Onofre)	Flywheel Bolting	1. The bolts faces of the coupling should be inspected to verify that they remain in a satisfactory condition. The mating surfaces of the coupling will be inspected if a disassembly is required due to misalignment, excessive vibration, or web deflection problems.						Perform once at the 5-year inspection. Refr: PNL-5600.

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-341A (San Onofre)	Pistons	1. Inspect the stud boss attachments of all piston skirts by LP and/or eddy current as appropriate. These inspections may be discontinued for individual skirts that have logged 750 hours.					X	Inspect at next dis-assembly or overhaul, whichever comes first. Refr: PNL-5600.

SITE-SPECIFIC MAINTENANCE MATRIX

<u>Component Number</u>	<u>Component Identification</u>	<u>PM Recommendation</u>	<u>Monthly</u>	<u>EOC</u>	<u>Alt. EOC</u>	<u>5 Year</u>	<u>Overhaul</u>	<u>Comments</u>
02-411B (San Onofre)	Governor Drive - Couplings, Pins and Keys	1. Perform a visual inspection of the couplings grid for cracks or wear.		X				Refr: San Onofre DR/QR 02-411B Task Descrip- tion (Items 1, 2, & 3)
		2. Inspect for correct key to keyway clearance.		X				
		3. Check that coupling is tight on shaft.		X				If the coupling is found to be loose, it should be removed, all mating surfaces cleaned, and the unit reassembled.

TDI
OWNERS GROUP
APPENDIX-II

CROSS REFERENCE INDEX
BY COMPONENT

PART E

Legend

1. Index sorted by component name.
2. Component number listed or "nonum" indicates that the utility engine should perform the maintenance as described.
3. Blank indicates that utility is not required to perform maintenance indicated.
4. Maintenance or surveillance requirements for a subcomponent should be disregarded for those engines not equipped with the subcomponent.

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Air Butterfly Valve	02-475B/ 03-475B	03-475B/ 02-475B	02-475B/ 02-475B	03-475B/ 02-475B	02-475B/ 02-475B	02-475B/ 02-475B
Air Dryers and Moisture Traps	02-835I/ 03-835H	03-835H/ 02-835F	02-835A/ 02-835G	03-835I/ GG-115	02-835A/ 02-835C	02-835G/ 02-835C
Air Filter to Starting Air Distributor	02-441B/ 03-441B	03-441B/ 02-441B	02-441B/ 02-441B	03-441B/ 02-441B	02-441B/ 02-441B	02-441B/ 02-441B
Air Start Block Valves	NONUM/ 03-441B	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM
Air Start Valves	02-359/ 03-359	03-359/ 02-359	02-359/ 02-359	03-359/ 02-359	02-359/ 02-359	02-359/ 02-359
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices, Y-Strainers (Small Bore Scope Only)	02-717C/ 03-717C	03-717D/ 02-717C	02-717C/ 02-717C	03-717D/ 02-717C	____/ ____/	02-717C/ 02-717D
Auxiliary Sub-Base & Oil & Water Piping - Jacket Water: Valves	02-717B/ 03-717B	03-717B/ 02-717B	02-717B/ 02-717B	03-717B/ 02-717B	02-717B/ 02-717B	02-717B/ 02-717B
Auxiliary Sub-Base Lube Oil Pipe and Fittings	02-717F/ 03-717H	03-717H/ 02-717F	02-717F/ 02-717F	03-717H/ 02-717F	NONUM/ 02-717F	02-717F/ 02-717H
Auxiliary Sub-Base Lube Oil/ Fuel Oil Valves	02-717G/K/ 03-717I/N	03-717I/N/ 02-717G/K	02-717G/K/ 02-717G	03-717H/N/ 02-717G/K	NONUM/ 02-717G/K	02-717G/K/ 02-717I

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Barring Device Air Filter	02-525C _____	03-525C _____	_____/_____ _____	_____/_____ _____	_____/_____ _____	_____/_____ _____
Barring Device Control Valve and Press Regulator	02-525B/ 03-525B	03-525B/ _____	02-525B/ _____	03-525B/ 02-525B	_____/_____ 02-525B	02-525B/ _____
Base Assembly	02-305A/ 03-305A	03-305A/ 02-305A	02-305A/ 02-305A	03-305A/ 02-305A	02-305A/ 02-305A	02-305A/ 02-305A
Cam Gear	02-350C/ 03-350C	03-350C/ 02-350C	02-350C/ 02-350C	03-350C/ 02-350C	02-350C/ 02-350C	02-350C/ 02-350C
Camshaft Assembly	02-350A/ 03-350A	03-350A/ 02-350A	02-350A/ 02-350A	03-350A/ 02-350A	02-350A/ 02-350A	02-350A/ 02-350A
Camshaft Bearings	02-350B/ 03-350B	03-350B/ 02-350B	02-350B/ 02-350B	03-350B/ 02-350B	02-350B/ 02-350B	02-350B/ 02-350B
Circuit Breakers and Contact Blocks	02-500C/ 03-500C	03-500C/ 02-500C	02-500C/ 02-500C	03-500C/ 02-500C	02-500C/ 02-500C	02-500C/ 02-500C
Connecting Rods, Bushings and Bearing Shells	02-340A/B/ 03-340A/B	03-340A/B/ 02-340A/B	02-340A/B/ 02-340A/B	03-340A/B/ 02-340A/B	02-340A/B/ 02-340A/B	02-340A/B/ 02-340A/B
Control Panel Assembly: Relays	02-500J/ 03-500J	03-500J/ 02-500J	02-500I/ 02-500J	03-500J/ 02-500J	02-500J/ 02-500J	02-500J/ 02-500J
Control Panel Switches Terminal Boards and Wiring	02-500N/ 03-500N	03-500N/ 02-500N	02-500M/ 02-500N	03-500N/ 02-500N	02-500N/ 02-500N	02-500N/ 02-500N

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Control Panel Valves	02-500G/ 03-500G	03-500G/ 02-500G	02-500G/ 02-500G	03-500G/ 02-500G	02-500G/ 02-500G	02-500G/ 02-500G
Crank to Lube Oil Pump Gear	02-355A/ 03-355A	03-355A/ 02-355A	02-355A/ 02-355A	03-355A/ 02-355A	02-355A/ 02-355A	02-355A/ 02-355A
Crankcase Assembly	02-311A/ _____	_____/_____ 02-311A	02-311A/ 02-311A	_____/_____ 02-311A	02-311A/ 02-311A	02-311A/ 02-311A
Crankcase Relief Valve (and covers)	02-385A/ 03-385A	03-385A/ 02-385A	02-385A/ 02-385A	03-385A/ 02-385A	02-385A/ 02-385A	02-385A/ 02-386A
Crankcase Vacuum Fan	02-387A/ _____	_____/_____ NONUM	_____/_____ _____	_____/_____ 02-387A	_____/_____ _____	_____/_____ _____
Crankshaft	02-310A/ 03-310A	03-310A/ 02-310A	02-310A/ 02-310A	03-310A/ 02-310A	02-310A/ 02-310A	02-310A/ 02-310A
Cylinder Block	02-315A/ 03-315A	03-315A/ 02-315A	02-315A/ 02-315A	03-315A/ 02-315A	02-315A/ 02-315A	02-315A/ 02-315A
Cylinder Head	02-360A/ 03-360A	03-360A/ 02-360A	02-360A/ 02-360A	03-360A/ 02-360A	02-360A/ 02-360A	02-360A/ 02-360A
Cylinder Head - Intake and Exhaust Valves	02-360B/ 03-360B	03-360B/ 02-360B	02-360B/ 02-360B	03-360B/ 02-360B	02-360B/ 02-360B	02-360B/ 02-360B
Cylinder Head Covers - Subcover Assembly	02-362A/ 03-362A	03-362A/ 02-362A	02-362A/ 02-362A	03-362A/ 02-362A	02-362A/ 02-362A	02-362A/ 02-362A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Cylinder Liners	02-315C/ 03-315C	03-315C/ 02-315C	02-315C/ 02-315C	03-315C/ 02-315C	02-315C 02-315C	02-315C/ 02-315C
Diesel Starting Air Compressors	02-835B/ 10-112	03-835G/ 02-835A	02-835D/ 02-835A	03-835D/ GG-113/14	NONUM/ 02-835B	02-835B/ _____
Emergency Generator	CP-101A/ 03-650A	03-650A/ SO-101	_____/_____ 02-650A	03-650A/ GG-101A	CN-119/ BL-101A	84-101A/ 02-650A
Emergency Generator Control Panel	CP-102/ 03-650B	03-650B/ _____	_____/_____ 02-650B	03-650B/ GG-119	_____/_____ BL-101B	84-121/ 02-650B
Emergency Generator Pedestal Bearing (and shaft)	CP-101B/ 03-650C	03-650C/ SO-103	02-650C/ 02-650C	03-650C/ GG-101B	CN-119A BL-101C	84-101B/ 02-650C
Engine Control Air Pressure Regulator (Valves, Orifices)	02-695B/ 03-695B	03-695B/ 02-695B	02-695B/ 02-695B	03-695B/ 02-695B	02-695B/ 02-695B	02-695B/ 02-695B
Engine Control Cabinet	02-500A/ 03-500A	03-500A/ 02-500A	02-500A/ 02-500A	03-500A/ 02-500A	02-500A/ 02-500A	02-500A/ 02-500A
Engine Control Pneumatic Switches	02-695C/ 03-695C	03-695C 02-695C	02-695C/ 02-695C	03-695C/ 02-695C	02-695C/ 02-695C	02-695C/ 02-695C
Exhaust Manifold	02-380A/ 03-380A	03-380A/ 02-380A	02-380A/ 02-380A	03-380A/ 02-380A	02-380A/ 02-380A	02-380A/ 02-380A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Flex Connection	02-805D/ 10-109	15-110/ 02-805C	02-805D/ 02-805D	03-805D/ GG-111	CN-121/ 02-805A	84-114/ 02-805D
Foundation Bolts	02-550/ 03-550	03-550/ 02-550	02-500/ 02-550	03-500/ 02-550	02-500/ 02-550	02-500/ 02-550
Fuel Injection Nozzles	02-365B/ 03-365B	03-365B/ 02-365B	02-365B/ 02-365B	03-365B/ 02-365B	02-365B/ 02-365B	02-365B/ 02-365B
Fuel Injection Pumps	02-365A/ 03-365A	03-365A/ 02-365A	02-365A/ 02-365A	03-365A/ 02-365A	02-365A/ 02-365A	02-365A/ 02-365A
Fuel Injection Tubing	02-365C/ 03-365C	03-365C/ 02-365C	02-365C/ 02-365C	03-365C/ 02-365C	02-365C/ 02-365C	02-365C/ 02-365C
Fuel Oil Filter	02-455A/ 03-455A	SC-014A 02-455A	02-455A/ 02-455A	03-455A/ 02-455A	02-455A/ 02-455A	02-455A/ 02-455A
Fuel Oil Injection Lines: Supports	02-365D/ 03-365D	03-365D/ 02-365D	02-365D/ 02-365D	03-365D/ 02-365D	02-365D/ 02-365D	02-365D/ 02-365D
Fuel Oil Strainers	02-455B/ 03-455B	SC-042B/ 02-455B	02-455B/ 02-455B	03-455B/ 02-455B	02-455B/ 02-455B	02-455B/ 02-455B
Fuel Pump Control Shaft	02-371A/ 03-371A	03-371A/ 02-371A	02-371A/ 02-371A	03-371A/ 02-371A	02-371A 02-371A	02-371A/ 02-371A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Fuel Pump Linkage Assembly and Bearings	02-371B/ 03-371B	03-371B/ 02-371B	02-371B/ 02-371B	03-371B/ 02-371B	02/371B 02-371B	02-371B/ 02-371B
Fuel Pump Linkage: Automatic Shutdown Cylinder	02-413B/ 03-371C	03-371C/ 02-413B	02-413B/ 02-413B	03-371C/ 02-413B	02-413B/ 02-413B	02-413B/ 02-413B
Fuel Tappet Assembly	02-345B/ 03-345B	03-345B/ 02-345B	02-345B/ 02-345B	03-345B/ 02-345B	02-345B/ 02-345B	02-345B/ 02-345B
Full Flow Lube Oil Filter(s)	02-820F/ 10-106	03-820E/ 02-820C	02-820F/ 02-717S	03-820B/ GG-820B	CN-110/ 02-820D	84-115/ 02-820E
Full Pressure Lube Oil Strainer	02-820H 03-820C	03-820C/ SE-014	02-820C/ SE-025	03-460A/ SE-025	SE-025/ 02-820C	SE-025/ 02-820A
Flywheel Bolting	_____ 03-330B	_____ 02-330B	_____ _____	_____ _____	_____ _____	_____ _____
Gear Train	_____ _____	_____ NONUM	_____ _____	_____ _____	_____ _____	_____ _____
Governor Booster Servomotor	02-415B/ 03-415B	03-415B/ 02-415B	02-415B/ 02-415B	03-415B/ 02-415B	02-415B/ 02-415B	02-415B/ 02-415B
Governor Drive - Couplings, Pins and Keys	02-411B/ 03-402B	03-402B/ 02-411B	02-411B/ 02-411B	03-402B/ 02-411B	02-411B/ 02-411B	02-411B/ 02-411B
Governor Drive - Governor and Tachometer Drive Gear and Shaft	02-411A/ 03-402A	03-402A/ 02-411A	02-411A/ 02-411A	03-402A/ 02-411A	02-411A/ 02-411A	02-411A/ 02-411A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Governor Heat Exchanger	02-415C/ 03-415C	03-415C/ NONUM	02-415C/ 02-415C	03-415C/ 02-415C	02-415C/ 02-415C	02-415C/ 02-415C
Governor Linkage	02-413A/ 03-413	03-413/ 02-413A	02-413A/ 02-413A	03-413/ 02-413A	02-413A/ 02-413A	02-413A/ 02-413A
Hydraulic Valve Lifters	02-390F/ 03-390F	_____/_____ 02-390F	02-390F/ _____	_____/_____ 02-390F	_____/_____ 02-390F	02-390F/ _____
Idle Gear Assembly	02-355B/ 03-355B	03-355B/ 02-355B	02-355B/ 02-355B	03-355B/ 02-355B	02-355B/ 02-355B	02-355B/ 02-355B
Intake Air Filters	02-805B/ 10-114	03-805B/ 02-805B	02-805B/ 02-805A	03-805B/ GG-118	CN-106/ 02-805C	84-111/ 02-805B
Intake and Exhaust Tappet Assembly	02-345A/ 03-345A	03-345A/ 02-345A	02-345A/ 02-345A	03-345A/ 02-345A	02-345A/ 02-345A	02-345A/ 02-345A
Intercoolers	F-068/ F-068	NB-002/ 41-127A	F-068/ F-068	F-068/ F-068	F-068/ F-068	F-068/ F-068
Jacket Water Fittings - Pipe and Fittings (Small Bore Scope Only)	02-435A/ 03-435A	03-435A/ 02-435A	02-435A/ 02-435A	03-435A/ _____	_____/_____ 02-435A	02-435A/ 02-435A
Jacket Water Heat Exchanger	02-810C/ 10-103	_____/_____ _____	02-810B/ 02-717Q	03-810A/ GG-103	CN-120/ 02-810A	02-717N/ 02-810C
Jacket Water Heaters	02-810E/ 03-800A	03-810C/ 02-810	02-810D/ 02-717N	03-800A/ 02-810A	CN-128/ 02-810D	02-810B/ 02-810A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Jacket Water Pump - Gear	02-425A/ 03-425A	03-425A/ 02-425A	02-425A/ 02-425	03-425A/ 02-425A	02-425A/ 02-425A	02-425A/ 02-425A
Jacket Water Standpipe and Miscellaneous Bolting	02-700F/ _____	03-700F/ 02-700F	_____/_____ 02-700F	_____/_____ 00-700F	_____/_____ 02-700F	02-700E/ 02-700F
Jacket Water Standpipe: Valves	02-700B/ 00-700B	03-717B/ 02-700B	02-700B/ 02-700B	00-700B/ 00-700B	02-700B/ 02-700B	02-700B/ 02-700B
Lube Oil Heat Exchanger	02-820G/ 10-104	03-820D/ 02-820B	02-820G/ 02-717R	03-820A/ GG-104	CN-111/ 02-820A	02-717D/ 02-820B
Lube Oil Keep-Warm Filter	02-820E/ 10-117	03-820G/ 02-820E	02-820E/ 02-717V	03-820D/ GG-121	CN-122/ 02-820E	02-717S/ 02-820G
Lube Oil Keep-Warm Pump	02-820C/ 03-820C	03-820F/ 02-820D	02-820B/ 02-717U	03-820C/ GG-109	CN-109/ 02-820G	02-717R/ 02-820F
Lube Oil Keep-Warm Strainer	02-820D/ _____	03-820H/ _____	02-820D/ _____	_____/_____ _____	_____/_____ _____	02-717V/ 02-465D
Lube Oil Pressure Regulating Valve	00-420/ 00-420	00-420/ 00-420	00-420/ 00-420	00-420/ 00-420	00-420/ 00-420	00-420/ 00-420
Lube Oil Sump Tank Heaters	02-820A/ 03-800B	03-820B/ 02-820	02-820A/ 02-717P	03-800B/ 02-820A	02-540D/ _____	02-820A/ 02-820C
Lube Oil Sump Tank	02-540A/ 03-540A	03-540A/ 02-540A	02-540A/ 02-540A	03-540B/ 02-540A	02-540A/ 02-540A	02-540A/ 02-540A

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Lube Oil Tubing and Fittings - Internal	02-307B/ 03-307B	03-307B/ 02-307B	02-307B/ 02-307B	03-307B/ 02-307B	02-307B/ 02-307B	02-307B/ 02-307B
Main Bearing Caps - Studs and Nuts	02-305C/ 03-305C	03-305C/ 02-305C	02-305C/ 02-305C	03-305C/ 02-305C	02-305C/ 02-305C	02-305C/ 02-305C
Main Bearings Shells	02-310B/ 03-310B	03-310B/ 02-310B	02-310B/ 02-310B	03-310B/ 02-310B	02-310B/ 02-310B	02-310B/ 02-310B
Overspeed Trip Drive Couplings	02-410C/ 03-410C	03-410C/ 02-410C	02-410C/ 02-410C	03-410C/ 02-410C	02-410C/ 02-410C	02-410C/ 02-410C
Overspeed Trip Governor	02-410A/ 03-410A	03-410A/ 02-410A	02-410A/ 02-410A	03-410A/ 02-410A	02-410A/ 02-410A	02-410A/ 02-410A
Overspeed Trip Governor and Accessory Drive	02-410B/ 03-410B	03-410B/ 02-410B	02-410B/ 02-410B	03-410B/ 02-410B	02-410B/ 02-410B	02-410B/ 02-410B
Overspeed Trip Vent Valve	02-410D/ 03-410D	03-410D/ 02-410D	02-410D/ 02-410D	03-410D/ 02-410D	02-410D/ 02-410D	02-410D/ 02-410D
Piping System	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM	NONUM/ NONUM
Piston Pin Assembly	02-341C/ 03-341C	03-341C/ 02-341C	02-341C/ 02-341C	03-341C/ 02-340E	02-341C/ 02-341C	02-341C/ 02-341C
Piston Rings	02-341B/ 03-341B	03-341B/ 02-341B	02-341B/ 02-341B	03-341B/ 02-340D	02-340D/ 02-341B	02-341B/ 02-341B

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Pistons	02-341A/ 03-341A	03-341A/ 02-341A	02-341A/ 02-341A	03-341A/ 02-340C	02-340C/ 02-341A	02-341A/ 02-341A
Push Rods	02-390C/ 03-390C	03-390C/D/ 02-390C	02-390C/ 02-390C	03-390C/ 02-390C	02-390C/ 02-390C	02-390C/ 02-390C
Rocker Arm Bushings	02-390E/ 03-390E	03-390E/ 02-390E	02-390E/ 02-390E	03-390E/ 02-390E	02-390E/ 02-390E	02-390E/ 02-390E
Rocker Arm Capscrews, Drive Studs (Pop Rivets)	02-390G/ 03-390G	03-390G/ 02-390G	02-390G/ 02-390G	03-390G/ 02-360G	02-390G/ 02-390G	02-390G/ 02-390F
Starting Air Distributor Assembly	00-442A/ 03-442A	03-442A/ 02-442A	00-442A/ 02-442A	03-442A/ 02-442A	02-442A/ 00-442A	00-442A/ 02-442A
Starting Air Storage Tank	02-835J/ 10-111	03-835F/ 02-835E	02-835B/ 02-835D	03-835A/ _____	CN-112 02-835A	02-835F/ 02-835D
Thermocouples	02-630D/ 03-630D	03-630D/ 02-630D	02-630D/ 02-630D	03-630D/ 02-630D	02-630D 02-630D	02-630D/ 02-630D
Thermostatic Valves	02-810D/ 03-515	03-799A/ 02-515	02-810C/ 02-717W	03-515/ 02-515	C136/40/ 02-810C	02-810A/ 02-810E
Thrust Bearing Ring	02-310C/ 03-310C	03-310C/ 02-310C	02-310C/ 02-310C	03-310C/ 02-310C	02-310C/ 02-310C	02-310C/ 02-310C
Turbo/water Piping - Pipe and Fittings	02-437/ 03-437A	03-437A/ 02-437A	02-437/ 02-437A	03-437A/ 02-437	02-437/ 02-437	02-437/ 02-437

TDI COMPONENT NUMBER CROSS REFERENCE

<u>COMPONENT DESCRIPTION</u>	<u>COMANCHE PEAK/ SHOREHAM</u>	<u>RANCHO SECO/ SAN ONOFRE</u>	<u>PERRY/ VOGTLE</u>	<u>RIVER BEND/ GRAND GULF</u>	<u>CATAWBA/ BELLEFONTE</u>	<u>WNP-1/ SHEARON HARRIS</u>
Turbocharger	MP-022/23/ MP-017	MP-020/ MM-19/20	MP-022/3/ MP-022/3	MP-017/ MP-022/3	MP-022/3/ MP-022/3	MP-022/3/ MP-022/3
Turbocharger Lube Oil Fittings: Pipe, Tubing, Fittings and Flexible Coupling (Small Bore Scope Only)	02-467A/ 03-467A	03-467A/ 02-467A	02-467A/ 02-467A	03-467A/ 02-467A	02-467A/ 02-467A	02-467A/ 02-467A
Turbocharger: Bracket Bolting and Gaskets	02-475A,C/ 02-475A,D	03-475A,C/ 02-475A,C	02-475A,C/ 02-475A,C	02-475A,C/ 02-475A,C	02-475A,C/ 02-475A,C	02-475A,C/ 02-475A,C
Water Discharge Manifold - Jacket Water Discharge Piping, Couplings and Seals	02-317A&B/ 03-317A&B	03-317A&B/ 02-317A&B	02-317A&B/ 02-317A&B	03-317A&B/ 02-317A&B	02-317A&B/ 02-317A&B	02-317A&B/ 02-317A&B
Woodward Governor	02-415A/ 03-415A	03-415A/ 02-415A	02-415A/ 02-415A	03-415A/ 02-415A	02-415A/ 02-415A	02-415A/ 02-415A

ENGINEERING REVIEW CRITERIA DOCUMENT
FOR
THE DESIGN REVIEW OF THE TDI DIESEL
SMALL BORE PIPING, TUBING AND SUPPORTS
FOR THE TDI OWNERS GROUP

Report No. 11600.60-DC-02
Revision 0

Prepared
by

Stone & Webster Engineering Corporation
Boston, Massachusetts

August 1984

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
1.0	INTRODUCTION	1
2.0	APPLICABILITY	1
3.0	OBJECTIVE	1
4.0	REVIEW METHODS	1
4.1	REVIEW OF EXISTING TDI DOCUMENTATION	1
4.2	REVIEW OF SMALL BORE PIPING	2
4.3	REVIEW OF TUBING	3
4.4	REVIEW OF SMALL BORE PIPING AND TUBING SUPPORTS	3
4.5	REVIEW OF ENGINE INDUCED VIBRATION	4
5.0	SPECIAL COMPONENTS	4
5.1	DRESSER COMPRESSION COUPLINGS	4
5.2	PIPING FLANGES	4

TDI OWNERS GROUP

ENGINEERING REVIEW CRITERIA DOCUMENT FOR THE DESIGN REVIEW OF THE TDI DIESEL SMALL BORE PIPING, TUBING AND SUPPORTS FOR THE TDI OWNERS GROUP

1.0 INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program requires Design and Quality Revalidation reviews to independently verify the structural adequacy of the small bore piping, tubing and associated supports to withstand the effects of normal operating and earthquake loadings. This report provides the criteria to be used to perform the review.

2.0 APPLICABILITY

The requirements of the review contained in this report are applicable to all TDI supplied small bore piping and tubing systems including associated supports contained in the diesel engine and its skid, unless specifically excluded by an approved Task Description in accordance with TDI Diesel Generator Owners Group Procedure DG-3.

3.0 OBJECTIVE

The objective of this report is to provide the criteria to be utilized to verify that the small bore piping, tubing and supports will perform their intended function under all normal and earthquake loadings.

4.0 REVIEW METHODS

4.1 Review of Existing TDI Documentation

The initial method to be utilized in determining a component's acceptability is to perform a review of all existing small bore pipe stress and support documentation provided by TDI.

The documentation will be reviewed to determine if it provides an adequate design basis in accordance with the appropriate codes as delineated by the individual utilities design specification for the diesel engine. The review shall also compare the as built piping and support condition to the existing design basis to determine compatibility.

If, after completing the review, the engineer determines that the component is acceptable, based on the existing documentation, the Component Design Report will be issued stating the conclusion of acceptability.

If TDI documentation is not available, or if it is determined that the available documentation does not readily lead to a conclusion of acceptability the engineer will alternatively continue the review as outlined in the following paragraphs.

4.2 Review of Small Bore Piping for Acceptability

In cases where the review of TDI documentation does not lead to component acceptability, the engineer will judge if the component will perform its intended function under all normal and earthquake loadings. This judgment will be based on a review of the following information:

Quality approved as built piping isometrics

System operating parameters

Physical piping data

Site specific amplified response spectra

System function

In addition to reviewing the above information, a physical walkdown of the engine and skid piping may be required. The walkdown would include a review of the piping to determine pipe support type and function, as well as a review for the following:

Thermal flexibility: The engineer will determine if sufficient flexibility exists for each between support section of small bore piping. The thermal movement imparted by the supports onto the piping will also be considered.

Deadweight spans: The deadweight spans between supports will be reviewed by the engineer and acceptability will be based on judgment.

Seismic spans: The seismic spans between supports will be reviewed by the engineer and acceptability will be based on judgment. The engineer's judgment will consider the site specific amplified response spectra and all components, fittings and branch connections. Engine induced vibration will also be considered in determining acceptability of seismic spans and is further discussed in paragraph 4.5.

The engineer will document the reviews of the individual components by a written trip report. The trip report will serve as a summarization of the engineering walkdown.

In cases where the engineer judges that the component will perform its intended design function the Component Design Report will be issued stating the conclusion of acceptability.

In cases where the engineer judges that a modification may be required to assure functional capability, a recommendation for the modification will be stated in the conclusions of the Component Design Review. The analyst may perform calculations to support the judgment in cases where it is not apparent that a modification is required. The object of these calculations is not to provide code compliance, but specific codes may be referenced for guidance.

4.3 Review of Tubing for Acceptability

A field walkdown of all critical tubing components will be required. The same methods as outline in paragraph 4.2 for small bore piping review will be employed for tubing.

4.4 Review of Small Bore Piping and Tubing Support

In cases where the review of TDI documentation, as outlined in paragraph 4.1, does not lead to component acceptability the engineer must continue the review based on the following:

- 1) Quality approved as built support sketches, if available.
- 2) Physical support data
- 3) Anticipated support loads

In addition to, or in conjunction with, reviewing the above information, a physical walkdown of the engine and skid supports may be required. The walkdown would consist of a review of the following support components so that the engineer may judge if the support will perform its intended function:

- 1) Structural members
- 2) Structural bolts and base plates
- 3) Welds

The engineer will document the review and recommend modifications as outlined in paragraph 4.2.

4.5 Engine Induced Vibration

The effects of engine induced vibration will be considered in determining the adequacy of the piping spans for dynamic loading. Specifically, the engineer

will determine if the existing piping spans may cause the piping to respond at the resonant frequency of the engine. This determination may be based on calculation or review of the vibration test results obtained at Shoreham and Comanche Peak. Another acceptable method of considering engine induced vibration is to compare the specific engine small bore piping or tubing with proven acceptable design experience.

The documentation of acceptability or recommendation of modifications will be in accordance with paragraph 4.2.

5.0 SPECIAL COMPONENTS

5.1 Dresser Compression Coupling

Based on review of the small bore Dresser couplings at Shoreham, it is not required to perform qualifying calculations for the coupling on the remaining engines. The couplings are inherently qualified based on acceptability of the attached piping.

5.2 Pipe Flanges

Based on review of the small bore pipe flanges at Shoreham, it is not required to perform qualifying calculations for the flanges on the remaining engines. The flanges are inherently qualified based on acceptability of the attached piping.

DESIGN CRITERIA FOR
DIESEL GENERATOR
LARGE DIAMETER PIPING FOR SAN ONOFRE

Submitted to
TDI Owners Group
Charlotte, North Carolina

Prepared by
Impell Corporation
225 Broad Hollow Road
Melville, New York 11747

Report No. 02-0630-1282
Rev. A

Job No. 0630-037-1641

November, 1984

TABLE OF CONTENTS

	Title Page
	Table of Contents
1.0	PURPOSE
2.0	APPLICABLE CODES
2.1	Diesel Generator Specification Requirements
2.2	Code Requirements
2.2.1	DEMA Standards
2.2.2	American Bureau of Ships Building Codes
2.2.3	ANSI B31.1 and B31.3
2.2.4	ANSI B31.7
2.2.5	ASME Code Section III
2.3	Applicable Code Acceptance Criteria
2.4	Conclusion
3.0	ACCEPTANCE PHILOSOPHY
3.1	Considerations for the Exhaust Manifold
4.0	LOADING CONSIDERATION
5.0	SPECIAL COMPONENT CONSIDERATIONS
5.1	Mitered Joints
5.2	Unreinforced Branches
5.3	Pressure Retaining Butt welds
5.3.1	Weld Penetration Considerations
5.3.2	Weld Joint Capacity
5.3.3	Stress Intensification Factor

TABLE OF CONTENTS (continued)

5.4	Dresser and Compression Couplings
5.4.1	Code Acceptability of Dresser and Compression Couplings
5.4.2	Coupling Validation
5.4.3	Effects of Couplings on Pipe Stress Analysis
5.5	Pipe Flanges
5.5.1	Standard Flanges
5.5.2	Non-Standard Flanges
6.0	REFERENCES

1.0 PURPOSE

The purpose of this document is to provide structural acceptance criteria for evaluation of the Transamerica Delaval, Inc. (TDI), large diameter, diesel generator skid mounted piping at the San Onofre Nuclear Generating Station, Unit No. 1, (SONGS). This criteria was based primarily upon the philosophy embodied in industry accepted Codes and Standards for design of nuclear power station piping.

2.0 APPLICABLE CODES

2.1 Diesel Generator Specification Requirements

The SONGS Diesel Generator Specification (Ref. 1) invokes ANSI B31.1 (Ref. 2) for the subject piping.

2.2 Code Requirements

2.2.1 Diesel Engine Manufacturers Association (DEMA) Standards

The DEMA Standard (Ref. 3) extensively covers the detailed performance requirements of systems and subsystems for diesel engine driven electric power generating units, but does not cover analytical requirements or allowable stresses for piping systems. It relies on other codes for these requirements but does not specifically reference any.

2.2.2 American Bureau of Ships Building Code

Section 36 of the American Bureau of Ships Building Code (Ref. 4) discusses requirements for pumps and piping systems. This code presents very few design requirements, providing specific analytical formulas only for pipe wall thickness versus piping design pressure. The code makes no specific provisions for analysis for deadweight, thermal expansion, or dynamic effects. Piping materials and allowable membrane stresses are addressed in this code. For example, ASTM A53 Grade B and A106 Grade B are approved materials. It is noted that this code provides tabulated membrane stress allowables which are the same as for B31.1 (Ref. 2) and ASME III Class 3 and 2 (Refs. 5 and 6).

2.2.3 ANSI B31.1 and B31.3

The general philosophy of ANSI B31.1 (Ref. 2) and B31.3 (Ref. 7) is to parallel those provisions of Section I "Power Boilers" of the ASME Boiler and Pressure Vessel Code, as they can be applied to piping systems functioning at elevated pressures and temperatures. These codes are conservative, reflecting the general need for long service life and maximum reliability in power, chemical, and petroleum refinery installations.

B31.1 and B31.3 are quite similar, except that B31.3 allowable stresses are somewhat more permissive than B31.1 values. Both are all inclusive codes which set forth engineering requirements for design and construction of piping systems. These codes contain basic reference data and formulas deemed necessary for design, including the following:

- (1) Material specifications and component standards which have been accepted for code usage;
- (2) The designation of proper dimensional standards for the elements comprising piping systems;
- (3) Requirements for the design of component parts and assembled units, including necessary pipe supporting elements;
- (4) Requirements for the evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature, and external forces;
- (5) Requirements for the fabrication, assembly, and erection of piping systems.
- (6) Requirements for testing and inspection of elements before assembly or erection and of the completed systems after erection.

2.2.4 ANSI B31.7

ANSI B31.7 "Nuclear Power Piping" (Ref. 8) was the precursor of ASME III-Class 1 Subarticle NB-3600, which covers ASME Code Class 1 piping design, and embraces the same design philosophy as ASME III-Class 1 (Ref. 9).

2.2.5 ASME Code, Section III

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. Section III of this Code addresses nuclear power plant components, and consists of two (2) divisions. Division 2 covers concrete reactor vessels and containments and is not pertinent here. Division 1 consists of the following subsections:

NCA	General Requirements
NB	Class 1 Components
NC	Class 2 Components
ND	Class 3 Components
NE	Class MC Components
NF	Components Supports
NG	Core Support Structures
Appendices	

Each subsection is divided into articles as follows:

Article 1000	Introduction and Scope
Article 2000	Material
Article 3000	Design
Article 4000	Fabrication and Installation
Article 5000	Examination
Article 6000	Testing
Article 7000	Overpressure Protection
Article 8000	Nameplates, Stamping and Reports

The code recognizes that various components have different levels of importance associated with the components' function, as related to the safe operation of the nuclear power plant. The code classes thus permit a choice of rules that provide assurance of structural integrity and quality commensurate with the relative importance assigned to the individual items. Class 1 components are assigned the highest level of importance. Reactor coolant pressure boundary components are examples of what is normally assigned as ASME III-Class 1. Class 2 components are assigned the next lower level of importance. Nuclear safety related components other than reactor coolant pressure boundary components are examples of what is normally assigned to ASME III-Class 2. Class 3 components are usually of the same level of importance as Class 2 components, but are assigned to ASME III-Class 3 by virtue of their moderate normal operating temperatures and pressures.

ASME Code Section III does not provide guidance in the selection of component classification and places the responsibility of such component classification on the owner of the nuclear power plant.

2.3 Applicable Code Acceptance Criteria

Those portions of the applicable building codes and standards which refer to structural integrity of the subject piping are addressed herein. The portions of these codes which provide requirements for documentation and other quality assurance related requirements, as well as adequacy of system design requirements such as overpressure protection adequacy, are not part of this scope.

The SONGS Diesel Generator Specification (Ref. 1) invokes ANSI B31.1 (1973 edition), which is the precursor to ASME Section III Class 3 and embraces the same design philosophy. These codes are consistent with the moderate service temperatures and pressures associated with the subject piping. ASME III Class 3 applies specifically to nuclear safety related piping, having rigorous analytical requirements that are acceptable to the nuclear industry and the U.S. Nuclear Regulatory Commission. ANSI B31.3 by virtue of its similarity, is also applicable.

Since ASME III-Class 3 permits qualification to a more stringent code subsection, it is permissible to provide ASME III-Class 2 (Ref. 6) or ASME III-Class 1 (Ref.9) analysis for this purpose. ANSI B31.7 (Ref. 8) is the predecessor to ASME III-Class 1 and is, therefore, similarly applicable.

ASME III-Class 1 has considerably higher allowable stresses for material such as ASTM A106 Grade B. However, this is applicable only if ASME III-Class 1 stress analysis is performed. Note that ASME III-Class 1 analysis provides design rules for rigorous evaluation of fatigue life and must be used if the piping is justified on that basis.

2.4 Conclusion

It was concluded that the SONGS diesel generator piping design utilizes the philosophy and intent of ASME III - Class 3 design (Ref. 5) to provide analytical justification of piping design acceptability. The other above referenced codes (References 2, 6, 7, 8 & 9) were also judiciously considered where applicable, as described in Section 3.0.

3.0 ACCEPTANCE PHILOSOPHY

The intent and philosophy of ASME III - Subsection ND design rules for Class 3 components (Ref. 5) was utilized as the basis of acceptance. The requirements of other codes and standards (Refs. 2, 6, 7, 8 and 9) were also considered for applicability. The analysis was performed in steps, as follows:

1. Pipe stress analysis was first performed in accordance with the design rules of ASME III - Class 3 (Ref. 5), using conservative assumptions for modeling and stress intensification described in detail in 5.0 (below).
2. If this analysis indicated excessive stresses, then the results were evaluated to determine if relaxing some of the conservatisms could be justified for the particular piping systems being considered.

For example, it was, at times beneficial to consider the more rigorous, ASME III-Class 1 analysis in an attempt to justify thermal expansion stresses on the basis of adequate thermal fatigue life.

3. If pipe stress was still excessive after relaxing conservatisms, support removal and/or modification was then considered.
4. The applicable piping system was then reanalyzed to reflect the above referenced analytical modification. Or, as an alternative, hand calculations were performed to account for a highly localized effect.

3.1 Considerations for the Exhaust Manifold

The Exhaust Manifold (EM) piping has operating temperatures above those classified as moderate. In view of the elevated temperature, ASME III - Class 2 rules would normally be used. However, since the design rules for ASME III - 2 and -3 are identical, either may be utilized for the design evaluation. There are additional concerns associated with the EM elevated temperature service; specifically, the effect of graphitization and creep on the structural integrity of the piping. However, based upon data contained in Reference 10 the diesel is predicted to operate approximately 1200 hours during the 40 year plant life, for an average of approximately only 30 hours each year. Thus, the effects of graphitization and creep are considered negligible since the high temperature exposure is for a very short duration, permitting steel rehabilitation by creep recovery and preventing the formation of embrittling graphite nodules in chain-like arrays.

Allowable stresses were developed based upon the criteria set forth in the ASME Codes for negligible creep and graphitization. The criteria specifies that the allowable stress is based upon a fraction of the minimum yield and ultimate strength of the subject material at the elevated temperature.

Consistent with the intent and philosophy of the ASME Code, the adoption of an inspection program, which provides a means for identifying the possible degradation of the EM components, particularly the welded joints, was recommended (Ref. 11).

4.0 LOADING CONSIDERATIONS

The pipe stress analysis accounts for all loads due to deadweight, thermal expansion, and earthquake.

The effects of earthquake were determined by dynamic pipe stress analysis utilizing appropriate seismic response spectrum envelopes. As noted in the Diesel Generator Specification (Ref. 1) Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE or DBE) were considered. Consistent with Reference 1, a three-directional earthquake was assumed. The effects of each of the vertical and two horizontal earthquakes was first determined by combining across modes by square root sum of squares (SRSS) with closely spaced modes considered by the ten percent method. The three directions of earthquake were then combined by SRSS to determine the seismic results. Seismic spectra was based on Reference 1, Appendix 4F.

Damping values were selected consistent with Reference 12. Also, based upon data provided in Reference 13, the diesel and its supporting skid have first mode natural frequencies in the rigid range of the applicable response spectrum. Therefore, consideration of the dynamic amplification of those components was not necessary. Reference 13 also states that the auxiliary skid has frequencies within the seismic range. The piping attached to equipment and/or supports on the auxiliary skid was evaluated on a case by case basis.

The analytical piping model for both thermal and seismic analyses included the pipe supports, which were modeled as springs whose spring constants were derived based on similarities with Shoreham and Comanche Peak where applicable. Otherwise, nominal spring constants were developed based on previous experience. In addition, to more accurately represent both the flexibility of equipment and its dynamic effect on the piping, the equipment was included in the analytical piping model using cross-sectional properties and component weights derived from the applicable equipment details. However, if a particular piece of equipment was apparently rigid, based on engineering judgement, then that equipment was not included in the analytical model.

5.0 SPECIAL COMPONENT CONSIDERATIONS

This section provides discussions relating the analytical considerations of special configurations and components. These include specialty items such as Dresser and Compression Couplings, flexible hose and pipe flanges, and also includes special configurations such as mitered joints, unreinforced branches, including unreinforced lateral connections, and circumferential butt welds.

5.1 Mitered Joints

Mitered joints are permitted by ASME III-Class 1, 2 and 3 (Refs. 5, 6, and 9), as well as B31.1 (Ref. 2) and B31.3 (Ref. 7). Flexibility characteristic (h), flexibility factor (k), and stress intensification factor (i), as tabulated in Figure NC-3673.2(b)-1 and Figure ND-3673-2(b)-1 in Ref. 5 and 6, were utilized for ASME III-Class 2 and 3 analyses, respectively.

Furthermore, to assure that the miter joint induced discontinuity stresses were acceptably low, equation 4(c), paragraph 304.2.3 of B31.3 (Ref 7) was evaluated to determine the pressure capacity of the joint as compared with the normal operating pressure of the pipe in question.

5.2 Unreinforced Branches

The use of unreinforced branch connections, including unreinforced lateral connections as used in the SONGS diesel generator skid mounted piping, is permitted by ASME III-Class 1, 2 and 3, as well as by B31.1 and B31.3.

Flexibility characteristic (h), flexibility factor (k) and stress intensification factor (i), as tabulated in Figure NC-3673.2(b)-1 and Figure ND-3673.2(b)-1 were utilized for ASME III-Class 2 and 3 respectively.

Additional analysis was performed to confirm that the pipe is "self-reinforcing" and that the rules for metal reinforcement requirements set forth in the codes (e.g., ASME III-NC-3643.3, et. al.) were satisfied. It is noted that since the design pressure was small in relation to the actually furnished pipe wall thickness, there was considerable excess wall thickness available for self-reinforcing of the branch penetrations.

5.3 Pressure Retaining Butt welds

Seamless pipe was furnished for the SONGS Diesel Generator skid mounted piping (Ref. 14). Longitudinal butt welds were not used and therefore require no further discussion. However, circumferential butt welds were used throughout to join adjacent piping spool pieces. These welds are discussed below.

5.3.1 Weld Penetration Considerations

For the seamless on-engine piping, weld only in the bevel region was assumed. No weld penetration in the land region (assumed as 1/16 inch) was assumed.

5.3.2 Weld Joint Capacity

Minimum wall thickness requirements dictated by design pressure (e.g. ASME III-NC-3641.1, Equation (3), et. al.) must be maintained at the circumferential butt welds, which join adjacent spool pieces.

For the SONGS diesel generator piping, it was conservatively assumed that the material available for design pressure requirements was equal to the pipe wall thickness minus 3/32 inch, to account for the worst possible minimum weld thickness. Minimum weld thickness to minimum required pipe wall thickness ratios were determined for all of the subject pipe sections. The smallest ratio of (tw/tmin) was found to be 2.0 (or 200 percent of minimum required wall thickness). Thus, these welds always met minimum Code requirements for pressure dependent pipe wall thickness. This excess wall provides adequate generic margin against corrosion. More specific data regarding corrosion is provided in the specific component reports where applicable.

All pipe stress calculations, other than design pressure vs. wall thickness calculations, utilized the nominal pipe wall thickness, since a local thinning of the pipe affects its pressure capacity but has a negligible effect on gross bending stresses. This is consistent with the philosophy of ASME III and ANSI codes.

Applying this philosophy to the circumferential welds, it was thus assumed that for deadweight, thermal expansion and seismic loading stress analysis, the available wall thickness was the nominal wall thickness minus the nominal flat landing of 1/16 inch. The evaluation of stresses at the circumferential butt welds considered this reduction in section.

If the stresses thus derived were adequately low, then strength capacity of the circumferential weld joints furnished for the subject piping was considered to be adequate.

5.3.3 Stress Intensification Factor

The initial analysis utilized a stress intensification factor (SIF) of 1.8, which was the upper limit specified in ASME III-ND (1974 version including addenda through Winter 1975) Figure ND-3673.2(b)-1 for a mismatch of an as welded butt weld (which is in excess of 0.1, i.e., having a ratio of mismatch to pipe wall thickness $[\delta/t_n]$).

This approach was a conservative necessity. If it could easily be determined that the ratio (δ/t_n) is 0.1 or less, then the code permits an SIF of 1.0 for as welded or flush butt weld. However, since the pipe had independent I.D., O.D., and out of round tolerances, it was not possible to determine the actual pipe wall mismatch (δ) between two adjacent spools by visual inspection of the outside of the piping. Thus the conservative value of 1.8 was utilized.

5.4 Dresser and Compression Couplings

Dresser Couplings (see Figure 1) and Compression Couplings (see Figure 2) were utilized throughout the SONGS diesel generator skid mounted piping. These couplings provide a flexible, leak proof seal at the pipe spool piece interface, without pipe threading, or welding, and do not require precise spool piece end preparation or precise piping alignment.

These couplings have an 80 year record of successful service on all kinds of piping such as water mains, sewage treatment, and water filtration piping, and in all branches of the oil industry, and have been used extensively by TDI for other diesel generator installations.

5.4.1 Code Acceptability of Dresser and Compression Couplings

ASME III-NC-3649 (for Class 2 components) and ASME III-ND-3649 (for Class 3 components) permit the use of pressure retaining products not specifically covered in the code, which are shaped, proportioned, and sized similar to components that have been proven satisfactory by successful performance under comparable service conditions.

By virtue of their long record of satisfactory service for moderate pressure/temperature systems of this type of application, the Dresser Couplings meet the intent of ASME-III Class 2 and Class 3 (Refs. 5 and 6) and were therefore acceptable components.

5.4.2 Coupling Validation

1. Selection

The Dresser catalog specifies limiting pressures and temperatures for the various couplings. The subject service conditions were evaluated against these requirements and some couplings, because of the gaskets supplied, were slightly marginal with respect to the temperature requirements. For these couplings, replacement with an upgraded model was specified if leaks developed.

2. Displacement Verification

When acceptable piping/pipe support results are obtained, the relative translations and rotations of the joined pipes were compared to the vendor allowables for the coupling to validate the analysis.

5.4.3 Effects of Couplings on Pipe Stress Analysis

1. Pressure Effects

Pressure integrity of the piping is achieved by wedging the coupling gasket against the outside of the pipe and into the mating fitting (Reference Figures 1 and 2). However, this configuration permits axial pipe movements of the adjacent pipe spool pieces. Thus, when the pipe is pressurized, it would tend to slip out of the coupling and separate, if some external axial anchorage were not also furnished. Pipe supports and terminal end connections were relied upon to prevent slipping. The pipe stress analysis included the effects of these resulting unbalanced pressure forces.

2. Constraint of Thermal Expansion

As shown in Figures 1 and 2, a gap is intended to be maintained between the two pipe spool pieces during installation. This would accommodate a modest amount of thermal pipe expansion. However, if this gap is not maintained during the installation of the piping, then the thermal expansion relief is partially negated.

Pipes joined by couplings have only the gasket and its frictional capacity to provide any mutual stiffening across the joint. Since this is very low, the coupling connection was analyzed as completely free to rotate and translate relatively.

3. Seismic Interaction at the Couplings

Examination of Figures 1 and 2 indicates that modest translations and rotations between the two adjacent piping spool pieces are possible, by virtue of the soft gaskets, and the gaps within the couplings. For seismic analysis, it is not conservative to neglect this flexibility.

In order to account for this, seismic pipe stress analysis first conservatively assumed the piping systems to be completely separated at the coupling, thus taking no credit for any mutual stiffening across the coupling. If the seismic stresses were acceptable, then no further evaluation was performed.

5.5 Pipe Flanges

5.5.1 Standard Flanges

Flanges fabricated to standards listed in ASME III-NC-3132-1 (for Class 2) and ND-3132-1 (for Class 3) are acceptable for ASME III Class 2 and 3. For these flanges the established pressure/temperature rating was first compared with operating pressure/temperature to evaluate the flange selection.

Since the operating pressures for the subject piping systems were modest, the flange had excess capacity to carry mechanical loads imposed on the flange. This was confirmed by conservative hand calculations using techniques outlined in ASME III - Subsection ND 3658.

5.5.2 Non-Standard Flanges

At a number of locations within the SONGS Diesel Generator skid mounted piping, square or rectangular, flat plate flanges were utilized. These flanges were analyzed as flat plates, using conservative assumptions.

6.0 REFERENCES

1. Southern California Edison Company Specification for the Diesel-Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition, Specification No. E-73001, Rev. 6.
2. American National Standards Institute (ANSI) Document ANSI/ASME B31.1, "Power Piping" (B31.1), 1973.
3. Diesel Engine Manufacturers Association (DEMA), "Standards and Practices for Low and Medium Speed Stationary Diesel and Gas Engines," 1972.
4. American Bureau of Ships, "Rules for Building and Classing Steel Vessels," 1976.
5. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components" (ASME III) Subsection ND Class 3 Components (ASME III-Class 3).
6. ASME III, Subsection NC, Class 2 Components (ASME III-Class 2).
7. ANSI document ANSI/ASME B31.3, "Chemical Plant and Petroleum Refinery Piping" (B31.3).
8. ANSI B31.7, "Nuclear Power Piping" (B31.7).
9. ASME III, Subsection NB, Class 1 Components (ASME III-Class 1).
10. Record of Conversation between A. J. Palumbo and D. Rickett, October 26, 1984.

11. Impell Report No. 02-0630-1277, Rev. A "TDI Owners Group for San Onofre Nuclear Generating Station, Unit 1, Exhaust Manifold Piping (Large bore Scope Only) Component Part No. 02-380A." Dated November, 1984.
12. NRC Regulatory Guide 1.61, October 1973.
13. Structural Dynamics Research Corporation Report No. 7416 Dated November 6, 1976 "Seismic Qualification Report on Delaval DSRV-20 Diesel Generator Unit."
14. Delaval letter to Mr. D. Nanda from Mr. F. P. Robinson dated May 24, 1977 "Material Specification Information Request Specification No. E-73001 Standby Power Addition San Onofre Nuclear Generating Station, Unit #1."

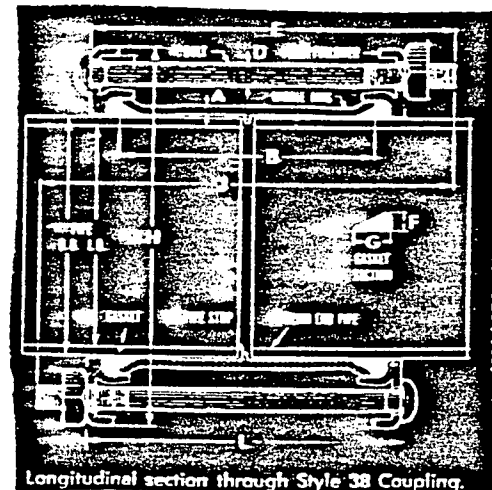
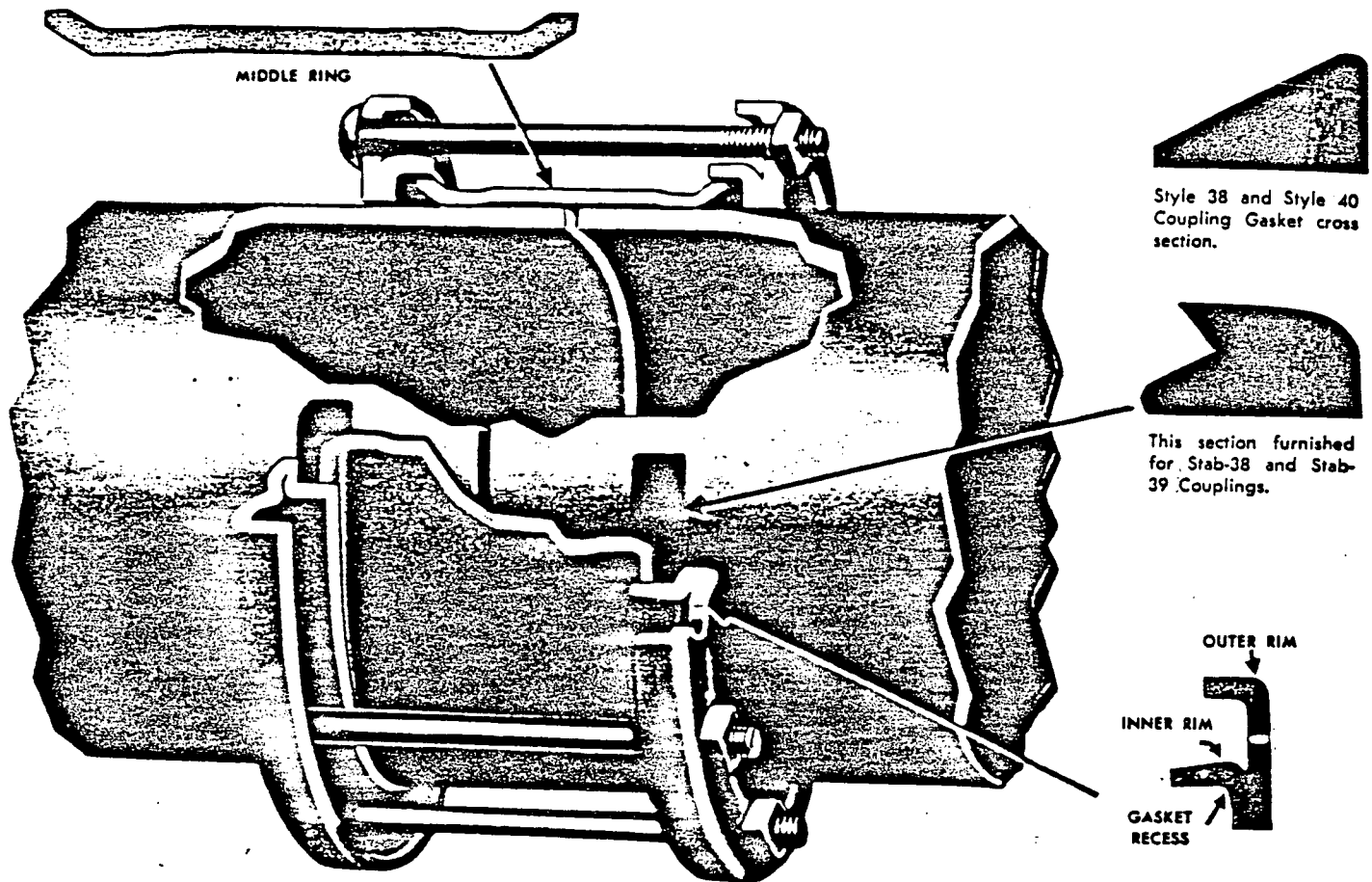


FIGURE 1
DRESSER COUPLING

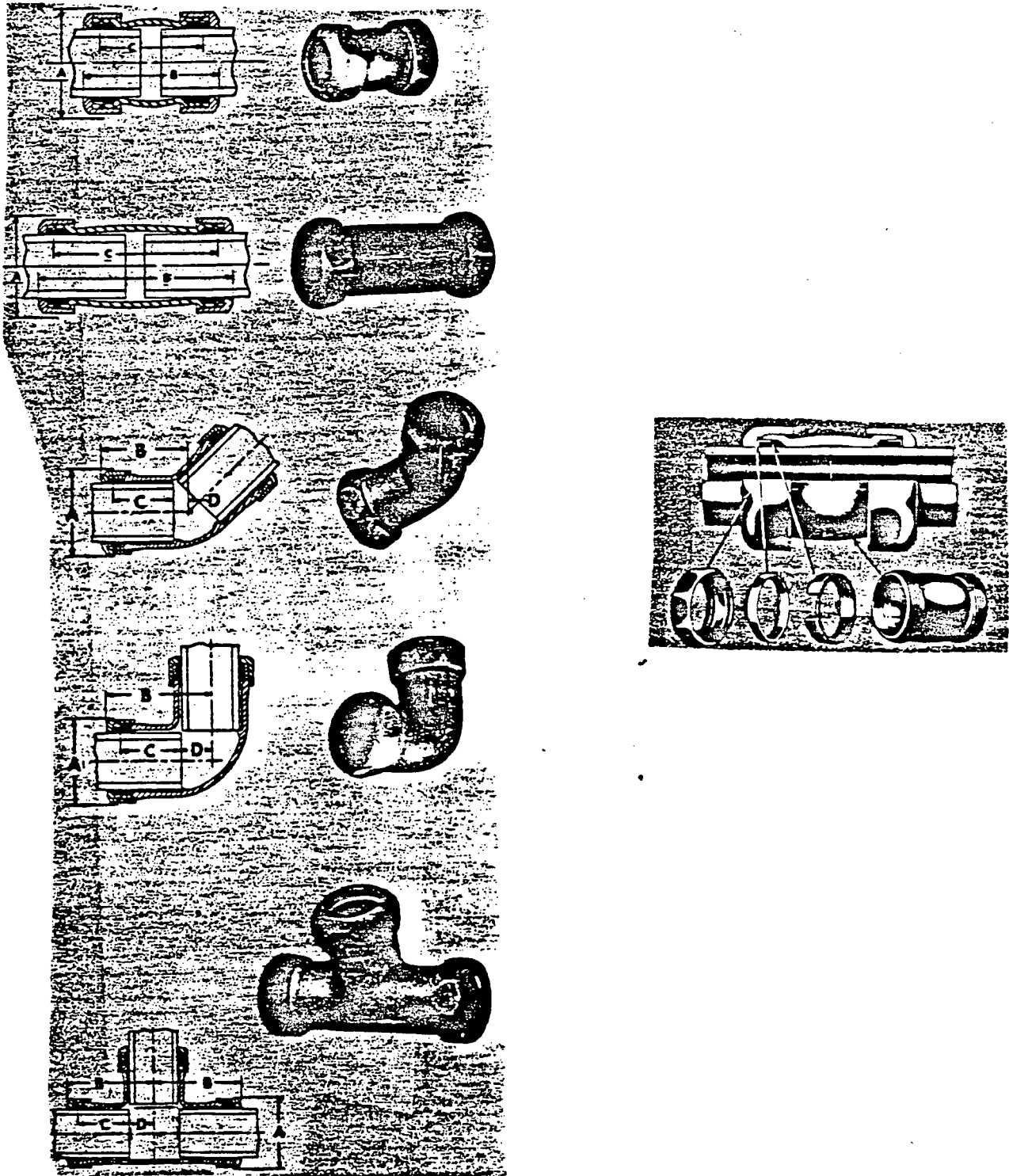


FIGURE 2
COMPRESSION COUPLING