

**TDI DIESEL GENERATOR**

**DESIGN REVIEW  
AND  
QUALITY REVALIDATION  
REPORT**

**Prepared For**

**SOUTHERN CALIFORNIA EDISON**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**By**

**TDI DIESEL GENERATOR OWNERS GROUP**

**VOLUME 3**

## 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 As- sembly & 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

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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

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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 Injection	4
02-450B	Fuel Oil Header: Piping/Tubing	Fuel Oil Injection	4



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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

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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 Instu- 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 Instu- 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

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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)

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

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

Starting Air Distributor: COMPONENT <u>Distributor Assembly</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>00-442A</u>	TASK DESCRIPTION NO. <u>DR-09-00-442A-1</u>
SNPS GPL NO. <u>03-442A</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTIONS

Design review is not required for this component, based on the Comanche Peak lead engine DR/QR report which establishes the acceptability of the distributor assembly. The parts under review are the same as those of the lead engine, with the exception of the housing. The housing for the V-20 is similar, having two additional positions for the sleeves and valve spools.

A review of the Component Tracking System indicates no significant applicable nuclear or non-nuclear industry experience.

The following Quality Revalidation inspection recommendations, to be performed on one station engine only, are made to ensure component quality and performance:

- Verify proper timing per instruction procedures.
- Visually inspect poppets for signs of scoring/wear after 100 hours run or pre-operational testing to verify proper lubrication. Specifically, after verifying the correct timing of each starting air distributor as described in the TDI Manual, the evaluation of wear on the cam and valve contact should be performed as follows:

1. Remove the distributor from the engine
2. Visually inspect the wear marks on the cam lobes.

Note the position and orientation of the lube oil jet. Oil flow from the jet should cover the wear mark region on the cam lobe.

3. Visually inspect the wear marks on the end of each valve spool where it slides on the cam. Measure the average diameter of the "flat" worn area on the end of each spool to the nearest 1/64-inch. If the largest of these measurements is more than 1.5 times the smallest, an engineering evaluation of the observed wear should be performed and a superficial hardness measurement should be made on the end "wear flat" of each valve spool. If the hardness of any spool end is significantly below 30 Rc, it should be replaced.

COMPONENT DESIGN REVIEW CHECKLIST

- Verify installation of follower lobe on camshaft.

In addition to the normal maintenance tasks of water removal and filter replacement for the starting air system, the following maintenance recommendations from the lead engine DR/QR report should be implemented:

- Maintain surveillance inspection to assure that the starting air manifold vent remains open and effective.
- Perform an inspection of the poppet valves and cams on all engines during refueling outages, to assess the degree of wear.

There are no modification recommendations for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

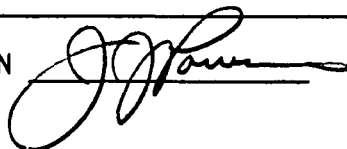
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DOCUMENTATION REQUIRED

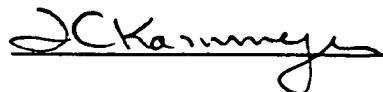
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Starting Air Distributor- <u>Distributor Assembly</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating <u>Station - Unit 1</u>
GPL NO.	<u>00-442A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-442A</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation
2. Verify the proper timing of the air start distributor as described in the TDI Manual.
3. After verifying the correct timing of each starting air distributor, as described in the TDI Manual, the evaluation of wear on the cam and valve contacts should be performed as follows:
  - a. Remove the distributor from the engine.
  - b. Visually inspect the wear marks on the cam lobes.

Note the position and orientation of the lube oil jet. Oil flow from the jet should cover the wear mark region on the cam lobe.
  - c. Visually inspect the wear marks on the end of each valve spool where it slides on the cam. Measure the average diameter of the "flat" worn area on the end of each spool to the nearest 1/64-inch. If the largest of these measurements is more than 1.5 times the smallest, an engineering evaluation of the observed wear should be performed and a superficial hardness measurement should be made on the end "wear flat" of each valve spool. If the hardness of any spool end is significantly below 30 Rc, it should be replaced.
4. Verify the installation of the follower lobe on the camshaft (one engine only)

Engine 2

1. Same as Engine 1
-

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Timing of the air start distributor.
3. Proper lubrication of poppets by lack of scoring or wear on poppet surface.
4. Proper installation of the follower lobe on the camshaft.

Engine 2

1. Same as Engine 1
- 

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Timing in accordance with TDI Manual.
- 3-4. Review of inspection report by Design Group.

Engine 2

1. Same as Engine 1
- 

REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures, TDI Instruction Manual
3. Approved Site NDE Procedures, TDI Instruction Manual, TER# 99-020
4. Approved Site NDE Procedure, TDI Instruction Manual

Engine 2

- Same as Engine 1
-

DOCUMENTATION REQUIRED

Engine 1

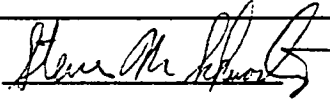
- 1. Document Summary Sheet
- 2-4. Inspection Report

Engine 2

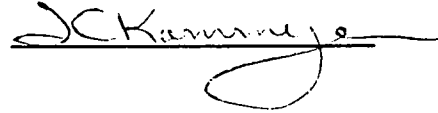
Same as Engine 1

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1

Engine 2

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RESULTS AND CONCLUSION

Engine 1

Engine 2

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GROUP CHAIRPERSON \_\_\_\_\_

PROGRAM MANAGER \_\_\_\_\_

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

STARTING AIR DISTRIBUTOR - TUBING, FITTINGS AND GASKETS

COMPONENT PART NO.: 00-442B

This component number has been deleted. All Air Distributor Tubing is addressed under component numbers 02-441A & C.

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

COMPONENT <u>Air Start Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-359</u>	TASK DESCRIPTION NO. <u>DR-09-02-359-0</u>
SNPS GPL NO. <u>03-359</u>	CLASSIFICATION TYPE <u>A</u>

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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 not previously addressed in the lead engine report.
- A review of the lead engine DR/QR report for Comanche Peak.
- Similarities between San Onofre component and the lead engine component.

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

- Remove, inspect and, if necessary, clean the air start valves during every refueling outage. The inspection should include inspection of the piston/cap and guide/housing sliding surfaces to evaluate severity of wear and corrosion present. This recommendation is based on discussions with TDI.
- Ensure that the dryer between the compressor after cooler and air receiver is functioning properly by blowing down the air receivers daily and noting any moisture content. Appropriate action should be taken if moisture is noted.

The following modifications should be implemented.

- SIM 329, copper gasket between valve and head.
- SIM 360, capscrew length and torque requirements.

An inspection of air start cap screw torques for Engine 2 on cylinders 2R, 2L, 6R, 6L, 10R and 10L indicated all were unsatisfactory with the exception of 10R. Proper implementation of TDI SIM 360 should prevent this problem.

The following Quality inspections should be performed on Engines 1 and 2 unless otherwise noted:

- Verify that adequate seating exists between valve and valve ring.
- S02235/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-359-0

TASK DESCRIPTION (continued)

- Verify that no carbon deposits exist on valve internals.
- Verify initial and hot torque values for hold down capscrews (Engine 1 and remainder of Engine 2).
- Perform dimensional check of hold down capscrews.
- Perform a material comparator test on the hold down capscrews (two per bank).
- Perform a hardness test on the hold down capscrews (two per bank).

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

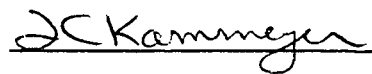
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Air Start Valve UTILITY Southern California Edison  
San Onofre Nuclear Generating  
Station - Unit 1  
GPL NO. 02-359 REV. NO. 1  
SNPS GPL NO. 03-359

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation including 10CFR21 response.
2. Perform a visual inspection to verify that adequate seating exists between the valve and valve ring.
3. Perform a visual inspection to verify that no carbon deposits exist on the valve internals.
4. Verify the initial and hot torque values for the hold down capscrews.
5. Perform a dimensional check of the hold down capscrews.
6. Perform a Material Comparator test on the hold down capscrews (two per bank).
7. Perform a Hardness test on the hold down capscrews (two per bank).

Engine 2

Same as Engine 1

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ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper seating of valve to valve ring

ATTRIBUTES TO BE VERIFIED (continued)

Engine 1 (continued)

3. Lack of carbon deposits on the valve internals
4. Proper torque values
5. Length of capscrews
6. Material of capscrews
7. Hardness of capscrews

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. A continuous metallic appearing ring exists on the valve ring contact surface.
3. No carbon deposits exist on the valve internals.
4. Torque values are in accordance with the TDI Instruction Manual.
- 5-7. 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, TDI Instruction Manual

Engine 2

Same as Engine 1

---



DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*Steve M Schwartz*

PROGRAM MANAGER

*JC Kammerer*

---

COMPONENT REVIEW

Engine 1

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

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
  - 2-3. No inspection reports have been received which fulfill these requirements.
  4. The capscrews were torqued to 150 ft-lbs for cylinders 2R, 2L, 6R, 6L, 10R and 10L. This was reported by TER# 09-012.
  - 5-7. No inspection reports have been received which fulfill these requirements.
-

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 Neta A. Sletta

PROGRAM MANAGER J. Kammerer

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

STARTING AIR MANIFOLD: PIPING, TUBING, AND FITTINGS  
(LARGE BORE SCOPE ONLY)  
COMPONENT PART NO. 02-441A

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 starting air manifold piping for the effects of normal operating and earthquake loadings.

The primary function of the starting air manifold piping is to provide adequate starting air from the off-skid supply piping to each engine cylinder.

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 the 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 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.

With respect to the Dresser couplings, Impell evaluated the couplings against the manufacturer's selection and service requirements. These include the design service conditions, relative end displacements from both translation and rotation of the joined pipes, and shelf and service life. The movements at the Dresser couplings are within the manufacturer's end movement requirements (Ref. 3). There are no service life constraints (Ref. 4) because this style of coupling has 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 couplings are adequate with respect to manufacturer's service condition limits.

It is recommended that support modifications be effected in order to provide stiffer load paths and to relieve thermal restraint in certain directions by support removal or partial support removal through bolt hole elongations. In addition, it is recommended that supports be added in order to mitigate seismic loads and stresses. Details on these support modifications and additions are summarized in Reference 5.

Historical corrosion data for carbon steel starting air systems was not available. However, the subject starting air piping and interconnecting welds have a limiting wall thickness of 5.15 times that required (Ref. 2), which should be sufficient margin against corrosion.

All pipe loads on the engine have been 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 the results are consistent with the final conclusions of this report.

Based on the above review, it is concluded that the subject piping components, with the above recommended modifications and additions, 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. 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 R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modification for Validation of Impell's Design Review for Component No. 02-441A, - San Onofre," dated November 8, 1984.

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

Starting Air Manifold  
Piping  
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison Company  
GROUP PARTS LIST NO. 02-441A TASK DESCRIPTION NO. DR-09-02-441A-0  
SNPS GPL NO. 03-441A CLASSIFICATION TYPE B

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---

TASK DESCRIPTIONS

Evaluate structural integrity of the starting air manifold 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

Provide adequate starting air from off-skid supply piping to each engine cylinder.

---

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-09-02-441A-0

REFERENCES

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

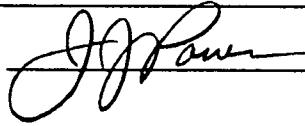
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DOCUMENTATION REQUIRED

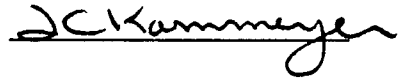
Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

Starting Air Manifold: Piping, Tubing, and FITTING	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
COMPONENT		
GPL NO. 02-441A	REV. NO. 2	
SNPS GPL NO. 03-441A		

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

---

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 piping, tubing and fittings if available from the Owner.

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*ah/sey*

PROGRAM MANAGER

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

COMPONENT NO. 02-441A

Effective Printout Date: 10/17/84

COMPONENT TYPE: Starting Air Manifold: Piping, Tubing And Fittings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Manifold purge from air intake manifold to prevent moisture/corrosion.	TDI SIM 323	TDI SIM #323 is concerned with purging moisture from the starting air manifold. Historical data on corrosion in carbon steel starting air lines was not available. However, Impell evaluation of subject piping determined that the nominal available pipe wall thickness was 5.15 times the minimum required. Therefore, there is adequate pipe margin against corrosion in the subject lines. TDI SIM #323 is concerned mainly with fouling of starting air valves from corrosion.
<u>NON-NUCLEAR</u>		
None		

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

Starting Air Manifold -  
Piping, Tubing, and Fittings  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-441A TASK DESCRIPTION NO: DR-09-02-441A-0  
SNPS GPL NO. 03-441A CLASSIFICATION TYPE A

---

TASK DESCRIPTIONS

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

There are no maintenance recommendations for this component. However, the lead engine report does address site specific additions of supports. The necessity for similar additions on San Onofre has been assessed by the 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 02-441C.

Quality revalidation for this component is not required.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-441A-0

REFERENCES

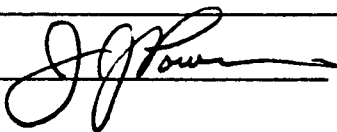
- 1) "Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," report No. 11600.60-DC-02, Revision 0.
- 

DOCUMENTATION REQUIRED

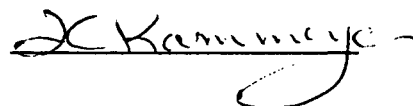
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Starting Air Manifold: COMPONENT <u>Valves, Strainers, Filters</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-441B</u>	TASK DESCRIPTION NO. <u>DR-09-02-441B-0</u>
SNPS GPL NO. <u>03-441B</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 not addressed previously in lead engine report.
- A review of the lead engine DR/QR report for Comanche Peak.
- Similarity of components used at San Onofre and lead plant.

The following maintenance recommendations from the lead engine DR/QR should be implemented at each outage:

- All starting air system valves should be disassembled, cleaned and inspected. Test to assure leak tightness upon reassembly; apply locking compound as needed.
- Replace O-ring in starting air admission valves and clean valves screened fitting.
- Other maintenance should include daily blow down of strainers, air drier and low point moisture collectors. The strainer and filter should be inspected and cleaned/replaced on a monthly basis (more frequently if necessary).

In accordance with TDI memo M. Lowrey (TDI) to J. Kammeyer (SWEC) free flowing drains should be added to air distributor filter. This is the only modification required as a result of the lead engine design report.

- Quality Revalidation is not required for this component.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-441B-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

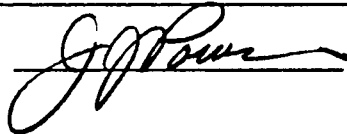
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DOCUMENTATION REQUIRED

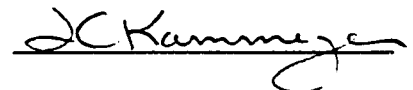
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Starting Air  
 Manifold Supports  
 COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-441C TASK DESCRIPTION NO. DR-09-02-441C-0  
 SNPS GPL NO. 03-441C 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. 02-441A, 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. 02-441A.

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-09-02-441C-0

REFERENCES

Not required

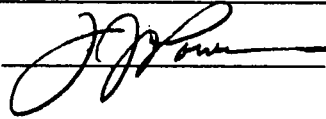
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DOCUMENTATION REQUIRED

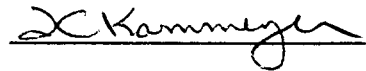
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

STARTING AIR MANIFOLD - SUPPORTS  
(SMALL BORE SCOPE ONLY)  
COMPONENT PART NO. 02-441C

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 starting air manifold 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 starting air manifold tubing components.

II OBJECTIVE

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

III METHODOLOGY

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

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the 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 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 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.

In order to support the tubing of Component 02-441C, it is recommended that the following supports be added:

- Supports should be added to the tubing running from the distributor to the horizontal tubing runs on top of the engine. The supports should be two-directional, attached to a rigid structure, and located a) on riser a maximum of 6 inches from the top of engine horizontal run; b) a maximum of 12 inches from distributor; and c) within 6 inches of each change in tubing direction.
- A two-directional lateral support should be added to each 1/2-inch tube entering and exiting the air filter. The supports should be located on the horizontal portion of the loops directly above the filter.

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

Starting Air Manifold -  
Tubing Supports  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-441C TASK DESCRIPTION NO. DR-09-02-441C-1  
SNPS GPL NO. 03-441C CLASSIFICATION TYPE A

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---

TASK DESCRIPTIONS

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

---

PRIMARY FUNCTION

Provide adequate restraint to the starting air manifold tubing component in the intended support load directions.

---

ATTRIBUTE TO BE VERIFIED

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

---

SPECIFIED STANDARDS

IEEE 387  
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.

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COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2  
DR-09-02-441C-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	<u>Starting Air Manifold: Supports</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-441C</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-441C</u>		

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---

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

---

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3  
09-02-441C

ACCEPTANCE CRITERIA

Engine 1

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

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

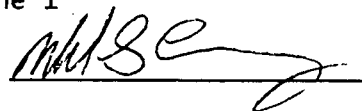
Engine 1

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

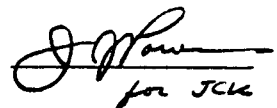
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER

  
for JCL

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

---

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

Nick A. Galita

PROGRAM MANAGER

E. J. Power  
for JCK

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

COMPONENT NO. 02-441C

Effective Printout Date 09/17/84

COMPONENT TYPE: Starting Air Manifold - 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

COMPONENT Barring Device-Pneumatic  
Regulator Valve/Shutoff Valve UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-525B TASK DESCRIPTION NO. DR-09-02-525B-0  
SNPS GPL NO. 03-525B CLASSIFICATION TYPE C

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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).
- Barring device is supplied by air source independent of diesel generator starting air supply.

No maintenance or modifications are 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

---

REFERENCES

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-525B-0

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

*J. J. Power*

PROGRAM MANAGER

*X. Kammerer*

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

Barring Device: Pneumatic-  
COMPONENT Mounting Bracket & Supports

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-525D

TASK DESCRIPTION NO. DR-09-02-525D-0

SNPS GPL NO. 03-525D

CLASSIFICATION TYPE C

TASK DESCRIPTIONS

The lead engine review was limited to considering the effects of this device on the engine while the engine is running, not it's acceptability as a maintenance tool.

A Design Review and Quality Revalidation for the engine barring device is not required on San Onofre due to the following:

- Supply air to the device does not utilize diesel engine starting air supply; therefore, it can not affect engine operation.
- The device is mounted on the floor and does not have the potential to fall into the flywheel while the engine is running.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-525D

REFERENCES

Not required

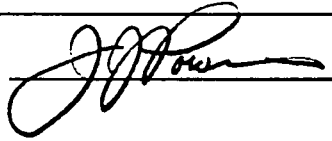
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DOCUMENTATION REQUIRED

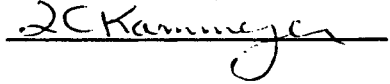
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Barring Device-Pneumatic: Mounting Bracket/Supports</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-525D</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-525D</u>		

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---

TASK DESCRIPTIONS

No further review of component 02-525D is required for the following reasons:

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

---

GROUP CHAIRPERSON *Nita A. Salata* PROGRAM MANAGER *J.C. Kammerer*

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

COMPONENT Starting Air Tank UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-835E TASK DESCRIPTION NO. DR-09-02-835E-0  
SNPS GPL NO. 10-111 CLASSIFICATION TYPE A

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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.
- The Grand Gulf air start tank is nearly identical to that used at San Onofre; both are ASME VIII tanks. The Grand Gulf tank was reviewed and found acceptable.
- A detailed finite element analysis was performed by SDRC to seismically qualify the tank, Ref. 2.

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

- The tank drain valve should be opened daily and excessive amounts of moisture should be reported to determine its cause.

No Quality Revalidation is required for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-835E-0

SPECIFIED STANDARDS

Not required

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REFERENCES

Specification E-73001, "Diesel Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition" Through Rev. 6 dated 2-13-1978.

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.


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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Air Start Tank  
Relief Valves UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-835G TASK DESCRIPTION NO. DR-09-02-835G-0  
SNPS GPL NO. 03-800C CLASSIFICATION TYPE A

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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)

No maintenance or modifications are required based on the lead engine DR/QR Report.

No Quality Revalidation is required for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required



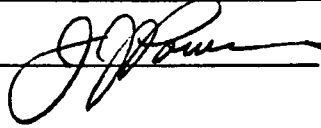
COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-835G-0

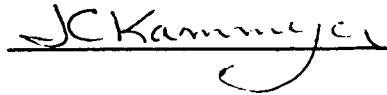
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



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

Skid Base - Starting  
COMPONENT Air Equipment

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-835H

TASK DESCRIPTION NO. DR-09-02-835H-0

SNPS GPL NO. 99-835A

CLASSIFICATION TYPE C

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.
- Each diesel generator set has two complete independent air start systems. Each start system has one air receiver tank which is capable of providing air for 5 starts without operation of the compressors (Ref. 2). The tanks are not skid mounted, Ref. 1. The tanks are isolated from the skid components via a check valve. Thus failures in skid components are primarily maintenance concerns and will not affect safety related starts.
- A review of the lead engine report (Comanche Peak) indicated no design deficiencies relating to TDI design of this component.

No maintenance or modifications are 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-09-02-835H-0

SPECIFIED STANDARDS

Not required

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REFERENCES

TDI drawing No 100883, "Starting Air Equipment Ass'y"

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

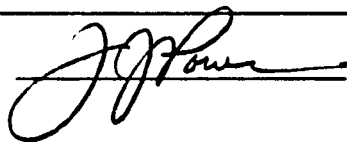
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DOCUMENTATION REQUIRED

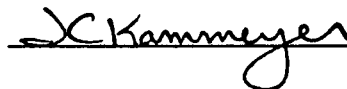
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

CONNECTING RODS: CONNECTING RODS & BUSHINGS  
COMPONENT PART NO. 02-340A

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 connecting rod assembly to determine the adequacy of design for the intended use at San Onofre. The function of the connecting rod is to transmit cylinder firing forces from the wrist pins to the crankshaft such that the reciprocating motion of the piston is translated into rotation and torque at the crankshaft. The connecting rod assembly consists of the following:

<u>Item</u>	<u>Part No.</u>	<u>Manufacturer</u>
Master Rod	1A-5787	TDI
Link Rod	1A-4294	TDI
Line Pin	1A-2484	TDI
Wrist Pin Bushing	R-3195	TDI
Rod Cap Bolt	02-340-10AH	Various Vendors
	02-340-04AJ	Various Vendors

II OBJECTIVE

The objective of this review was to address the structural integrity of the connecting rod assembly and to verify adequate cooling and lubrication passages.

III METHODOLOGY

In order to meet the stated objective the following tasks were performed:

- Determination of connecting rod and wrist pin bushing strength.
- Finite-element, fracture mechanics and fatigue stress analysis of connecting rods and evaluation of rod cap bolt strength.
- Rod-eye analysis.
- Investigation of cooling and lubrication passages.

- A review of San Onofre site, nuclear, and non-nuclear experiences (see Appendix C for results).
- A review of the Falcon Shipping (M/V Star of Texas) failure.
- Review of the Quality Revalidation Checklist results and TERs for acceptability.

#### IV RESULTS AND CONCLUSIONS

Metallurgical evaluations of a cracked connecting rod from the M/V Star of Texas were performed by fractographic examination, microscopy and chemical analysis. Rockwell Hardness (RHC) was determined. Yield and ultimate strengths of the connecting rod were determined to be 89 and 115 ksi, respectively. The 0.2 percent offset compressive yield strength for a Shoreham wrist pin bushing was determined to be 19 ksi (Refs. 1 and 3).

Two dimensional finite-element stress analysis of the lower connecting rod assembly was performed. Combined inertial and gas pressure loads were considered at various crank angles to determine the maximum range of cyclic stress. Stress analysis indicated adequate rod cap bolt strength. Fracture mechanics analysis including crack initiation, fatigue threshold, and life prediction analyses were performed on the connecting rod at the most critical locations (near the first bolt above the crank pin) (Ref. 1 and 2). The maximum range of stress is below the fatigue initiation curve, and the maximum cyclic stress intensity factor is below the fatigue threshold.

The connecting rod is therefore adequate for its intended design use, provided pre-existing flaws are eliminated. Hence, inspection by magnetic particle, liquid penetrant, or eddy current of the first pair of bolts and bolt holes above the crank pin is recommended. The inspection methods employed must have a verified capability to detect a crack which is no larger than 1/8 inch deep and 1/4 inch long. Proper bolt torque and adequate contact as specified by TDI should exist at the serrated joint. This verification should be performed at the next refueling outage, sooner if practical, but before accumulation of an additional 200 hours of operation. In addition, the joint should be visually inspected for fretting damage any time the connecting rods are disassembled. If fretting has occurred, a further engineering evaluation will be required.

It is recommended that the clearance between the link pin and link rod be examined. This examination should be performed with the engine assembled. SIM 349 recommends that this dimension be checked with a 0.0015 inch feeler gauge. However, this dimension must be zero when the specified bolt torque of 1050 ft-lb is applied.

Conservative fracture mechanics analysis indicates that fatigue cracks could propagate from a 0.04-inch deep surface discontinuity at the intersection of the oil hole with the bore of the rod-eye. In the absence of material defects, such discontinuities in smoothly polished surfaces would be readily apparent on visual inspection. It is concluded that there is no risk of fatigue failure from the oil hole of rod eyes manufactured in accordance with the TDI manufacturing procedures (Ref. 3).

Evaluation of the connecting rods indicates adequate cooling and lubrication passages.

Failure analysis of the Falcon Shipping (M/V Star of Texas) connecting rod indicates that fracture was the result of progressive fatigue crack growth from a threaded bolt hole. The exact cause of the failure has not been determined.

The information provided on TER-09-008 has been reviewed and is consistent with the final conclusions of this report.

All remaining inspections should be completed as indicated in the Component Quality Revalidation Checklist (Appendix B), including magnetic particle inspection of connecting rod bolts, eddy current inspection of rod box female threads, verification of connecting rod bolt torque, and visual inspection for fretting of the serrated joint. Alternative inspection methods, including liquid penetrant, may be used for the bolts and bolt holes. The methods used must have a verified capability to detect a crack which is no larger than 1/8 inch deep and 1/4 inch long.

Based on the review above, it is concluded that the connecting rod assembly is acceptable for its intended use at San Onofre pending satisfactory results of the Quality Revalidation inspections.

V REFERENCES

1. "Design Review of Connecting Rods for Transamerica Delaval DSRV-4 Series Diesel Generators," FaAA-84-3-14, August 1984.
2. FaAA Support Package No. SP-84-6-17(e).
3. "Design Review of Connecting Rods of Transamerica Delaval Inline DSR-48 Emergency Diesel Generators," FaAA-84-3-13, June 1984.

COMPONENT DESIGN REVIEW CHECKLIST  
SAN ONOFRE NUCLEAR GENERATING STATION

Connecting Rods:		
COMPONENT	<u>Connecting Rods &amp; Bushings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO.	<u>02-340A</u>	TASK DESCRIPTION NO. <u>DR-09-02-340A-0</u>
SNPS GPL NO.	<u>03-340A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS:

Evaluate structural ability to withstand firing and inertia loadings.

Review Falcon failures.

Review information provided on TERs.

PRIMARY FUNCTION:

Transmits forces from pistons to crankshaft.

ATTRIBUTES TO BE VERIFIED:

Connecting rod stiffness, buckling strength and fatigue resistance. Adequate cooling and lubrication passages. Rod cap bolt strength. Wrist pin bushing strength.

SPECIFIED STANDARDS:

None.

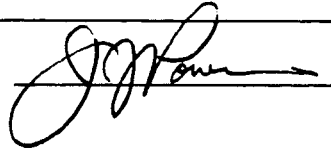
REFERENCES:

None.

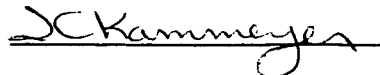
DOCUMENTATION REQUIRED:

Drawings, engine operating parameters, component physical parameters, torques, failure histories, and material specifications.

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Connecting Rods - <u>Connecting Rods &amp; Bushings</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating <u>Station - Unit 1</u>
GPL NO.	<u>02-340A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-340A</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a material comparator test on the connecting rods (sample of 4). Use spares if available.
3. Perform a hardness test on the connecting rods (sample of 4). Use spares if available.
4. Perform Eddy Current test on all rod box female threads.
5. Perform a Magnetic Particle test on all connecting rod bolts.
6. Perform a visual inspection of all connecting rod bolt washers and contact surfaces for signs of galling.
7. Verify that the torque loads on all connecting rod bolts are in accordance with the latest TDI recommended values.
8. Perform a Liquid Penetrant test on the surface of the internal diameter of all the wrist pin bushings.
9. Perform a visual inspection of the rack teeth connection for signs of fretting.
10. Perform a clearance check of the link rods and link pins for proper alignment.

Engine 2

1. Assemble and review existing documentation.



TASK DESCRIPTIONS (continued)

Engine 2 (continued)

2. Perform an Eddy Current test on all rod box female threads.
3. Perform a Magnetic Particle test on all connecting rod bolts.
4. Perform a visual inspection on all connecting rod bolt washers and contact surfaces for signs of galling.
5. Verify that the torque loads on all the connecting rod bolts are in accordance with the latest TDI recommended values.
6. Perform a Liquid Penetrant test on the surface of the internal diameter of all wrist pin bushings.
7. Perform a visual inspection of the rack teeth connection for signs of fretting.
8. Perform a clearance check of the link rods and link pins for proper alignment.

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ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Material of the connecting rods and bushings
3. Hardness of the connecting rods and bushings
4. Surface integrity of the rod box female threads
5. Surface integrity of the connecting rod bolts
6. Surface integrity of the connecting rod bolt washers and contact surfaces
7. Proper torque loads are applied to the connecting rod bolts
8. Surface integrity of the wrist pin bushings
9. Surface integrity of the rack teeth connection
10. Proper clearance of the link rods and link pins

ATTRIBUTES TO BE VERIFIED (continued)

Engine 2

1. Quality status of Component Document Package
2. Surface integrity of the rod box female threads
3. Surface integrity of the connecting rod bolts
4. Surface integrity of the connecting rod bolt washers and contact surfaces
5. Proper torque loads are applied to the connecting rod bolts
6. Surface integrity of the wrist pin bushings
7. Surface integrity of the rack teeth connection
8. Proper clearance of the link rods and link pins

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ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
- 2-3. Material to be AISI-4140
- 4-5. Review of inspection report by the Design Group
6. No signs fo galling on the connecting rod bolt washers and contact surfaces
7. Torque loads on the connecting rod bolts are in accordance with the TDI Instruction Manual
8. Absence of linear indications on the internal diameter (bottom dead center  $\pm 15^\circ$  only) of the wrist pin bushings (see Attachment A)
9. No signs of fretting on the rack teeth connection
10. Clearance dimension must be zero when the specified torque of 1050 ft.-lb. is applied.

ACCEPTANCE CRITERIA (continued)

Engine 2

1. Satisfactory Document Package
- 2-3. Material to be AISI-4140
4. No signs of galling on the connecting rod bolts washers and contact surfaces
5. Torque loads on the connecting rod bolts are in accordance with the TDI Instruction Manual.
6. Absence of linear indications on internal diameter (bottom dead center  $\pm 15^\circ$  only) of the wrist pin bushings (see Attachment A).
7. No signs of fretting on the rack teeth connection
8. Clearance dimension must be zero when the specified torque of 1050 ft.-lb. is applied.

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REFERENCES

Engine 1

1. QCI No. 52
- 2-6. Approved Site NDE Procedures
7. TDI Instruction Manual
- 8-9. Approved Site NDE Procedures
10. TDI Instruction Manual

Engine 2

1. QCI No. 52
- 2-4. Approved Site NDE Procedures
5. TDI Instruction Manual
- 6-7. Approved Site NDE Procedures
8. TDI Instruction Manual

DOCUMENTATION REQUIRED

Engine 1

1. Document Summary Sheet
- 2-10. Inspection Report

Engine 2

1. Document Summary Sheet
- 2-8. Inspection Report

GROUP CHAIRPERSON Nuta A. Saldin

PROGRAM MANAGER J. J. Down  
for JCK

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COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
- 2-6. No inspection reports have been received which fulfill these requirements.
7. The connecting rod bolts were torqued to 1700 ft-lbs for cylinders 1, 6 and 10. This was reported by TER# 09-008.
- 8-10. No inspection reports have been received which fulfill these requirements.

Engine 2

1. All EDGCTS site experience documents were assembled and reviewed with unsatisfactory results. NCR No. 84-1570 remains open.
- 2-4. No inspection reports have been received which fulfill these requirements.
5. The connecting rod bolts were torqued to 1700 ft-lbs for cylinders 2, 6 and 10. This was reported by TER# 09-008.

COMPONENT REVIEW (continued)

Engine 2 (continued)

6-8. No inspection reports have been received which fulfill these requirements.

NOTE: A Magnetic Particle test was performed on the master and link rods for cylinders 2, 6 and 10 with satisfactory results. No indications were in evidence as reported by TER# 09-008.

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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.

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GROUP CHAIRPERSON

*N. A. Suleta*

PROGRAM MANAGER

*J. J. Fow*  
for JCK

LIQUID PENETRANT ACCEPTANCE CRITERIA

Acceptance criteria are generally included in the code or specification which establishes the required examination. Such specified criteria shall be used to determine the specific type, size and location of observed discontinuities.

When acceptance criteria is not specified in the documentaion establishing the requirement for the examination, the following relevant indications are unacceptable. Only indications with major dimensions greater that 1/16 inch shall be considered relevant.

a.) Wrought, Forged or Welded Items:

1. Any crack or linear indication
2. Rounded indications with dimensions greater than 1/8 inch for thickness less than 5/8 inch and greater than 3/16 inch for thickness of 5/8 inch and greater.
3. Four or more indications in line separated by 1/16 inch or less edge to edge.
4. Ten or more indications in any 6 square inches of area whose major dimension is no more than 6 inches with the dimensions taken in the most unfavorable location relative to the indications being evaluated.

b.) Bolts and Bolting Material Greater than 1 inch Normal Size

1. Any linear nonaxial indications.
2. Linear axial indications greater than 1 inch.

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

COMPONENT NO. 02-340A

Effective Printout Date 09/12/84

COMPONENT TYPE: Connecting Rods and Bushings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Normal surveillance being performed. Investigation revealed one of the two rod cap retaining bolts had come out allowing engine torque to break second retainer bolt, which allowed the rod to separate from the crankshaft. Manufacturer: Fairbanks-Morse	LER Hatch 2, 366-81127-1 811216	Not applicable to San Onofre; different design.
Surveillance performed on diesel generator. Investigation revealed cotter pins that lock connecting rods in place in one cylinder were broken, allowing connecting the rod to separate from the crankshaft resulting in engine failure. Manufacturer: Fairbanks-Morse	LER Hatch 2, 366-80159-1, 801126	Not applicable to San Onofre; different design.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
During operation, the upper piston connecting rod bearing cap capscrews sheared. This resulted in ejection of the rod through the crankcase cover. This was probably caused by a series of unlubricated dry starts. Manufacturer: Fairbanks-Morse	LER Millstone 2, 336-76000, 761218	Not applicable to San Onofre; different design.
Inspection found bolt head cracked on connecting rod of No. 3 diesel. Cause unknown. Replaced all connecting rod bolts. Manufacturer: Norberg	NPRDS Brunswick 2, 820417, Hit 252	Not applicable to San Onofre; different design.
Info-connecting rod wrist pin bushings locked in place if no oil groove.	TDI SIM 312	Not applicable to San Onofre. Connecting rod bushings have oil grooves.
Cylinder failure caused by failure of piston rod pin bolts. Failure caused by articulating rod pin bolts and piston pin bolts being stretched, probably during partial piston seizure.	LER Cooper 298-80027, 800508	Not applicable to San Onofre; different design.
<u>NON-NUCLEAR</u>		
Delaval inspected defective connecting rod bolts and heavy fretting noted in the link rod bushing bores. Damaged rod bolt received from TDI. (M/V Columbia)	Hunton & Williams (12/29/83) to C. Seaman. Letter from L. Block (TDI) to M. Zbinden (State of Alaska) 06/02/80. Letter from M. Zbinden (State of Alaska) to M. Martini (TDI) dated 01/16/80. M.V. Columbia--Repair part status (starting date 07/27/79)	Not applicable to San Onofre; different design. San Onofre has 1 1/2-inch bolts.



<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Delaval advised that forgings required to fabricate replacement for the cracked connecting rod link boxes will be shipped shortly. (M/V Columbia)	Hunton & Williams (12/29/83) to C. Seaman. Letter from L. Block (TDI) to M. Zbinden (State of Alaska) dated 06/02/80	Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.
Columbia taken out of service prematurely because of cracking connecting rods. (M/V Columbia)	Hunton & Williams (12/29/83) to C. Seaman. Letter from L. Block (TDI) to M. Zbinden (State of Alaska) dated 06/02/80. Letter from A. McDonald (State of Alaska) to J. Eide (Div. of Marine Hwy. Systems) dated 12/26/79	Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.
Action taken since vessel delivery changed original rod bolts to those with rolled aircraft type threads-cracking continues. (M/V Columbia)	Hunton & Williams (12/29/83) to C. Seaman. Letter to TDI 03/24/80 from M. Zbinden (State Alaska)	Not applicable to San Onofre; different design. San Onofre; has 1 ½-inch bolts.
Connecting rod capscrews installed to replace cracked ones. Increased torque caused mating surfaces to become galled. (M/V Columbia)	Hunton & Williams (12/29/83) to C. Seaman. Memo from M. Zbinden (State of Alaska) to file 04/09/81. Memo from M. Zbinden (State of Alaska) to R. Ward dated 12/10/80	Not a design problem.

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

TDI believes damage to link rod bushing rail area caused by foreign (dirty) material in lube oil. State of Alaska believes that the drilled oil passages were not properly machined--the remaining raised area or burr around oil hole is the cause of the damage. (M/V Columbia)

Letter B. Zurie (TDI) from M. Zbinden (State of Alaska) dated 02/29/80

Manufacturing defects not not a design problem.

Damage to rod bolts including cracking. (M/V Columbia)

Hunton & Williams (12/29/83) C. Seaman. Letter to TDI (D. Martini) dated 03/24/80 & 03/19/79 from M. Zbinden (State of Alaska). Letter from M. Zbinden to W. Hudson dated 02/02/79

Not applicable to San Onofre; different design. San Onofre has 1 1/2-inch bolts.

Cracking of connecting rod boxes and bearing shells. Fretting of link rod and link rod pins at their attachment. Insufficient connecting rod bearing wear/contact area to journal wherein it is less than 15% of the total bearing area. (1979 Season). (M/V Columbia)

Hunton & Williams (12/29/83) to C. Seaman. Letter to TDI (D. Martini) dated 03/24/80 from M. Zbinden (State of Alaska)

Not applicable to San Onofre connecting rods; different 1 1/2-inch bolts.

EXPERIENCEREFERENCE DOCUMENTSSAN ONOFRE STATUS

Cracking on connecting rods usually in the link pin area between the link pin bushing and serrated bushing. Modifications made. Rod box has distress in link pin bushing. High loading forces at the serrated joint between master connecting rod and connecting rod box. Caused by uneven firing, surface finishes. Connecting rods should be more reliable if engine is derated. (M/V Columbia)

SES Report #123-01 dated April 1983, pp. 3-16 through 3-19, 4-4

Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.

Connecting rod split near the piston pin bushing. Failure was caused by a stress riser that existed at the gear case end of the rod eye.

Failure Analysis Report No. 0117 dated 11/06/78 (File No. T-18)

Fatigue failure predicted to be possible from a 0.04 inch discontinuity in surface of oil hole. It is concluded that no machining problem nor risk of fatigue failure is expected with the San Onofre rods.

Conrod failure caused by fatigue. (M/V Cooper Valley Electric/Glenn Allen)

Interoffice memo from H. Schilling (TDI) dated 08/21/78 (File No. T-32)

Failure is attributed to low bolt torque. Proper torque will be verified at San Onofre.

Connecting rod box and bolt failed because of bolt and box thread damage. (Bhel Jizan)

TDI Failure Analysis report to TDI dated 01/23/79 (File No. T-11)

Manufacturing defect, not design related.

Connecting rod cracks thought to be caused by improper bolt torque. (M/V Star of Texas)

Telex from A. Barich (TDI) to J. Molina (Falcon Shipping) to C. Mathews (TDI) dated 12/05/83 (File No. T-38).  
Telex from J. Molina (Falcon Shipping) to C. Mathews (TDI) dated 12/05/83 (File No. T-38)

Proper torque will be verified at San Onofre.

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Connecting rod bolt failures. (City of Homestead, Fla.)

Letter from J. A. Smith (City of Homestead) to G. E. Trussell (TDI) dated 06/14/77 (File No. T-10)

Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.

Connecting rod bolts #1 & 2 both had cracked and stripped threads. Failure was caused by the flexibility of the box assembly. (Kodiak Electric Assn.)

Failure Analysis Report No. 0115 dated 06/13/78 (File No. T-20)

Not a connecting rod failure. Stripped threads possibly caused by the flexibility of the box due to low bolt torque. Proper torque will be verified at San Onofre.

Connecting rod bolt failures have been attributed to thread fretting between the threads of the box and bolts. (RV-4 Owners)

TDI Failure Analysis Report No. 0136 dated 01/16/81 (File T-35)

Failures are attributed to low bolt torque. Proper torque will be verified at San Onofre.

Lost both right and left bank connecting rods. (10/07/75) Engine No. 18. (City of Homestead, Fla.)

Engine incidence report (City of Homestead, Fla.) dated 09/30/78 (File No. T-10). Letter from J.A. Smith (City of Homestead) to G.E. Trussell (TDI) dated 06/14/77 (File No. T-10)

Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.

No.3 rod bearing broken. The upper bolt left side also broken. Rod damaged bottom side of both left bank and right bank liners and damaged valves in heads. (07/21/78) Engine No. 19. (City of Homestead, Fla.)

Engine incidence report (City of Homestead, Fla.) dated 09/30/78 (File No. T-10)

Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
All connecting rod bearings show cracks on back of bearing shell and No.8 was found to be cracked and right bank liners and damaged valves in heads. (07/21/78) Engine No. 19. (City of Homestead, Fla.)	Engine incidence report (City of Homestead, Fla.) dated 09/30/78 (File No. T-10)	Not applicable of San Onofre; different design. San Onofre has 1 ½-inch bolts.
Conrod bolt bent; another four were found to have cracks. (Kuosheng/Taiwan Power).	Letter from S. Chang (Taiwan Power Co.) to M. Sande (LILCO) dated 05/24/83	Incorrect handling. Not a design problem.
Connecting rod bolt failures.	Memo from R. Desrumeaux (TDI) to J. Miller (Falls City) 03/06/81 (File No. T-5)	Connecting rods must be inspected for indication of cracks as recommended in the DR/QR report for San Onofre.
Connecting rod box and bolting cracked. Both the failure of the bolts and rod box was caused by bolt preload being too low. (M/V Marine Transport Lines - S/L Mediterranean)	TDI Failure Analysis Report #0128 to TDI dated 02/22/80 (File No. T-12)	Proper bolt preload will be verified at San Onofre.
Conrod bushing failed and turned conrod bushings. (various locations)	TDI (Failure Analysis Dept.) Report No. 0122 dated 02/20/79 (File No. T-32). TDI (Failure Analysis Dept.) Report No. 0118 dated 10/26/78 (File No. T-32)	Bushing failed from inadequate lubrication caused by turning of bushing and shutting off the oil supply. Experience indicated that this is primarily a bearing problem. San Onofre has adequate cooling and lubrication passages.
Catastrophic failure of engine. The root cause was thought to be an improperly torqued link rod bolt. (Najran Power Station)	Telex from Schmitz (TDI) to Pratt. Husher (TDI) dated 09/82 (File No. T-32)	Proper torque will be verified at San Onofre.

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Cracked connecting rod box and bolts. Failure of the box is caused by a fretting fatigue stress raiser in a cycle low tensile stressed connecting rod box. Failure of the bolts result from either or both a fretting fatigue stress raiser or a cut thread sharp root stress raiser, in a cycle low stressed bolt. Both the failure of the bolts and rod box was probably caused by bolt preload being too low, possibly the result of insufficient tightening torque.  
(M/V Sealift Mediterranean)

Letter from R. Asazawn (TDI) to J. McCauley (Marine Transport Lines) dated 04/17/80 (File No. T-28).  
TDI (Failure Analysis Dept.) Report No. 128 dated 02/22/80 (File No. T-28)

Failure caused by insufficient torque. Proper torque will be verified at San Onofre.

Conrod bushing failure due to loss of lube oil pressure at 110% load. Recommendations--redesign lube oil system for better controls, add an alarm system and add improved lube oil centrifuging system.  
(M/V Cleveland)

TDI (Failure Analysis Dept.) Report No. 0114 dated 06/07/78 (File No. T-33)

Failure caused by loss of lube oil pressure at 110% load. San Onofre has adequate cooling and lubrication passages.

Master rod box cracks resulted in bearing shell cracking  
(M/V Columbia).

Report by George G. Sharp, Inc., "Overview of Reports, Analysis and Recommendations Remain Propulsion Engines M/V Columbia" by 07/26/83

Not applicable to San Onofre; different design. San Onofre has 1 1/2-inch bolts.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Cracks in connecting rod bolts and box. Cause: bolt cracked and the threads fretted against box; bolt cracking - bolts must be tight enough to prevent movement. (P.H.L.)	TDI Failure Analysis Report to G.E. Trussell (TDI) from Harold V. Shilling (TDI) 05/07/82 (File No. T-54)	Failure attributed to low bolt torque. Proper torque will be verified at San Onofre.
Cracks in connecting rod bolts and connecting rod box. Caused by loose connecting rod bolts. (Medan-Sumatra-Indonesia)	TDI Failure Analysis Report No. 0144 dated 04/29/82 (File No. T-58)	Failure caused by loose connecting rod bolts. Proper torque will be verified at San Onofre.
Connecting rod bolts - bearing and rod box cracks - probable cause is low torquing values (Town of Jonesboro).	Letter to TDI from Town of Jonesboro Mayor J. P. Gimbors 06/10/77 (File No. T-55)	Failure attributed to low bolt torque. Proper torque will be verified at San Onofre.
Eng. S/N 79002 exploded. No. 3 cylinder connection rod damaged. Attributed to multiple head gaskets (Rafha, Saudi Arabia).	Rafha Electricity Co. & Suburbs, Saudi Co. Ltd., Saudi Arabia, dated 07/12/81. No addressee or transmittal letter available. No. 3 Gen. (File No. T-57)	Failure attributed to multiple head gaskets. Not a design related problem.
Top 5 inches was discolored from heat. Setscrew suffered fatigue failure at line of shear between bushing and connecting rod (Rafha/Saudi Arabia).	Telex from Schmitz (TDI) to R. Pratt (TDI) dated 10/21/82	Insufficient information to perform an evaluation.
Broken connecting bolts and box, master rod and connecting rod shells damaged - evidence supports low torque - low bolt force was caused by installing bolt washer backwards (Tulia, Tex.)	TDI Failure Analysis Report from Harold Schilling (TDI) to Ed Deane 08/23/77 (File No. T-56)	Failure caused by low bolt torque. Proper torque will be verified at San Onofre.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Connecting rod box and bolt failure. Connecting rod box failure was caused by insufficient rigidity of connecting rod assembly. (Anamax)	TDI Failure Analysis Report from Harold Schilling (TDI) to Ed Deane (File No. T-56)	Failure possibly caused by insufficient bolt torque. Proper torque will be verified at San Onofre.
Broken connecting rod bolts caused by bolts not torqued up to correct value. (Titi Kuning/Indonesia)	Report "Investigation of Connecting Rod Bearing Failures Medan-Titi Kuning" by Robert Gray (File No. T-49)	Failure caused by bolts not torqued up to correct value. Proper torque will be verified at San Onofre.
Connecting rod link rod boxes broken and connecting rods have become unusable because of fretting. (Titi Kuning/Indonesia)	Report "Investigation of Connecting Rod Bearing Failures Medan-Titi Kuning" by Robert Gray (File No. T-49)	Failure attributed to relative movement between master rod and link rod box because of insufficient clamping force between the two parts. Proper torque will be verified at San Onofre.
Various reports of out-of-round rods, new connecting rod bushings, etc.	Chronological summary of Glencoe events - 4 pages - dated 02/20/80. Eng. S/N 72052 (File No. T-57)	Manufacturing defect. Not a design problem.
Longitudinal split along the oil hole initiated in fatigue from the rod eye bore in DSR-46 Engine in Glennallen, Alaska, operated by Cooper Valley Electrical Association.	FAA Report 84-3-13, "Design Review of Connecting Rods of TDI Inline DSR-48 Emergency Diesel Generators," June 1984. Failure Analysis report - Delaval Engine & Compressor Division - for Glennallen, Alaska, November 6, 1978	Fatigue failure predicted to be possible from a 0.04 inch discontinuity in surface of oil hole. It is concluded that no machining problem nor risk of fatigue failure is expected with San Onofre rods.
Replaced #6 and #10 connecting rods with new connecting rods due to excessive fretting at bearing fit. 05/17/77-Engine No. 18 (City of Homestead, Fla.)	Engine Incidence report (City of Homestead, Fla.) dated 09/30/78 (File No. T-10)	Not applicable to San Onofre; different design. San Onofre has 1 ½-inch bolts.



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

Connecting Rod: COMPONENT <u>Bearing Shells</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-340B</u>	TASK DESCRIPTION NO. <u>DR-09-02-340B-1</u>
SNPS GPL NO. <u>03-340B</u>	CLASSIFICATION TYPE <u>A</u>

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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 establishes the acceptability of the bearing shells for their intended purpose.
- Nuclear and non-nuclear industry experience listed in the EDG Component Tracking System is addressed in the Phase I report of the Connecting Rod Bearing Shells.
- Stresses imposed by engine operation are less at San Onofre than at Shoreham due to lower peak cylinder firing pressure and reduced BMEP at full load.

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 connecting rod bearing shells associated with future service should also be less severe. Therefore the Owners Group recommended quality and maintenance inspections for this component, outlined below, should be conducted initially during the first major engine overhaul to confirm the adequacy of the connecting rod bearing shells.

(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.)

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

- Inspect and measure connecting rod bearing shells to verify lube oil maintenance, which affects wear rate. The visual and dimensional inspection of the bearing shells should be conducted at the fuel outage which precedes 500 hours of operation by at least the sum of hours of operation in a LOOP/LOCA event plus the expected hours of operation between outages.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-340B-1

- Perform an X-ray examination on all of the 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.

There are no modification recommendations for this component.

All quality inspections that have been performed to date have been reviewed. Unsatisfactory conditions have been dispositioned by the utility. The following Quality Revalidation Inspection recommendations are made to ensure proper component quality and performance, and should be performed on engine DG#1:

- Perform a radiographic inspection of the connecting rod bearing shells.
- Perform a liquid penetrant test of the connecting rod bearing shells.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON

*K.T. Fitzpatrick*

PROGRAM MANAGER

*J. Kammer*

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Connecting Rod Bearing Shells</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-340B</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-340B</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a visual inspection of the connecting rod bearing shells.
3. Perform a Liquid Penetrant test on the connecting rod bearing shells.
4. Perform a dimensional check of the connecting rod bearing shells.
5. Perform a Radiographic inspection of the connecting rod bearing shells.
6. Perform an Eddy Current test as required to identify surface discontinuities.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
- 2-3. Surface integrity of bearing shells
4. Proper bearing shell dimensions
5. Integrity of the bearing shells

ATTRIBUTES TO BE VERIFIED (continued)

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
- 2-3. Review of the inspection report by the Design Group
4. Dimensions are in accordance with the TDI Instruction Manual
5. See Attachments A and B
6. Review of the inspection report by the Design Group

Engine 2

Same as Engine 1

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REFERENCES

Engine 1

1. QCI No. 52
- 2-3. Approved Site NDE Procedure
4. TDI Instruction Manual or applicable drawing
5. Approved Site NDE Procedure, TER# 99-011, FaAA NDE Procedure 9.3
6. Approved Site NDE Procedures

Engine 2

Same as Engine 1

---

DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*Steve R. Schwartz*

PROGRAM MANAGER

*J. Kammerer*

---

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. A visual inspection was performed on the journal and rod side of both upper and lower bearing shells for cylinders 1, 6 and 10 with no indications noted. This was reported by TER# 09-009.
- 3-6. No inspection reports have been received which fulfill these requirements.

Engine 2

1. No inspection reports have been received which fulfill these requirements.
2. A visual inspection was performed on bearing skill nos. 2, 6, and 10 with unsatisfactory results. This was reported by TER# 09-009.
3. A Liquid Penetrant test was performed on both upper and lower bearing shells for cylinders 2, 6, and 10 and spares. Unsatisfactory results were found on the no. 6 upper bearing shell. A Liquid Penetrant test was performed on the no. 6 upper and lower replacement bearing shells with satisfactory results. These results were reported by TER# 09-009.
4. No inspection report has been received which fulfills this requirement.

COMPONENT REVIEW (continued)

Engine 2 (continued)

5. A Radiographic test was performed on both upper and lower bearing shells for cylinders 2, 6, and 10 with unsatisfactory results. This was reported by TER# 09-009.
6. No inspection report has been received which fulfills this requirement.

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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

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GROUP CHAIRPERSON Vita A. Saleta PROGRAM MANAGER J. Kammerer

Component: Connecting Rod Bearing Shells, Upper and Lower.  
 Examination: X-ray, FaAA NDE 9.2 (R-48); FaAA NDE 9.3 (V-12, V-16, V-20).  
 Examination: Upper Bearing Shell, see attached figures:  
 Area

R-48: 0.050 inch area, 0.4 inch inward from each side to a line 1.4 inches inward from each side, extending circumferentially 2.5 inches on either side of the oil hole. This is the critical area.

V-12, V-16, V-20: 0.050 inch area, 0.4 inch inward from each side to a line 1.4 inches inward from each side, extending circumferentially 5.0 inches on either side of the center of the bearing. This is the critical area.

0.250 inch area, remainder of bearing.

Lower Bearing Shell: 0.250 inch area, all of bearing.

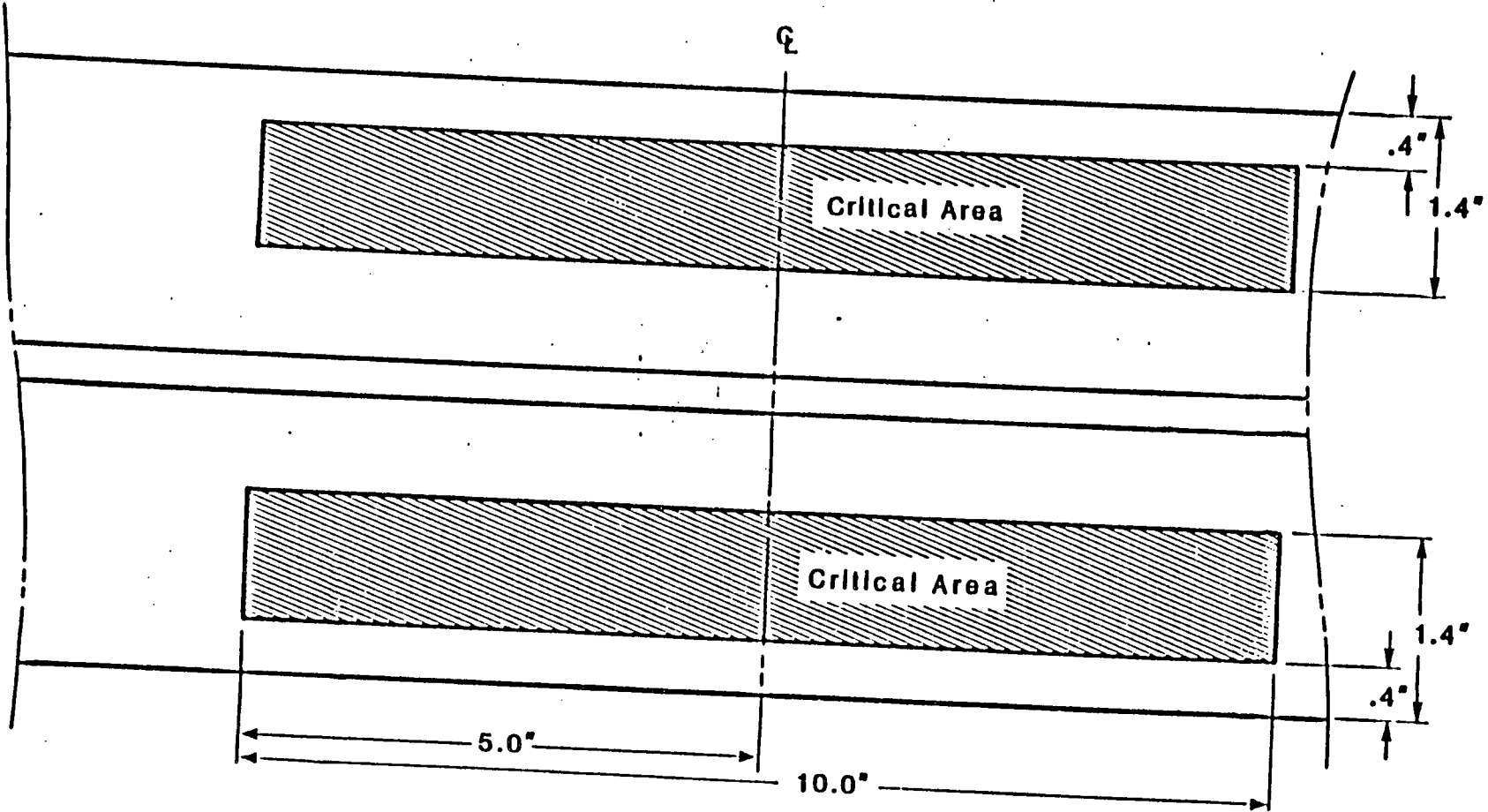
Acceptance: The following are unacceptable, based on 3/4 inch reference  
 Criteria radiographs of ASTM E-155, for aluminum.

	<u>UPPER BEARING 0.050 INCH AREA</u>	<u>UPPER &amp; LOWER BEARING 0.250 INCH AREA</u>
Gas Holes	0.050 diameter	Grade 5
Gas Porosity (Rounded)	Grade 5	Grade 7
Gas Porosity (Elongated)	Grade 3	Grade 5
Shrinkage Sponge	Grade 3	Grade 4
Foreign Material Less Dense	0.050 diameter	Grade 3
Foreign Material More Dense	0.050 diameter	Grade 4
Cracks	Unacceptable	Unacceptable
Shrinkage Cavity	Unacceptable	0.250

- Note: ° Mottling/segregation and micro shrinkage shall not be evaluated for rejection.
- ° Radiographic features that are associated with the babbitt (lead alloy) layer on the bearing I.D. shall not be evaluated for rejection.

For further clarification of these criteria, please contact the Owner's Group.





Ref: FaAA NDE 9.3

DESCRIPTION: BEARING SHELL CRITICAL AREA; TDI V-12, V-16, V-20

TOLERANCES UNLESS OTHERWISE SPECIFIED

DESCRIPTION	DRAWN	CHECKED	APP'D
1 - 1	JC	<i>LS</i>	<i>LS</i>
1 - X - 1			

**Failure Analysis Associates**  
 2225 East Bayshore Road  
 P.O. Box 51470  
 Palo Alto, California 94303

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

COMPONENT <u>Piston</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-341A</u>	TASK DESCRIPTION NO. <u>DR-09-02-341A-0</u>
SNPS GPL NO. <u>03-341A</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

Design review is not required for this component based on review of the Phase I reports and the applicable industry experience in the EDG Component Tracking System.

San Onofre presently uses modified AF pistons. The modification consisted of spot-facing each of the four bosses through which studs extend to secure the piston crown and replacement of the originally supplied spherical washer sets with two stacks of Belleville washers. The modification was done because some of the originally supplied spherical washers failed in service resulting in piston crown separation. As of December 1983, 252 AF style skirts had been modified. These 252 modified AF skirts accumulated in excess of 1,772,000 hours of operation without a failure attributable to design (Ref. 1).

The city of Homestead, Florida, operates a V-20 engine equipped with modified AF pistons. The engine has accumulated approximately 1500 hours with these pistons at loads ranging from 4000 kW to 5000 kW (similar to San Onofre) (Ref. 2). No modified AF piston failures have been reported. Other engines having operating experience with modified AF pistons include Shoreham and Grand Gulf. Both of these utilities inspected their modified AF pistons and found linear indications in the stud boss area. These field inspections are consistent with the Phase I reports that conclude that cracks may initiate, however, they are predicted to arrest at depths less than .5 inch, and therefore not result in piston failure. The reduced operating load at San Onofre adds further margin in this respect.

The Phase I report concludes that the modified AF skirts are satisfactory for service provided inspections of the stud boss attachment area are carried out, or under conditions of operation below full rated load. Both of these apply to San Onofre as follows:

1. Liquid penetrant examinations on 25% of the piston skirts (both engines) have been performed. An acceptance criteria of 3/16" was used, and no relevant indications were found (Ref. 3).
2. San Onofre's engines operate well below full rated load, and as a result of this, there is a 24.9% reduction in stress for the pistons (Ref. 4).

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-341A-0

TASK DESCRIPTIONS (continued)

The following Quality inspection as delineated in the CQRC is recommended:

- Perform a liquid penetrant test on the piston skirts in accordance with acceptance criteria in the CQRC. Map all linear indications in the stud boss area and document with photographs.

Note: This inspection should be performed on the 15 piston skirts (either engine) that were not already inspected. If no rejectable indications are found, only one station engine need be inspected.

There are no maintenance or modification recommendations for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

1. Minutes of Users' group meeting of November 30, 1983 attached to letter dated December 15, 1983 from C.S. Matthews (TDI) to C.W. Angle (MP&L).
2. Letter dated November 7, 1984 from C. L. Ray (Duke) to C. H. Berlinger (NRC).
3. TER 09-010
4. Memo dated 09/21/84 from G. King (FaAA) to John Kammeyer (SWEC).

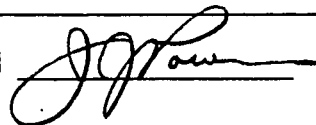
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DOCUMENTATION REQUIRED

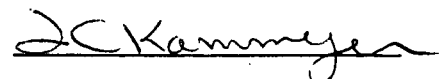
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Piston UTILITY Southern California Edison,  
San Onofre Nuclear Generating  
Station-Unit 1

GPL NO. 02-341A REV. NO. 1

SNPS GPL NO. 03-341A

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Prior to installation, perform a Liquid Penetrant test on the piston skirts. Map all linear indications in the stud boss area and document with photographs. In addition, "AN" pistons should be inspected adjacent to the wrist pin boss.
3. If Liquid Penetrant test results from task #2 reveal indications greater than 1/32 inch length, one of the following tasks should be performed:
  - a) Remove the indications by surface conditioning; or
  - b) Perform an Eddy Current test to determine if the indications must be removed.
4. Perform a Liquid Penetrant test on the rib area near the wrist pin and on the rib at the intersection of the wrist pin boss to check for indications in the casting ("AE" pistons only). See attached sketch.

Engine 2

Same as Engine 1

NOTE: If no rejectable indications are found, inspections should be performed on one station engine only.

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
- 2-3. Surface integrity of the piston skirts
4. Surface integrity of the rib and rib area

Engine 2 (continued)

Same as Engine 1

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ACCEPTANCE CRITERIA

Engine 1

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

Engine 2

Same as Engine 1

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REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures
3. Approved Site NDE Procedures, TER# 99-027
4. Approved Site NDE Procedures, TER# 99-010

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

Steve M Schwartz

PROGRAM MANAGER

JC Kammerer

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COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. A visual inspection and Fluorescent Penetrant test were performed on the piston skirts for cylinders 1R, 1L, 6L, 10R, and 10L with satisfactory results. This was reported by TER# 09-010.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
  2. A visual inspection and Fluorescent Penetrant tests were performed on the piston skirt boss areas for cylinders 2R, 2L, 6L, 10R, and 10L with satisfactory results. In addition, the replacement piston skirt for cylinder 6L was penetrant tested with satisfactory results. This was reported by TER# 09-010.
- 

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

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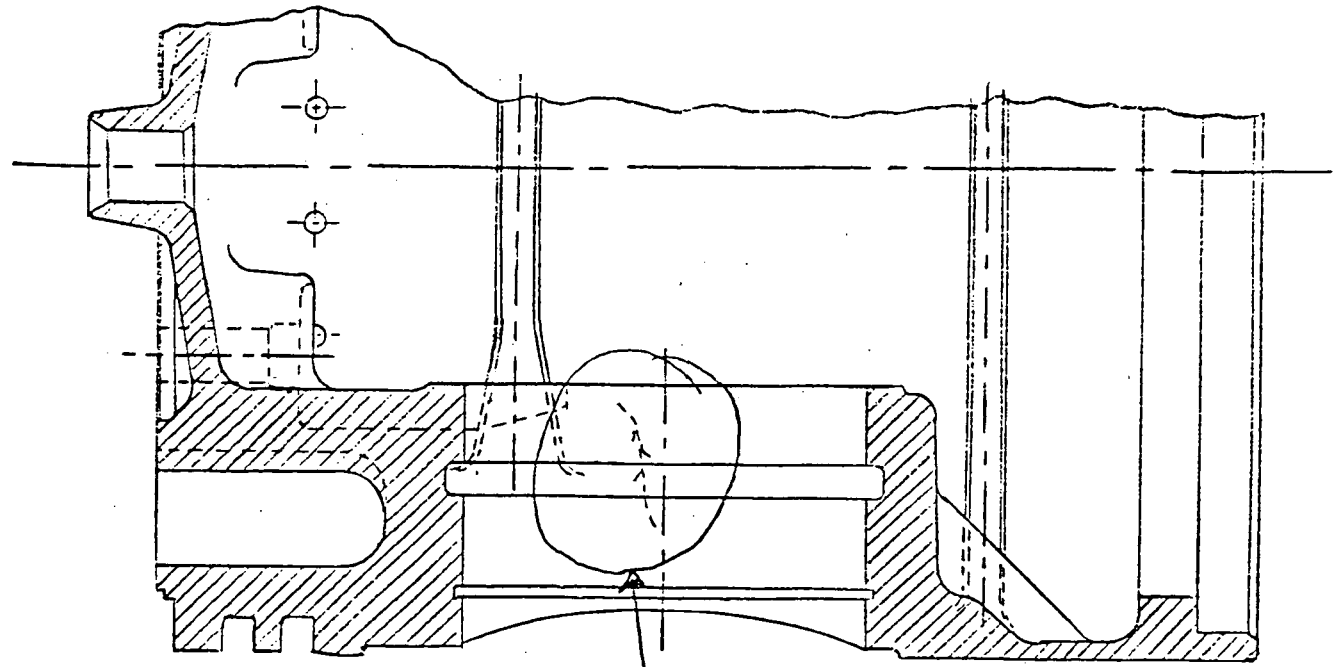
GROUP CHAIRPERSON

Nutor A Sabela

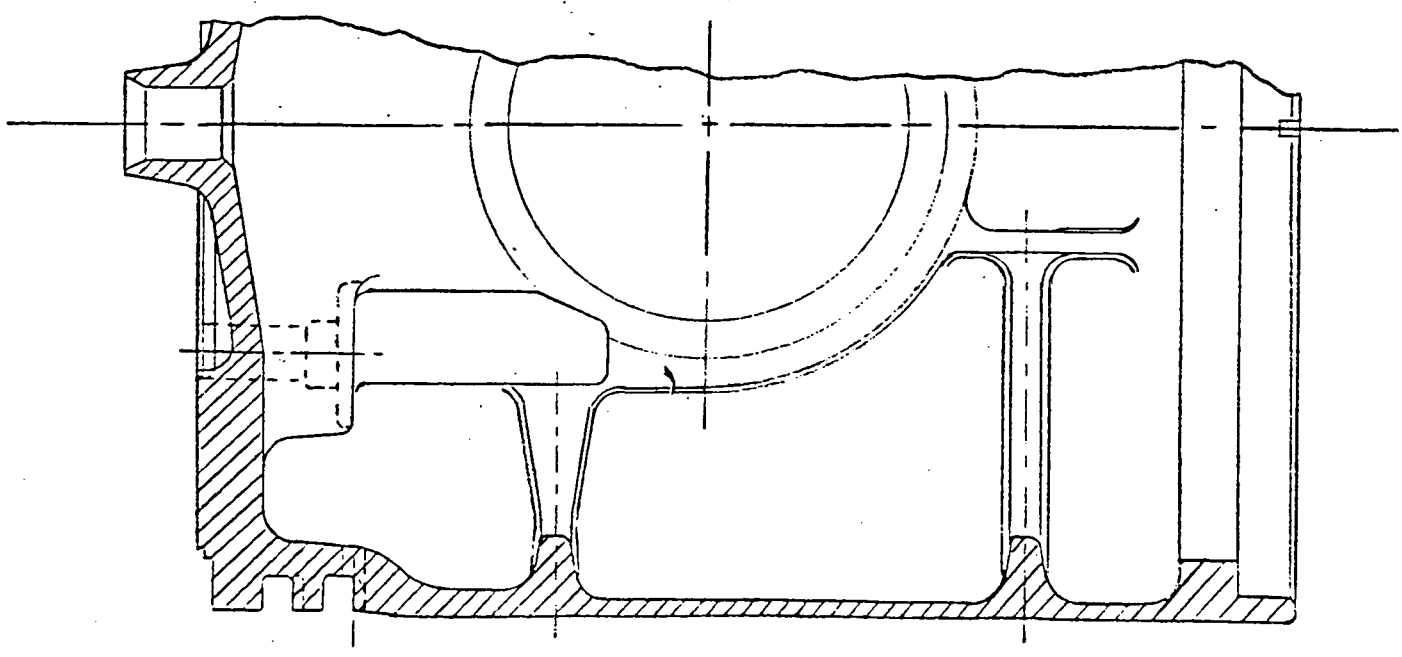
PROGRAM MANAGER

JC Kammerer

AL PISTON



AREA TO BE INSPECTED  
(“NE” Piston only)



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

COMPONENT <u>Piston: Rings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-341B</u>	TASK DESCRIPTION NO. <u>DR-09-02-341B-0</u>
SNPS GPL NO. <u>03-341B</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTION:

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 piston ring assembly for its intended purpose.
- A review of the Component Tracking System indicates that there was no significant applicable nuclear or non-nuclear experience.
- Stresses imposed by engine operation are less at San Onofre than at Shoreham because of lower peak cylinder firing pressure and reduced BMEP at full load.

The following maintenance recommendations from the Lead Engine DR/QR should be implemented:

- Inspect and measure replacement piston rings for clearance values per TDI inspection and maintenance records.
- To assure freedom from harmful scuffing, the cylinder liners should be inspected at each fuel outage. Ring replacement and cylinder liner honing should be performed in accordance with TDI maintenance procedures.
- When replacing engine oil use high detergent oil that 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 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, Mobil Guard 412 or an equivalent product, may be used to insure improved lubrication. Do not mix lube oil brands or types. When changing lube oil replace the entire lube oil charge.



COMPONENT DESIGN REVIEW CHECKLIST

- 135° fuel oil spray tips may be used if inspection results indicate a need for action to improve lubrication and reduce coke buildup.

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

- Verify that the piston ring installation is in compliance with the TDI assembly requirements.
- Analyze coke buildup in piston ring grooves.

There are no modification recommendations for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

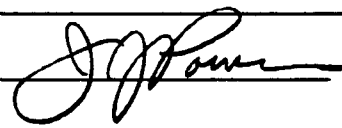
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DOCUMENTATION REQUIRED

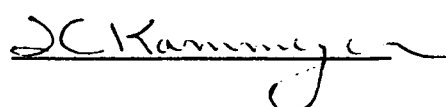
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Piston: Piston Pin UTILITY Southern California Edison  
 COMPONENT PART NUMBER 02-341C TASK DESCRIPTION NO. DR-09-02-341C-0  
 SNPS GPL NO. 03-341C CLASSIFICATION TYPE A

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TASK DESCRIPTIONS

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

Presently San Onofre uses spiral ring retainers (P/N F-108-030) to prevent lateral movement of the wrist pins. For increased engine reliability as stated in the Shoreham DR/QR report it is recommended that:

- The present spiral ring retainers be replaced with Waldes snap ring retainers (P/N GE-003-067) at the first fuel outage.

Quality inspections conducted to date on five DG2 wrist pins for signs of distress have been completed with satisfactory results. It is recommended that the remaining Quality inspections be performed for all engines, unless otherwise noted.

- Perform visual inspection for signs of distress (engine 1 only).
- Record as-built dimensions on one spare pin.
- Perform material comparator test and superficial hardness test on one spare piston pin and on one engine piston pin, for one engine only
- Perform visual inspection of rolled end plug installation

The following maintenance inspections are recommended for this component:

- Visually inspect all pins for chrome plate damage.
- Inspect end plugs and reroll or replace any that are loose.

Note: The above inspections should be performed during major engine overhauls and also whenever the pistons are removed and disassembled to an extent that such inspections are possible.

- Perform a liquid penetrant test or a magnetic particle test on all new or replacement pins before installation in engines.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-341C-0

PRIMARY FUNCTION

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ATTRIBUTE TO BE VERIFIED

---

SPECIFIED STANDARDS

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

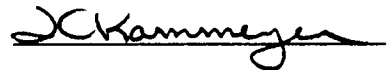
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Piston - Pin Assembly</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-341C</u>	REV. NO. <u>1</u>
SNPS GPL NO. <u>03-341C</u>	

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a Material Comparator test on one wrist pin and one spare.
3. Perform a Hardness test on one wrist pin and one spare.
4. Visually inspect the rolled-end oil plug installations.
5. Visually inspect the wrist pins for signs of distress.
6. Perform a dimensional check of one spare wrist pin.

Engine 2

1. Assemble and review existing documentation.
2. Visually inspect the rolled-end oil plug installations.
3. Visually inspect the wrist pins for signs of distress.

NOTE: Inspections to be performed on four wrist pins - except where noted. (Engine 1 and 2)

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Material of the wrist pins
3. Hardness of the wrist pins
4. Proper installation of rolled-end oil plugs
5. Surface integrity of the wrist pins
6. Proper wrist pin dimensions

Engine 2

1. Quality status of Component Document Package
2. Proper installation of the rolled-end oil plugs
3. Surface integrity of the wrist pins

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Material to be AISI-8630
3. Review of inspection report by Design Group
4. Piston pin assembly installed in compliance with the TDI Instruction Manual.
- 5-6. Review of inspection report by Design Group

Engine 2

1. Satisfactory Document Package
2. Piston pin assembly installed in compliance with the TDI Instruction Manual.
3. Review of inspection report by Design Group

REFERENCES

Engine 1

1. QCI No. 52
- 2-3. Approved Site NDE Procedures
4. Approved Site NDE Procedures, TDI Instruction Manual
5. Approved Site NDE Procedures

Engine 2

1. QCI No. 52
2. Approved Site NDE Procedures, TDI Instruction Manual
3. Approved Site NDE Procedures

---

DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

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

GROUP CHAIRPERSON

*Steven M Schwartz*

PROGRAM MANAGER

*JC Kammerer*

---

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents are in evidence.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page 4 of 4  
09-02-341C

COMPONENT REVIEW (continued)

Engine 1 (continued)

- 2-6. No inspection reports have been received which fulfill these requirements.

Engine 2

1. No EDGCTS site experience documents are in evidence.
2. No inspection report has been received which fulfills this requirement.
3. A Magnetic Particle test was performed on wrist pins nos. 2R, 2L, 6L, 10R and 10L with no relevant indications found. This was reported by TER# 09-011.

---

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 conclusion in support of the final report.

Engine 2

Same as Engine 1

---

GROUP CHAIRPERSON

Nata A. Salata

PROGRAM MANAGER

JC Kammejer

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

---

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

Nicta A. Salita

PROGRAM MANAGER



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

COMPONENT <u>Tappets and Guides: Intake &amp; Exhaust Tappet Assembly</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-345A</u>	TASK DESCRIPTION NO: <u>DR-09-02-345A-0</u>
SNPS GPL NO. <u>03-345A</u>	CLASSIFICATION TYPE <u>A</u>

---

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 report (Comanche Peak).

The maintenance recommendation for this component is as follows:

- Inspect the tappet assemblies to verify that they are free to rotate, and that there is no measurable clearance between the roller pin and cam roller. This inspection should take place at each fuel outage, using TDI inspection and maintenance record form No. 345-1-1.

There are no modification recommendations for this component.

The following Quality inspections are recommended to be performed on all station engines:

- Verify that the intake and exhaust tappet rollers are free to rotate.
- Verify that no measurable clearance exist between the pin and roller.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-345A-0

REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON

J. J. Power

PROGRAM MANAGER

J. C. Kammerer

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

Tappets and Guides: COMPONENT <u>Fuel Tappet Assembly</u>  GROUP PARTS LIST NO. <u>02-345B</u>  SNPS GPL NO. <u>03-345B</u>	UTILITY <u>Southern California Edison</u>  TASK DESCRIPTION NO. <u>DR-09-02-345B-0</u>  CLASSIFICATION TYPE <u>A</u>
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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 report (Comanche Peak).

The maintenance recommendation for this component is as follows:

- Inspect the tappet assembly to verify that it is free to rotate, and that there is no measurable clearance between the roller pin and cam roller. This inspection should take place at each outage, using TDI inspection and maintenance record from 345-1-1.

There are no modification recommendations for this component.

The following Quality inspections are recommended to be performed on all station engines:

- Verify that the fuel tappet rollers are free to rotate.
- Verify that no measurable clearance exist between the pin and roller.

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-345B-0

REFERENCES

Not required

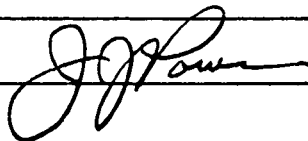
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DOCUMENTATION REQUIRED

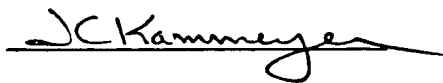
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Tappets and Guides - Fuel Pump Base Assembly</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-345C</u>	TASK DESCRIPTION NO. <u>DR-09-02-345C-0</u>
SNPS GPL NO. <u>03-345C</u>	CLASSIFICATION TYPE <u>B</u>

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TASK DESCRIPTIONS

Design review of this component is not required for San Onofre based on the review of applicable industry and site experience. No experience items have been reported. The same fuel pump base assembly as that used for the San Onofre engines (assembly IA-3443) has been successfully used for the Grand Gulf engine. The Grand Gulf engines have accumulated 900 hours and 1400 hours of operating time with no reported problems with the pump base. The two San Onofre engines have operated for 723 hours for engine #75041 and 555 hours for engine #75042 with no reported problems with the fuel pump base.

No maintenance requirements were identified in the lead engine report (Shoreham).

There are no modifications recommended for this componnt.

Quality revalidation is not required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-345C-0

REFERENCES

Not required

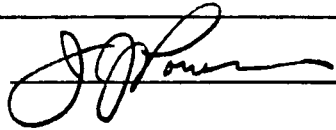
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DOCUMENTATION REQUIRED

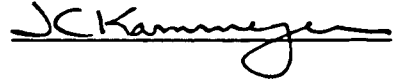
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Camshaft: Camshaft Assembly</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-350A</u>	TASK DESCRIPTION NO. <u>DR-09-02-350A-1</u>
SNPS GPL NO. <u>03-350A</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

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

- A review of the Comanche Peak and Shoreham DR/QR reports which establishes the acceptability of the camshaft assembly for its intended purpose.
- A review of the Component Tracking System indicates that there was no significant applicable nuclear and non-nuclear industry experience.
- Stresses imposed by engine operation are less at San Onofre than at Shoreham due to lower peak cylinder firing pressure and reduced BMEP at full load.

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 camshaft assembly associated with future service should also be less severe. Therefore the Owners Group recommended quality and maintenance inspections for this component, outlined below, should be conducted as noted to confirm the adequacy of the camshaft assembly. 1

(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 maintenance recommendations from the lead engine DR/QR should be implemented:

- Perform a visual inspection each refueling outage of all cam lobe surfaces for signs of cracking, pitting or spalling. 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 and any corrective measures shall be implemented as indicated by this analysis. Signs of spalling shall result in immediate replacement of the cam.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-350A-1

TASK DESCRIPTIONS (continued)

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

- Visually inspect the cam lobes for indications of premature wear.
- No scoring or galling should be found on the camshaft lobes.

There are no modification recommendations for this component.

---

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

---

DOCUMENTATION REQUIRED

Not required

---

GROUP CHAIRPERSON

KI. Litgatski

PROGRAM MANAGER

JC Kammerer



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

COMPONENT <u>Camshaft: Camshaft Bearing</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-350B</u>	TASK DESCRIPTION NO. <u>DR-09-02-350B-1</u>
SNPS GPL NO. <u>03-350B</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review is not required for this component, based on the lead engine DR/QR reports for Shoreham and Comanche Peak, which establish the acceptability of the camshaft bearings.

A review of the Component Tracking System indicated no significant applicable nuclear or non-nuclear industry experience.

Quality revalidation is not required for this component.

No modification recommendations are made for this component.

The transient torsional crankshaft vibration report has been reviewed to compare the torsional vibrations experienced on the San Onfore 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 camshaft bearings associated with future service should also be less severe. Therefore, the Owners Group recommended maintenance inspection for this component, outlined in the maintenance matrix should be conducted during the first major engine overhaul to confirm the adequacy of the camshaft bearings.

(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.)

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-350B-1

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

---

GROUP CHAIRPERSON KI Fitzpatrick PROGRAM MANAGER J. Kammerer

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

CAMSHAFT - SUPPORTS, BOLTING AND GEARS;  
IDLER GEAR ASSEMBLY - CRANK TO PUMP GEAR;  
IDLER GEAR ASSEMBLY

COMPONENT PART NOS. 02-350C, 02-355A AND 02-355B

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 camshaft supports, bolting, gears, and the idler gear assembly. The primary function of these parts is to transmit torque from the crankshaft gear to the camshafts, lubricating oil pump, and cooling water pump.

The parts included in this review for evaluation are tabulated below.

<u>Component</u>	<u>Part Number</u>	<u>Manufacturer</u>
Crankshaft Gear	02-310-01-0B	TDI
Cam Gear	02-350-01-0A	TDI
Idler Gear	02-355-01-0E	TDI
Water Pump Drive Gear	02-355-03-AL	TDI
Lubricating Oil Pump Drive Gear	02-420-06-AF	TDI
Water Pump Idler Gear	02-425-02-AM	TDI
Water Pump Driven Gear	02-425-02-AK	TDI
Bolt-Idler and Cam Hubs to Gear	9167	Various Vendors and Modified by TDI
Capscrew-Water Pump Drive Gear to Crank	02-355-03-AN	Various Vendors and Modified by TDI

II OBJECTIVE

The objective of this design review was to evaluate the adequacy of the camshaft supports, bolting, gears, and the idler gear assembly for their intended service at San Onofre.

III METHODOLOGY

The following methods were used to assess the adequacy of these components:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for San Onofre site, nuclear and non-nuclear industry experience.
- A linear dynamic model of the gear assembly was formulated and used to determine the steady state and transient gear tooth loads that must be transmitted through the gear interfaces. The model includes as inputs both the torsional vibrations of the crankshaft gear and the time varying torque requirements of the camshafts.
- Calculations incorporating the gear tooth loads were performed to evaluate the resistance of the gears to failure because of pitting and bending, in conformance with American Gear Manufacturers Association (AGMA) standards (Ref. 1).
- Calculated gear tooth loads were used to assess the adequacy of the bolting connecting the gears to their hubs and/or shafts.

#### IV RESULTS AND CONCLUSIONS

The Component Tracking System shows only one industry experience item related to the gears involving a cracked timing gear that was attributed to incorrect machining during manufacture.

The results of the dynamic analysis of the gears and subsequent pitting resistance and bending strength calculations are shown in tabular form below (Ref. 2).

Gear Interface	Gear	Factors Of Safety		
		Pitting	Bending	
Idler/Crank Right Bank	Crank	1.66	2.70	
	Idler	1.57	1.77	
	Left Bank	Crank	1.76	3.05
		Idler	1.66	2.02
Idler/Cam	Right Bank	Idler	2.15	
		Cam	1.84	
	Left Bank	Idler	2.12	
		Cam	1.82	
Idler/Lube Oil Pump Drive	Idler	1.84	4.34	
	LO Drive	1.35	4.32	
Water Pump Drive/ Water Pump Idler	WP Drive	0.85	1.70	
	WP Idler	0.86	1.12	
Water Pump Idler/ Water Pump Driven	WP Idler	0.68	1.07	
	WP Driven	0.70	1.57	

These calculations include factors that involve the life of the parts and their reliability. The life factor is based on 4000 hours of operation and the reliability factor chosen is based on a statistical rate of failure of 1 in 1000 during the life of the machine. If a higher statistical failure rate is chosen, 1 in 100, the low factors of safety for the water pump idler gear can be increased to 0.85 and 1.34 for pitting resistance and bending strength respectively. Since the pitting mode of failure is progressive and can be monitored visually, the gears should be inspected on a regular and frequent basis.

The effect of the transient crankshaft torsional vibrations during start-up and roll-down were evaluated using typical crank gear displacement time histories to estimate the peak gear tooth loads. The results of that analysis are summarized in the table below:

<u>Gear Interface</u>	<u>Gear</u>	<u>Bending Factor of Safety</u>	
Idler/Crank Right Bank	Crank	1.40	
	Idler	0.89	
	Left Bank	Crank	1.64
		Idler	1.06
Idler/Cam Right Bank	Idler	2.16	
	Cam	2.74	
	Left Bank	Idler	2.16
		Cam	2.74
Idler/Lube Oil Pump Drive	Idler	2.45	
	LO Drive	2.56	
Water Pump Drive/ Water Pump Idler	WP Drive	0.58	
	WP Idler	0.40	
Water Pump Idler/ Water Pump Driven	WP Idler	0.39	
	WP Driven	0.57	

Like the previous calculations regarding the gears under nominal steady state vibrations, these results also involve a reliability factor for a statistical rate of failure of 1 in 1000 over the assumed 40 year life of the machine. Choosing a reliability index based on a failure rate of 1 in 100 would increase the 0.39 factor of safety to 0.50. However, there have been no reported failure of the gears to date. Nevertheless, due to the relatively low factors of safety against failure due to bending, the gears, especially the water pump drive, driven, and idler gears, should be inspected at all refueling outages to ensure that cranks do not develop in the root fillets between the gear teeth.

The evaluation of the bolting for the idler, cam, and water pump drive gears is summarized in tabular form below.

Bolted Gear	Factors Of Safety	
	Static Preload	Slipping
Cam	2.22	2.18
Idler	3.34	1.54
Water Pump Drive	3.24	6.46

These calculations are based on the  $70 \pm 20$  ft-lbf torque requirement for the cam bolts, the 60 ft-lbf (no tolerance) specification for the idler bolts, and the 70 ft-lbf (no tolerance) requirement for the water pump drive bolts, as specified in the TDI Instruction Manual (Ref. 3). In addition, the calculations assume SAE Grade 5 bolts and that all hub, gear, and shaft mating surfaces are clean. Two of the cam gear-to-hub bolts are used as dowels, so the cam gear-hub interface has more protection against slipping than the 2.18 figure indicated above. However, the idler gear is not assembled in the same manner; because of its low factor of safety against slipping, it is important to ensure that the mating surfaces between the idler gear and idler hub be thoroughly cleaned at assembly, as described in the recommendations below, to ensure that there is an adequate coefficient of friction.

Both the idler and cam bolts mate with slotted nuts and are to have cotter pins inserted. However, the TDI procedure for cotter pin insertion (Ref. 3) can reduce the preload on the idler bolts to zero or increase it to surpass the bolt's proof load; the assembly procedure for the cam has a specified torque tolerance that mitigates the problem. To ensure that an acceptable preload is introduced during assembly, another recommendation below is to increase the nominal idler bolt torque and ensure cotter pin insertion within an acceptable torque range.

There are no TERs associated with this component.

The Component Quality Revalidation Checklist results have been reviewed and show that to date the documentation covering the required inspections has not been submitted. Therefore, it is recommended that:

- The quality inspections outlined in Appendix B be performed and results submitted for engineering evaluation.

Furthermore, the following maintenance recommendations are made:

- The gears should be inspected at each refueling outage and any pitting, scoring, or cracks should be reported for an engineering evaluation. A photographic record of tooth surfaces should be maintained at the site to aid in the evaluation of surface durability.

- The mating surfaces between the idler gears and hubs should be thoroughly cleaned with solvent prior to assembly to ensure that there is an adequate friction coefficient between the parts.
- The idler gear-to-hub bolt torque specification should be  $80 \pm 20$  ft-lbf. If the cotter pin cannot be inserted at a torque greater than 60 ft-lbf and less than 100 ft-lbf, another bolt, washer and/or nut should be used.

Based on the above review, subsequent completion of inspections identified in Appendix B, and implementation of maintenance recommendations given above, the camshaft supports, bolting and gears, and the idler gear assembly are acceptable for their intended use at San Onofre.

V REFERENCES

1. "Rating the Pitting Resistance and Bending Strength of Spur and Helical Gear Teeth," AGMA Standard Publication 218.01, American Gear Manufacturers Association, Arlington, Virginia, December 1982.
2. FAA Support Package for the Gears at San Onofre, SP-84-6-24(e).
3. Instruction Manual, Model DSRV-20-4 Diesel Engine, Transamerica Delaval, Inc., May 1974.

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

<p>Camshaft - Supports, Bolting &amp; Gears Idler Gear Assembly - Crank to Pump Gear Idler COMPLEMENT <u>Gear Assembly Caps</u></p>	<p>UTILITY <u>Southern California Edison</u></p>
<p>GROUP PARTS LIST NO. <u>02-350C</u> <u>02-355A &amp; B</u></p>	<p>TASK DESCRIPTION NO. <u>DR-09-02-350C-0</u> <u>DR-09-02-355A-0</u> <u>DR-09-02-355B-0</u></p>
<p>SNPS GPL NO. <u>03-305A,C,D</u></p>	<p>CLASSIFICATION TYPE <u>A</u></p>

---

TASK DESCRIPTIONS

02-350C

Evaluate structural adequacy of supports, gears, and gear bolting under service load.

Investigate problems and failures of similar TDI installations involving supports, bolting and gears.

Review information provided on TERs.

02-355A

Conduct structural analysis of crank to pump gear bolting.

Review compliance with AGMA practice.

Review information provided on TERs.

02-355B

Analyze bolt structural integrity under preload and dynamic load.

Review compliance with industry practice.

Review information provided on TERs.



COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 3  
DR-09-02-350C-0  
DR-09-02-355A-0  
DR-09-02-355B-0

PRIMARY FUNCTION

02-350C

React to forces applied to camshaft; gears transmit drive torque from crankshaft to camshaft.

02-355A

Transmits torque from the crankshaft to the lube oil pump.

02-355B

Idler gear assembly transmit torque from the crankshaft to the camshaft.

---

ATTRIBUTES TO BE VERIFIED

02-350C

Structural integrity of camshaft supports, gear assembly and gear bolts.  
Determine gear strength and durability.

02-355A

Must have strength and durability to provide the specified service life.

02-355B

Must have sufficient strength and durability to provide adequate service life.

---

SPECIFIED STANDARDS

None

---

REFERENCES

AGMA

---

COMPONENT DESIGN REVIEW CHECKLIST

Page A3 of 3  
DR-09-02-350C-0  
DR-09-02-355A-0  
DR-09-02-355B-0

DOCUMENTATION REQUIRED

02-350C

Loadings; material specifications; assembly drawings.

02-355A

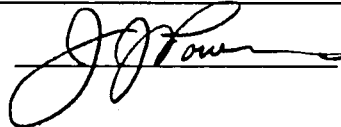
Material specifications and drawings; loadings; installation specifications.

02-355B

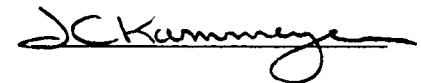
Drawings and material specifications; installation specification.

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Camshaft-Supports, Bolting and Gear</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-350C</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-350C</u>		

---

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Verify that the proper torque values are applied to the bolts (cam to cam gear).
3. Perform a visual inspection of the cam gears for signs of wear, pitting or any other discontinuities.
4. Determine the material of the cam gears.
5. Determine the hardness of the cam gears.

Engine 2

1. Assemble and review existing documentation.
2. Verify that the proper torque values are applied to the bolts.
3. Perform a visual inspection of the cam gears for signs of wear, pitting or any other discontinuities.

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper torque loads are applied to the bolts.

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 4  
09-02-350C

ATTRIBUTES TO BE VERIFIED (continued)

Engine 1 (continued)

3. Surface integrity of the cam gears
4. Material of the cam gears
5. Hardness of the cam gears

Engine 2

1. Quality status of Component Document Package
2. Proper torque loads are applied to the bolts.
3. Surface integrity of the cam gears

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
- 2-3. Review of inspection report by the Design Group
4. Material to be AISI-4340
5. Review of inspection report by the Design Group

Engine 2

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

---

REFERENCES

Engine 1

1. QCI No. 52
- 2-3. Approved Site NDE Procedures, TDI Instruction Manual
4. TER# 99-013

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 4  
09-02-350C

REFERENCES (continued)

Engine 1 (continued)

5. Approved Site NDE Procedures

Engine 2

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

---

DOCUMENTATION REQUIRED

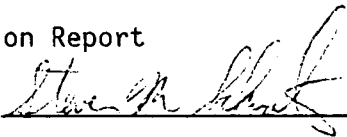
Engine 1

1. Document Summary Sheet
- 2-5. Inspection Report

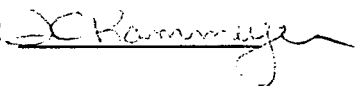
Engine 2

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

GROUP CHAIRPERSON



PROGRAM MANAGER



---

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
- 2-5. No inspection reports have been received which fulfill these requirements.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
  - 2-3. No inspection reports have been received which fulfill these requirements.
-

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B4 of 4  
09-02-350C

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

Vicita A. Saleta

PROGRAM MANAGER

J.C. Kammerer

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

COMPONENT NO. 02-350C, 355A&B

Effective Printout Date 10/15/84

COMPONENT TYPE: Camshaft - Supports, Bolting and Gears  
Idler Gear Assembly - Crank to Pump Gear;  
Idler Gear

<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>		
Damaged and cracked timing gear (near pitch line). M/V Columbia	Williams (12/29/83) to Seaman. Letter from Zbinden (State of Alaska) to Martini (TDI) dated 03/19/79. Letter from Zbinden to Hudson dated 02/02/79	Incorrectly manufactured. No effect on design.

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

COMPONENT <u>Subcover</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-362A</u>	TASK DESCRIPTION NO. <u>DR-09-02-362A-0</u>
SNPS GPL NO. <u>03-362A</u>	CLASSIFICATION TYPE <u>B</u>

---

TASK DESCRIPTIONS

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

There are no modification recommendations for this component.

The following Quality Revalidation inspections are recommended to assure component quality:

- Perform a visual inspection on the web area of the subcover assembly and examine for indications of cracking (four per engine).
- Perform a liquid penetrant test of the subcovers on the machined surfaces of the rocker shaft assembly bolt boss (pedestal) for evidence of linear indications.

Quality inspections conducted at Catawba and Comanche Peak identified several cracked subcover pedestals. The majority were located near the intermediate rocker arm assembly. The pedestals here are counterbored 1/2 inch deep to accept hollow dowels (bushings) that keep the rocker arm shafts from moving laterally under the loads generated by the connector pushrods. The reported pedestals each had a tight crack running down through the web between the counterbore and the machined surface. This type of cracking could be initiated by improper disassembly/assembly of the rocker shaft or an excessive interference fit between the rocker shaft dowel and the subcover pedestal counterbore (TDI drawings specify a clearance of .000 to .0015 inch). Metallurgical examination indicates that the crack, once initiated, may propagate by fatigue.

Although there is no documentation of engine failure directly attributed to cracked subcover pedestals, cracks that extend into the threaded portion of the hole for the rocker arm capscrews could cause a decrease in bolt torque. To prevent this possibility, the following inspection is recommended:



TASK DESCRIPTION (continued)

Perform a liquid penetrant test on the top and vertical machined surfaces of the subcover pedestals (connector pushrod side only) for signs of cracking at the counterbores. This inspection is to be performed in conjunction with the rocker arm bushing inspections when the rocker arm shafts are removed from the subcovers. Subcovers with pedestal cracks that extend through the counterbore web down to the threads should be replaced. This inspection should be performed at major engine overhauls (5 years).

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

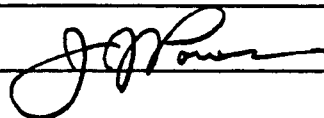
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DOCUMENTATION REQUIRED

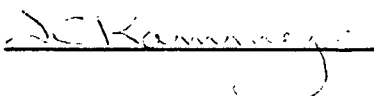
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Rocker Shaft Assemblies: Intake/  
 COMPONENT Intermediate & Exhaust UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-390A&B TASK DESCRIPTION NO. DR-09-02-390A&B-2  
 SNPS GPL NO. 03-390A&B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

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

- A review of the Comanche Peak and Shoreham DR/QR report which establishes the acceptability of the rocker shaft assemblies for their intended purpose.
- A review of nuclear and non-nuclear industry experience listed in the Component Tracking System indicated there had been no design related failures associated with this component.
- 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.

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 intake/intermediate and exhaust rocker arm assemblies associated with future service should also be less severe. Therefore the Owners Group recommended quality inspections for this component, outlined below, should be conducted during the first major engine overhaul on one station engine to confirm the adequacy of the intake/intermediate and exhaust rocker arm assemblies.

(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.)

There are no maintenance or modification recommendations for this component.

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

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-390A&B-2

TASK DESCRIPTION (continued)

- Perform a visual inspection (both engines) of the intake/intermediate and exhaust rocker arm assemblies for signs of distress, linear indications and chipped pieces in the swivel pads and the outer lips of the pushrod cups. The lips should be flush in the assembly.
- Perform a material comparator test on one intake/intermediate rocker arm shaft and one exhaust rocker arm shaft.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON K.T. Fitzpatrick PROGRAM MANAGER K. Kammerer

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Rocker Arms and Pushrods: Exhaust Rocker Shaft Assembly

COMPONENT PART NO.: 02-390B

See Component Part No.: 02-390A

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

COMPONENT <u>Main and Connector Pushrods</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-390C&amp;D</u>	TASK DESCRIPTION NO. <u>DR-09-02-390C&amp;D-1</u>
SNPS GPL NO. <u>03-390C&amp;D</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

- A review of the Shoreham DR/QR Reports which establishes the acceptability of the friction welded and forged head pushrods.
- A review of the nuclear and non-nuclear industry experience listed in the Component Tracking System indicated there had been no design related failures associated with friction welded or forged head pushrods.

There are no maintenance or modification recommendations for this component.

Quality inspections performed at San Onofre found that all the forged head main pushrods had linear indications at the plug welds. They were dispositioned by S.C.E. as acceptable because the forged heads were fully inserted into the pushrod tubes, relieving the plug welds of load. It is recommended that pushrods with cracks emanating from the edge of the plug weld that are greater than 1/4 inch be replaced. The connector pushrods are the welded ball type and all were found cracked at the weld. Although operation with this type of pushrod has not caused engine failure in similar TDI engines, the ball welded pushrods should be replaced with the friction welded pushrods to assure reliability.

The following Quality Revalidation inspections are recommended to assure proper component quality and performance and should be performed on all pushrods (both engines):

- Verify that the connector pushrods are friction welded and the intake/exhaust pushrods have the forged head design.
- Perform a liquid penetrant test on all friction welded pushrods. As an alternative, visual inspection may be used if a thorough wipedown of the surface is done to remove any coatings or deposits on the surface. No surface cracks should be allowed along the bond line between the rod end and the tube.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
09-02-390C&D-1

- Perform a liquid penetrant inspection of forged head plug welds and visual examination for full insertion of forged head into tube. Acceptance criteria is zero gap for forged head into tube.

For future purchases of friction welded pushrods, it is recommended that the purchase order specify destructive verification of weld quality by sectioning random samples from each manufacturing lot.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

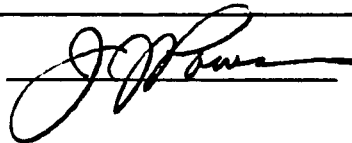
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DOCUMENTATION REQUIRED

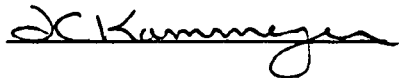
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Rocker Arms & Pushrods:  
Pushrods-Main and Connector UTILITY Southern California Edison  
San Onofre Nuclear Generating  
Station - Unit 1

GPL NO. 02-390C & D

REV. NO. 2

SNPS GPL NO. 03-390C & D

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Verify that the connector pushrods are friction welded.
3. Perform a Liquid Penetrant or Magnetic Particle test on all main and connector pushrods. If the above NDE inspections cannot be performed, a visual inspection is acceptable if the surface is thoroughly wiped down to remove any coatings or deposits.
4. Visually inspect the main pushrods to ensure full insertion of forged heads into tubes.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Connector pushrods are friction welded.
3. Surface integrity of all main and connector pushrods.
4. Main pushrod forged heads are fully inserted into the tubes.

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
-

ACCEPTANCE CRITERIA (continued)

Engine 1 (continued)

2. Connector pushrods are friction welded.
3. No surface cracks allowed along the bond line between the rod end and the tube.
4. Main pushrod forged heads are fully inserted into the tubes.

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures
3. Approved Site NDE Procedures, TER# 99-017, TER# 99-035
4. Approved Site NDE Procedures

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

*Steve M. Schwartz*

PROGRAM MANAGER

*J. Power for JCK*

---

COMPONENT REVIEW

Engine 1

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



COMPONENT REVIEW (continued)

2-3. No inspection reports have been received which fulfill these requirements.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.
3. A Liquid Penetrant test was performed on nos. 2, 6, and 10 intake and exhaust pushrods with unsatisfactory results. This was reported by TER# 09-014 and dispositioned by NCR S01-P-2681. Liquid Penetrant tests were performed on nos. 2, 6 and 10 connector pushrods with unsatisfactory results. This was reported by TER# 09-014 and dispositioned by NCR S01-P2680.
4. No inspection report has been received which fulfills this requirement.

---

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 Nilda A. Salita

PROGRAM MANAGER J. J. [Signature]  
for JCK

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Rocker Arms and Pushrods: Pushrods Connector

COMPONENT PART NO.: 02-390D

See Component Part No.: 02-390C

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

Rocker Arm & Pushrods: COMPONENT <u>Bushings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-390E</u>	TASK DESCRIPTION NO. <u>DR-09-02-390E-1</u>
SNPS GPL NO. <u>03-390E</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 establishes the acceptability of the bushings for their intended purpose.
- A review of the Component Tracking System indicates that there was no significant applicable nuclear or non-nuclear experience.
- Stresses imposed by engine operation are less at San Onofre than at Shoreham because of lower peak cylinder firing pressure and reduced BMEP at full load.

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 intake, intermediate and exhaust rocker arm bushings associated with future service should also be less severe. Therefore the Owners Group recommended maintenance inspections for this component, outlined below, should be initially conducted during the first major engine overhaul on one station engine to confirm the adequacy of the intake, intermediate and exhaust rocker arm bushings.

(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.)

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

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-390E-1

TASK DESCRIPTION (continued)

- Visually inspect and measure the intake, intermediate, and exhaust rocker arm bushings. The periods of engine operation to wear the bushings from an initial clearance of 0.0045 inch (diametral) to 0.010 inch (value at which bushings should be replaced) were calculated to be 2300 hours - Intake, 730 hours - Intermediate, and 1300 hours - Exhaust. It is recommended that an inspection be conducted at the fuel outage which precedes the applicable number of engine hours of operation in a LOOP/LOCA event plus the expected hours of operation between outages.

No Quality Revalidation is required for this component.

No modifications are recommended 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

*K. T. Fitzpatrick*

PROGRAM MANAGER

*J. C. Kammer*

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

Rocker Arms and Pushrods: COMPONENT <u>Lifters</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-390F</u>	TASK DESCRIPTION NO. <u>DR-09-02-390F-2</u>
SNPS GPL NO. <u>03-390F</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 report which establishes the acceptability of the hydraulic lifter for its intended purpose.
- A review of nuclear and non-nuclear industry experience listed in the Component Tracking System indicated there had been no design related failures associated with this component.

The only adverse experience with this component involved collapsed lifters which occurred when the lifters were installed upside down. Quality inspections recommended below will verify correct lifter installation at San Onofre.

There are no maintenance or modification recommendations for this component.

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

- Verify that the lifters are installed such that the hole in the plunger is at the top of the lifter assembly.
- Perform a leak down rate test on two lifters.

---

PRIMARY FUNCTION

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

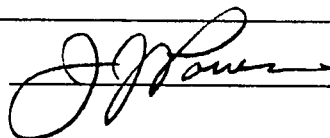
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DOCUMENTATION REQUIRED

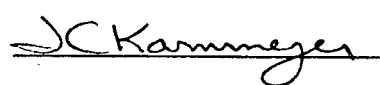
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Rocker Arms and Pushrods - Misc. Bolts and Drive Studs</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-390G</u>	TASK DESCRIPTION NO. <u>DR-09-02-390G-0</u>
SNPS GPL NO. <u>03-390G</u>	CLASSIFICATION TYPE <u>B</u>

---

TASK DESCRIPTIONS

Design review for this component is not required based on applicable industry experience, the Phase I report, and the lead engine DR/QR report (Comanche Peak). There is no site experience in the EDG Component Tracking System for this component. The industry experience of rocker arm bolt failures has been attributed to insufficient preloading.

The following maintenance recommendation is made for this component to improve reliability:

- Verify that the proper torque is applied to the rocker arm bolts (365 ft-lbs). This inspection should take place at each refueling outage.
- Verify that the rocker arm drive studs are intact and tight. This inspection should also be performed at each outage.

There are no modification recommendations for this component.

Quality inspections performed to date for engines DG1 and DG2 have been reviewed and found satisfactory.

The following Quality inspections are recommended to be performed on all station engines:

- Perform a magnetic particle test on the thread root area of all capscrews for linear indications.
- Perform a material comparator test on four capscrews.
- Perform a hardness test on four capscrews.
- Perform a visual inspection on the drive studs for signs of irregularity.

PRIMARY FUNCTION

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

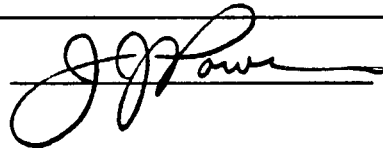
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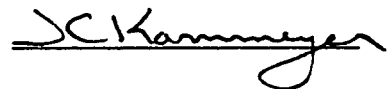
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Rocker Arms &amp; Pushrods - Misc. Bolts &amp; Drive Studs</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-390G</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-390G</u>		

---

---

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation
2. Perform a Magnetic Particle test on the thread root area of all capscrews for linear indications.
3. Perform a visual inspection on the drive studs for signs of irregularity.
4. Verify that the proper torque loads are applied to the rocker arm capscrews by reviewing existing documentation.
5. Determine the material of four capscrews.
6. Determine the hardness of four capscrews.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Surface integrity of the thread root area of all capscrews
3. Surface integrity of the drive studs
4. Proper torque loads are applied.

ATTRIBUTES TO BE VERIFIED (continued)

Engine 1 (continued)

5. Material of the capscrews
6. Hardness of the capscrews

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. No linear indications in the thread root area of the capscrews
3. No movement of the drive stud in the rocker arm
4. Torque loads are in accordance with the TDI Instruction Manual.
- 5-6. Review of inspection report by the Design Group

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1

1. QCI No. 52
- 2-3. Approved Site NDE Procedures
4. TDI Instruction Manual
- 5-6. Approved Site NDE Procedures

Engine 2

Same as Engine 1

---


DOCUMENTATION REQUIRED

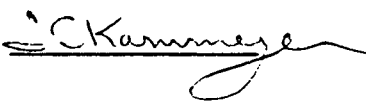
Engine 1

1. Document Summary Sheet
- 2-6. 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.
- 2-3. No inspection reports have been received which fulfill these requirements.
4. The proper torque loads were applied to the rocker arm capscrews for cylinders 1R, 1L, 6R, 6L, 10R and 10L. This was reported by TER# 09-015.
- 5-6. No inspection reports have been received which fulfill these requirements.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
- 2-3. No inspection reports have been received which fulfill these requirements.
4. The proper torque loads were applied to the rocker arm capscrews for cylinders 2R, 2L, 6R, 6L, 10R and 10L. This was reported by TER# 09-015.

COMPONENT REVIEW (continued)

Engine 2 (continued)

5-6. No inspection reports have been received which fulfill these requirements.

---

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

Nicola A. Saleta

PROGRAM MANAGER

J. Kammerer

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

COMPONENT <u>Front Gearcase Bolting</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-335B</u>	TASK DESCRIPTION NO. <u>DR-09-02-335B-0</u>
SNPS GPL NO. <u>03-330B</u>	CLASSIFICATION TYPE <u>C</u>

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.
- The San Onofre gearcase and bolting are the same as that used at Comanche Peak; the Comanche Peak bolting was found acceptable in the Comanche Peak design review.

There are no special maintenance requirements identified in the lead engine report, however, a QC inspection of the bolts at Shearon Harris (CP&L NCR 84-177) showed two bolts internal to the gearcase that were not evident on the parts manual drawing. These two bolts are part of the perimeter bolt pattern that attaches the cover to the block, but are internal and must be accessed by removing a cover plate or the governor supporting assembly. These bolts must be torqued the same as the other bolts. The CP&L inspection found that no positive means of locking was provided. Considering the damage these bolts could cause if they loosen, it is recommended that these bolts be inspected at San Onofre, and positive locking features (bent tab or lockwire) be added, and then properly torqued in accordance with the TDI manual.

The following Quality inspection is recommended to be performed:

- Verify bolting installation and torque.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

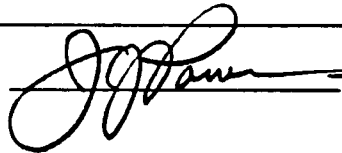
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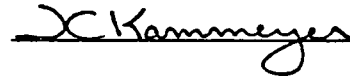
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Idler Gear Assembly: Crank To Pump Gear

COMPONENT PART NO.: 02-355A

See Component Part No.: 02-350C

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Idler Gear Assembly: Idler Gear Assembly

COMPONENT PART NO.: 02-355B

See Component Part No.: 02-350C



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

COMPONENT Flywheel

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-330A

TASK DESCRIPTION NO. DR-09-02-330A-0

SNPS GPL NO. 03-330A

CLASSIFICATION TYPE A

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TASK DESCRIPTIONS:

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

- There is no relevant nuclear or non-nuclear industry experience listed in the Component Tracking System.
- The DR/QR report for Comanche Peak indicated a sufficiently large factor of safety for the flywheel to cover the larger diameter flywheel used at San Onofre (90 inch versus 68 inch).

There are no maintenance or modification recommendations for this component.

Quality revalidation for this component is not required.

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PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

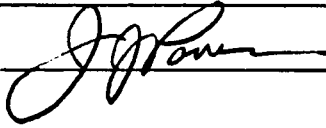
COMPONENT DESIGN REVIEW CHECKLIST

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DR-09-02-330A-0

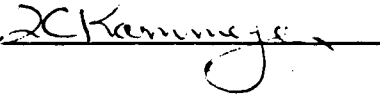
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

FLYWHEEL BOLTING  
COMPONENT PART NO. 02-330B

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 engine flywheel flange bolting. This connection serves as the joint between the generator shaft, flywheel and engine crankshaft and is the load path for power transmission between the engine and generator. Flywheel bolt connection component part numbers are listed below:

<u>Name</u>	<u>Part Number</u>	<u>Manufacturer</u>
Flywheel	02-330-01-AE	TDI
Flywheel Bolt	97253	Various Vendors
Nut	F-090-038	Various Vendors
Roll Pin	GC-001-182	Various Vendors

II OBJECTIVE

The objective of this review was to verify the adequacy of the bolt torque specifications and flywheel bolting to transmit engine torque, and to resist torque transients in the presence of other normal operating and earthquake loads as well as startup and coast-down torque transients.

III METHODOLOGY

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

Estimates of the maximum transient crankshaft torques were obtained (Ref. 4).

The design details of the San Onofre flywheel bolting were reviewed and compared with other TDI Owners Group engines. Torque transmission capabilities were calculated based on a fatigue evaluation of the bolts. Shear loads resulting from the average power related torque, torque transients, and deadweight were considered. Bolt tensile loads from bolt pretension were also considered. Loads were converted to estimates of alternating and mean stresses. Combined stress results were used, and the Goodman diagram was used to calculate the effects of alternating and mean stresses. Bolt clearances resulting from bolt fit-up and hole

reaming procedures were reviewed, and this along with a review of assembly lubricants contributed to assumptions as to the number of bolts that load in shear. A normal plus seismic load case was considered separately as a non-fatigue producing case. Seismic coefficients were derived from Reference 6. The performance of the San Onofre bolts was evaluated in the context of similar evaluations of Shoreham and previously reviewed Owners Group V-16 engines. Two types of torque transients were considered, that resulting from normal engine operation at rated speed, and that resulting from startup and coast-down.

#### IV RESULTS AND CONCLUSIONS

The peak torque transient for the San Onofre engine at its rated speed is less than that for the V-16 engine at Comanche Peak. However, the peak torque experienced during startup and coast-down is substantially larger. The bolting configuration is nearly identical for Comanche Peak and San Onofre, and both are assembled using an antisieze compound (Ref. 5). Based on estimates of the San Onofre startup and coast-down torques (Ref. 4), San Onofre's bolting, bolt torques and assembly procedures are acceptable (Ref. 1). Startup and coast-down bolt stresses are below the bolt material allowed stress for 50,000 stress cycles, with one half of the bolts assumed loaded in shear. Credit for the lesser number of stress cycles from startup and coast-down loads was used to conclude adequacy. 100 starts and stops were assumed, each with 50 equivalent maximum stress cycles. However, the design margin is less for San Onofre than for Comanche Peak. Consequently, it is recommended that assembly procedures include an effort to keep the flange faces of the flywheel, crankshaft and generator shaft free of antisieze compound. Antisieze compound may still be used on the center alignment plug and to aid in driving the bolts at assembly. This recommendation is not essential to demonstrate adequacy of the bolts but is intended to produce a consistent design margin with other TDI engines. Thus, it needs to be implemented only if the flywheel connection is disassembled.

The seismic plus normal load case also produced acceptable results (Ref. 1).

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 except that the required flywheel bolt torque was not verified by the Quality Revalidation program. Therefore, it is recommended that the TDI bolt torque requirements be documented by Southern California Edison.

Based on the above review, it is concluded that the flywheel bolting and torque specifications are adequate for their intended use at San Onofre provided that proper flywheel bolt torque is verified.

V REFERENCES

1. SWEC Calculation No. 11600.60 NM(B)-001-CZC-004, "Flywheel Mounting Bolts, Design Review".
2. Flywheel Bolt Drawing, TDI No. 97253
3. Flywheel Drawing TDI No. 02-330-02-AE
4. Memorandum from Lisa Shusto of FAA to P. Titus of SWEC, dated October 16, 1984 containing rated speed torque transients, and Telephone Memorandum, Dr. Paul Johnson of FAA and P.H. Titus of SWEC, dated October 23, 1984, containing estimated startup and coast-down torques.
5. Delaval Instruction Manual for San Onofre, page 2.5
6. Specification E-73001, February 13, 1975, Southern California Edison Company Diesel Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1.

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

COMPONENT Flywheel-Bolting

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-330B

TASK DESCRIPTION NO. DR-09-02-330B-0

SNPS GPL NO. 03-330B

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Review torque transmission mechanisms and basis for bolt torque specifications. Review flywheel bolt design. Consider the effects of engine torque variations during normal operating engine speed and startup and shutdown.

PRIMARY FUNCTION

Transmit engine torque to generator through the flywheel flange connection.

ATTRIBUTE TO BE VERIFIED

Adequacy of bolt torque specifications and acceptability of the bolt stresses.

SPECIFIED STANDARDS

Not required

REFERENCES

Telcon: Dr. P. Johnston of FAA and P. H. Titus of SWEC, 10-12-84

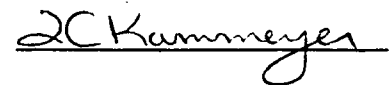
DOCUMENTATION REQUIRED

Final torque variation data for normal engine operation and start and stop transients.

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Flywheel Bolting UTILITY Southern California Edison  
San Onofre Nuclear Generating  
Station - Unit 1  
GPL NO. 02-330B REV. NO. 1  
SNPS GPL NO. 03-330B

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Verify that the torque loads applied to the flywheel bolting meets the latest specified requirements.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper torque loads are applied.

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. The flywheel bolts are torqued in accordance with TDI's specifications.

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

---

DOCUMENTATION REQUIRED

Engine 1

1. Document Summary Sheet

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*Steve M. Schwartz*

PROGRAM MANAGER

*J. Kammerer*

---

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.

Engine 2

Same as Engine 1

---



COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 3  
09-02-330B

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 Naitu A Selefa

PROGRAM MANAGER JC Kammerer

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

COMPONENT NO. 02-330B

Effective Printout Date 10/15/84

COMPONENT TYPE: Flywheel Bolts

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Increase torque on flywheel bolts to 3000 ft-lbs.	SIM 64H	SIM 64H does not apply to San Onofre.
<u>NON-NUCLEAR</u>		
None		

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

Engine and Auxiliary Module  
Wiring Material and Fittings;  
Pyrometer Conduit Assembly -  
COMONENT Conduit, Fittings and Supports UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-688A & 02-630A,B,C TASK DESCRIPTION NO. DR-09-02-688A-0 DR-09-02-630A,B,C-0

SNPS GPL NO. 02-630A,B,C 03-688A & 03-630A,B,C CLASSIFICATION TYPE A/C

---

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.
- Based on a walkdown/inspection of the engines.

The modifications listed in lead engine DR/QR report (Comanche Peak) are not applicable to San Onofre since the conduit layout and supports are generally different.

Based on walkdown and inspection of conduits and conduit supports and the results of analyses (Calc. No. 11600.60/CS-11, CS-12) using input from the design specification (Specification E-73001-SPA Songs 1) the following modifications are recommended:

- Perform an upgrade to tighten/fix, replace or add missing conduit supports as required and to repair disconnected/disjointed conduits.
- Additional supports are required at several locations for Category I rigid and flexible conduits (Ref. Memo from A.Y.C. Wong to J. C. Kammeyer dated 10/26/84).

The lead engine report for this component indicated no maintenance recommendations.

Quality Revalidation is not required for this component.

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-688A-0  
DR-09-02-630A,B,C-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

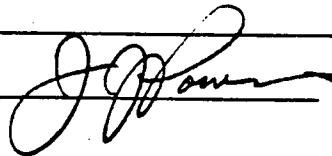
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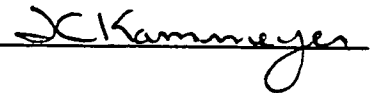
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Pyrometer Conduit Assembly: Conduit Fittings

COMPONENT PART NO.: 02-630B

See Component Part No.: 02-630A

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Pyrometer Conduit Assembly: Support

COMPONENT PART NO.: 02-630C

See Component Part No.: 02-630A

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

COMPONENT <u>Pyrometer Conduit Assembly: Thermocouples</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-630D</u>	TASK DESCRIPTION NO. <u>DR-09-02-630D-0</u>
SNPS GPL NO. <u>03-630D</u>	CLASSIFICATION TYPE <u>B</u>

---

TASK DESCRIPTIONS

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

- A review of Component Tracking System indicated that there was no significant nuclear and non-nuclear experience.
- A review of the Comanche Peak and Shoreham DR/QR reports which establish the acceptability of the thermocouples for their intended purpose.

No modifications are recommended for this component.

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

- Check that each thermocouple's indicated temperature is consistent with the engine's ambient temperature when the engine is cold. Any inconsistent reading traced to the thermocouple should result in replacement of the thermocouple. This is to be conducted during every 18-month maintenance outage.
- Remove, clean and inspect each thermocouple and thermocouple shield for indications of fatigue. Any indications of fatigue should result in replacement of the thermocouple and/or thermocouple shield. This will be conducted during every other 18-month maintenance outage.

No Quality Revalidation review is required for this component.

PRIMARY FUNCTION

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

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

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

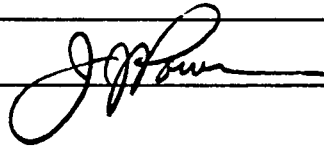
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DOCUMENTATION REQUIRED

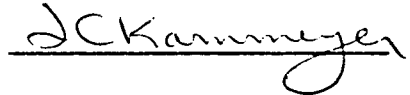
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Engine & Aux Module Wiring Material- Conduit & Fittings;

Pyrometer Conduit Assembly- Conduit, Fitting, Supports  
COMPONENT PART NO.: 02-688A

See Component Part No.: 02-630A

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

Engine & Aux Module Wiring  
COMPONENT Mat'l: Wiring & Termination

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-688B

TASK DESCRIPTION NO.: DR-09-02-688B-1

SNPS GPL NO. 03-688B

CLASSIFICATION TYPE A

---

TASK DESCRIPTIONS

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

- A review of the lead engine DR/QR Report for Shoreham and Comanche Peak.
- A review of the Phase I Report for this component (See References)
- A review of the component tracking system indicated that there was no significant applicable industry experience that had not been addressed in the Phase I report.

There are no maintenance/modification recommendations from the lead engine DR/QR Reports for this component.

However, as noted in Phase I report, it is recommended that the implementation of TDI SIM No. 361 on Engine No. 1 be confirmed.

There are no TERs associated with this component.

The visual inspection called for on the CQRC has been previously performed as part of the Phase I effort and has been documented in the Phase I report (See References). No further Quality Revalidation is required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Emergency Diesel Generator Auxiliary Module Control Wiring and Termination Qualification Review," prepared by Stone & Webster Engineering Corporation, July, 1984.

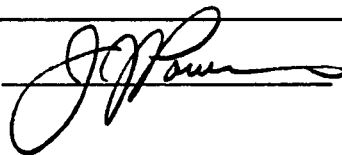
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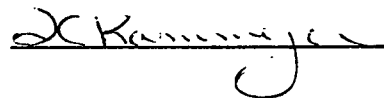
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

Eng. & Aux-Module Wiring COMPONENT <u>Mat'l - Boxes &amp; Terminals</u>	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO. <u>02-688C</u>	REV. NO. <u>2</u>	
SNPS GPL NO. <u>03-688C</u>		

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---

TASK DESCRIPTIONS

No further review of component 02-688C is required for the following reasons:

- a) Boxes and terminals were reviewed on the lead engine (Shoreham) and inspection results were satisfactory. In addition, terminals were reviewed for component 02-688B.
- b) There is no site or industry experience reported for this component.

---

GROUP CHAIRPERSON *Steve R. Schuch*

PROGRAM MANAGER *J. Kammejer*

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

COMPONENT On Engine Alarm Sensors UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-690 TASK DESCRIPTION NO: DR-09-02-690-0  
 SNPS GPL NO. 03-690 CLASSIFICATION TYPE B

---

TASK DESCRIPTION

The application of the on engine alarm sensors used on San Onofre is identical to Comanche Peak, with the exception of Barksdale pressure switch TDI Part No. F-577-062. This switch is used in the jacket water system, providing a low level jacket water alarm signal to the annunciator. This switch is of adequate design to perform this function.

There is no non-nuclear industry experience listed in the EDG Component Tracking System. Nuclear industry experience listed showed no significant experience items.

There are no modification or maintenance recommendations for this component.

Quality revalidation for this component is not deemed necessary.

Based on the above, a design review for the on engine alarm sensors is not required for San Onofre.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

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DR-09-02-690-0

REFERENCES

Not required

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DOCUMENTATION REQUIRED

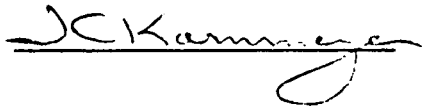
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Off-Engine Alarm SensorsUTILITY Southern California EdisonGROUP PARTS LIST NO. 02-691ATASK DESCRIPTION NO. DR-09-02-691A-0SNPS GPL NO. 99-691ACLASSIFICATION TYPE BTASK DESCRIPTION

The application of the off-engine alarm sensors used on San Onofre is identical to Comanche Peak, with the exception of Magnetrol level switch TDI Part No. F-528-021. This switch is used in the lube oil system, providing a low lube oil sump level alarm. The switch is of adequate design to perform this function.

There is no nuclear or non-nuclear industry experience listed in the EDG Component Tracking System for the off engine alarm sensors.

There are no maintenance or modification recommendations required for the off-engine alarm sensors.

Quality Revalidation of the off-engine alarm sensors is not deemed necessary.

Based on the above, a design review of the off-engine alarm sensors is not required for San Onofre.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

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DR-09-02-691A-0

REFERENCES

Not required

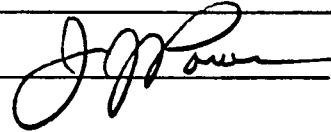
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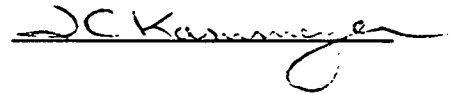
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GROUP CHAIRPERSON



PROGRAM MANAGER





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

COMPONENT <u>Overspeed Trip: Governor</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-410A</u>	TASK DESCRIPTION NO. <u>DR-09-02-410A-1</u>
SNPS GPL NO. <u>03-410A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review is not required for this component based on the Comanche Peak lead engine DR/QR report, which establishes the acceptability of the overspeed trip governor. The component parts under review are identical.

A review of the Component Tracking System indicates no significant applicable nuclear or non-nuclear experience.

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 overspeed trip governor associated with future service should also be less severe. Therefore the Owners Group recommended maintenance inspections for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the overspeed trip governor.

(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 Quality Revalidation inspection recommendations, to be performed on both engines, are made to ensure component quality and performance:

- Verify the proper installation and calibration of the governor overspeed trip, in accordance with the Installation and Oil Supply Topic of Woodward Documentation, TDI Manual.
- Verify that the proper operational procedures are used on the governor, in accordance with Woodward documentation.

The following maintenance items, from the Comanche Peak DR/QR report, are recommended for San Onofre to ensure reliability of the overspeed trip governor:

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-410A-1

TASK DESCRIPTION (continued)

- Modify the surveillance testing procedures to include verification that the overspeed trip is correctly set to an overspeed trip setting of  $518 \pm 5$  rpm at every refueling outage ensuring that both the electric governor and the mechanical backup governor are properly returned to their normal settings following the overspeed test. The test is to be performed with no load on the engine by increasing the normal governor's 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.
- After setting the overspeed governor, the adjustment screw positions should be marked with torque-seal to reveal any unintended changes in the set positions.

There are no modification recommendations 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

*K.T. Fitzpatrick*

PROGRAM MANAGER

*J. Kammerer*

S01950/2

REV. 1  
CARRY OVER FROM  
PREVIOUS PAGE

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

COMPONENT <u>Overspeed Trip: Governor &amp; Accessory Drive Assembly</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-410B</u>	TASK DESCRIPTION NO. <u>DR-09-02-410B-1</u>
SNPS GPL NO. <u>03-410B</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

Design review is not required for this component, based on the Comanche Peak lead engine DR/QR report which establishes the acceptability of the overspeed trip and accessory drive gear and shafting. The component parts under review are identical.

A review of the Component Tracking System indicates no significant applicable nuclear or non-nuclear experience.

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 governor and accessory drive assembly associated with future service should also be less severe. Therefore the Owners Group recommended quality inspections for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the governor and accessory drive assembly.

(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 Quality Revalidation inspection recommendations, to be performed on one station engine only, are made to ensure component quality and performance:

- Confirm that the material of the accessory drive gear is AISI 4340.
- Perform a visual inspection of assembled accessory drive gear for wear.
- Measure accessory drive gear shaft-to-bearing clearance. This clearance can be measured by placing a dial indicator on the gear and manually moving the gear in all directions.
- Perform a visual and LP inspection of the governor shaft.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-410B-1

TASK DESCRIPTION (continued)

- Perform a dimensional check of the governor shaft in the bearing area.
- Perform superficial hardness tests on outer gear tooth flat (top land) of overspeed governor drive gear.

There are no maintenance or modification recommendations for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

---

DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON KT Fitzpatrick

PROGRAM MANAGER DC Kammerer

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

Overspeed Trip: Couplings COMPONENT <u>(Flexible and Spider)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-410C</u>	TASK DESCRIPTION NO. <u>DR-09-02-410C-1</u>
SNPS GPL NO. <u>03-410C</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

Design review is not required for this component based on the Comanche Peak lead engine DR/QR report which establishes the acceptability of the overspeed trip couplings. The parts under review are the same as those of the lead engine.

A review of the EDG Component Tracking System indicates no significant applicable industry or site experience.

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 overspeed trip couplings associated with future service should also be less severe. Therefore the Owners Group recommended quality and maintenance inspections for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the overspeed trip couplings.

(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 Quality inspection is recommended to be performed:

- Visually inspect the couplings for proper installation and signs of deterioration, on all station engines.

The following maintenance recommendations should be implemented to improve the reliability of the San Onofre design:

TASK DESCRIPTION (continued)

- Either modify the maintenance specifications to replace the Lovejoy coupling spiders at every fuel outage, or, during the fuel outages, test the coupling elastomer for hardness and replace if it has exceeded the coupling manufacturer's specification.
- Discontinue use of Loctite 680 on heavy interference fits, but use Loctite 609 in a manner prescribed by TDI SIM #363 during assembly.
- Modify the maintenance specifications to check for coupling shaft looseness during fuel outages.
- Replace the present Lovejoy couplings with new units. The shafts upon which each half are to be mounted should be measured and machining modifications made to the coupling halves to keep the interference fit below 0.0005. Other procedures outlined in SIM 363 should be followed, except with using Loctite 609 in place of 680 when reassembled.

There are no modification recommendations 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

*KT. Subramanian*

PROGRAM MANAGER

*DC Kammerer*

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

COMPONENT Vent Valve: Overspeed Trip UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-410D TASK DESCRIPTION NO: DR-09-02-410D-0  
SNPS GPL NO. 03-410D CLASSIFICATION TYPE: A

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---

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.
- A review of the lead engine DR/QR Reports (Shoreham/Comanche Peak)

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

- Valve 0 rings should be changed every 5 years.

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

---

SPECIFIED STANDARDS

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-410D-0

REFERENCES

Not required

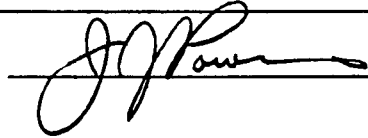
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DOCUMENTATION REQUIRED

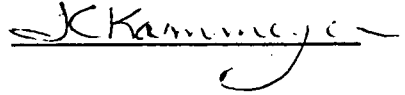
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





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

Governor Drive: Governor and Tachometer Drive COMPONENT <u>Gear and Shaft</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-411A</u>	TASK DESCRIPTION NO. <u>DR-09-02-411A-1</u>
SNPS GPL NO. <u>03-402A</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

Design review is not required for this component, based on the Comanche Peak lead engine DR/QR report which establishes the acceptability of the governor drive gears and shafts.

A review of the Component Tracking System indicates no significant applicable industry or site experience.

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 governor and tachometer drive gear and shaft associated with future service should also be less severe. Therefore the Owners Group recommended quality inspections for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the governor and tachometer drive gear and shaft.

(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 Quality inspections are recommended to be performed on one station engine:

- Determine the material of the governor drive gear (P/N 02-411-01-0B) and governor driven gear (P/N 02-411-02-AB) by use of comparator. Material to be AISI 4142.
- Perform LP inspections of governor drive for fatigue cracks (after pre-operational or 100 hours running) in the following areas:
  - (a) Gear/shaft contact surfaces and surfaces immediately adjacent;
  - (b) Gear pins and bores;

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-411A-1

TASK DESCRIPTION (continued)

- (c) Vertical shaft/gear keyway;
- (d) Reduced shaft diameter at coupling.

There are no modification or maintenance recommendations for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON *K.T. Fitzpatrick*

PROGRAM MANAGER *J.C. Kraemer*

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

Governor Drive: COMPONENT <u>Couplings, Pins &amp; Keys</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-411B</u>	TASK DESCRIPTION NO. <u>DR-09-02-411B-1</u>
SNPS GPL NO. <u>03-402B</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

Design review is not required for the Falk coupling at San Onofre, based on a review of the applicable industry experience listed in the EDG Component Tracking System, San Onofre site experience with the Falk coupling, and the lead engineer 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 governor drive couplings, pins and keys associated with future service should also be less severe. Therefore the Owners Group recommended maintenance inspections for this component, outlined below, should be conducted during the first major engine overhaul to confirm the adequacy of the governor drive couplings, pins and keys.

(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 maintenance items are recommended to ensure reliability of this component:

- Inspect the Falk couplings at each refueling outage. This is to include:
  - (a) A visual inspection of the grid for cracks or wear.
  - (b) An inspection for correct key to keyway clearance.
  - (c) Replace the neoprene gap spacer.

There are no modification recommendations for this component.

It is recommended that the following Quality inspections be performed:

- Verify set screw and drive pins are locked in place in accordance with installation instructions, on all station engines.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-411B-1

TASK DESCRIPTION (continued)

- Verify that the couplings employ an improved shot-peened grid, which can be identified by the Falk blue color coded grid.

In order to ensure appropriate selection of replacement grids, new grids should be inspected to verify blue color code prior to installation in the coupling. This new color code indicates the improved shot-peened grid.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

---

DOCUMENTATION REQUIRED

Not required

---

GROUP CHAIRPERSON K.I. Fitzpatrick

PROGRAM MANAGER J.C. Kammerer

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

COMPONENT <u>Governor Linkage</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-413A</u>	TASK DESCRIPTION NO. <u>DR-09-02-413A-0</u>
SNPS GPL NO. <u>03-413</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

A design review of the governor linkage is not necessary for San Onofre. Review of the governor linkage for both lead engines has indicated no inherent design flaws that cannot be addressed by appropriate maintenance procedures. Extensible link spring stresses were found to be substantial at Comanche Peak. Since the extensible link spring is identical for both Comanche Peak and San Onofre, and since the linkage controls four more injector pumps, a check of the assembly preload is recommended at the next refueling outage. Other typical concerns involve corrosion of the extensible link and integrity of the mechanical fasteners. Corrosion has not been a problem for engines in nuclear service. But because of the proximity of San Onofre to the ocean, monthly visual inspection for corrosion is recommended. Verification of the integrity of the mechanical fasteners should also be addressed. The following maintenance procedures are recommended:

- Monthly inspections for loose parts should be performed, and future tightening of this hardware should include the addition of lockwire to the lever arm clamp bolts and shaft roll pins.
- The cross shaft oilite bearing cups should be oiled monthly.
- The rod end fittings, especially those at the ends of the cross shaft, should be greased at least at every outage.
- As a San Onofre site specific recommendation, monthly visual inspections for corrosion of the extensible link should be performed. At least once per year the action of the extensible link should be observed during the actuation of the shut-down cylinder to ensure that link extends freely. Minor amounts of corrosion that do not inhibit link motion are acceptable.

The following Quality Inspection is recommended:

- Inspect linkage for signs of corrosion and/or wear.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-413A-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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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.

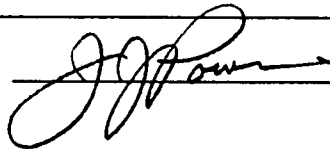
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DOCUMENTATION REQUIRED

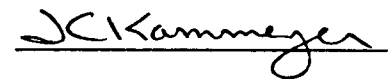
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Governor Assembly: COMPONENT <u>Woodward Governor</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-415A</u>	TASK DESCRIPTION NO. <u>DR-09-02-415A-1</u>
SNPS GPL NO. <u>03-415A</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTIONS

Design Review is not required for this component, based on the lead engine DR/QR report for Comanche Peak, which establishes the acceptability of the Woodward governor.

A review of the EDG Component Tracking System indicates no significant applicable industry experience.

The TDI suggested maintenance schedules, outlined in their instruction manual, should be carefully followed, including daily checks of the oil level, governor setting, and mechanical connections, and annual replacement of the hydraulic oil.

In addition the following maintenance recommendations should be implemented to improve component reliability:

- Modify the surveillance testing procedures to include an evaluation of the governor settings by means of the two tests given below:
  - a) Perform a test of the governor settings while under joint electrical and mechanical governor control, with the diesel generator off the grid in the isochronous mode;
  - b) Perform a test of the governor settings while under mechanical (only) governor control, with the diesel generator off the grid in the isochronous mode.

These test shall include examination of the engine speed transients during start and transient loading conditions. Included as part of the above tests, is the verification that the engine set speed of 450 rpm is not exceeded by more than 11.2 percent (500 rpm max.) either during an engine start or during the largest single load reduction.

- Augment the setting adjustment procedures, as described in the Woodward manuals to include tests of the governor response during an engine start to ensure agreement with the specifications indicated above.
- Modify the maintenance schedules to ensure that the hydraulic actuator is vented per the Woodward Instructions when more than a half quart of oil is added to the unit.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-415A-1

TASK DESCRIPTION (continued)

- Modify the cleanness control specification to ensure that appropriate procedures are followed when adding or changing the governor oil so as not to contaminate fresh oil and the interior of the governor.

There are no modification recommendations for this component.

The following Quality inspection is recommended to be performed:

- Review site instructions to ensure sufficient detail and clarity exists in order to properly set the governor.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

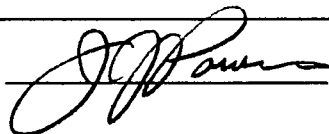
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DOCUMENTATION REQUIRED

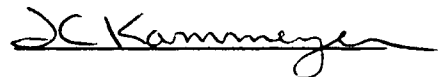
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





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

COMPONENT <u>Governor Assembly</u> <u>Booster Servomotor</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-415B</u>	TASK DESCRIPTION NO. <u>DR-09-02-415B-0</u>
SNPS GPL NO. <u>03-415B</u>	CLASSIFICATION TYPE <u>B</u>

---

TASK DESCRIPTIONS

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

There are no maintenance or modification recommendations for this component.

The following Quality inspections are recommended to be performed on all engines:

- Booster servomotor should be mounted on the engine at a lower level than the governor to prevent air infiltration into the booster oil lines;
- The inlet and outlet lines for the booster should be 3/8 inch and 1/4 inch tubing, respectively;
- Oil lines should slope upward from the booster to the governor and should have a minimum number of loops or bends.

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-415B-0

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

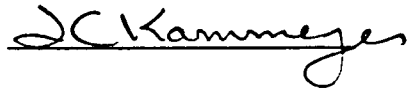
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

ENGINE SHUTDOWN EQUIPMENT - TUBING/FITTINGS & SUPPORTS  
(SMALL BORE SCOPE ONLY)  
COMPONENT PART NO. 02-695A

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 engine shutdown equipment - tubing/fittings and supports to withstand the effects of normal operating and earthquake loadings. The primary function is to maintain the capability to effect engine shutdown.

II OBJECTIVE

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

III METHODOLOGY

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

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the 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 engine internal tubing and supports, high temperature bearing trip, as defined by this Component Review, have been found to be acceptable based upon the results obtained from the review of the comparable components on the DSR-48 engines at Shoreham, and by the fact that a review of all nuclear and non-nuclear industry experiences indicates that there are no design problems that affect the structural integrity of this component.

In addition, it should be noted that because of spatial restrictions all sections of unsupported tubing will meet acceptable span lengths.

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

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 tubing and 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 be implemented as detailed in Reference 3.

It is recommended that two-way supports be added to the following lines such that the between support spans are limited to a maximum of 3 feet 6 inches for 1/4-inch tubing. Locations of supports should accommodate thermal expansion by providing a minimum of 6 inch tubing offset around elbows.

High Temperature Jacket Water (E16)

Add two-direction supports on tubing between the bulkhead and the temperature sensor as required to meet maximum span requirements on both engines. On engine 2, modify the existing spacer below the jacket water standpipe return line to a two-direction support. Note that this support must also support the air-bleed system tubing.

Overspeed Air to Combustion Air Throttle Valves (E20)

Add a two-direction support between the air cylinder and the first support on the engine block to meet the maximum span requirements, typical for 4 lines on both engines.

Vibration Sensors, Front and Rear Turbos and Engine (E23H, E24)

Add three-direction supports within 12 inches of instrument connections to minimize operating vibrations at instrument connections on both engines.

Intake Manifold Air Pressure (E28, E59)

Add a two-direction support between the combustion air manifold and the first support on the engine block to meet maximum span requirements, typical for 4 lines on both engines.

Starting Air Pressure (E31)

Add a two-direction support between the air start header and the first support on the engine block to meet maximum span requirements, typical for each line on both engines.

Turbocharger Oil Pressure Rear Turbochargers (E33R, E34R)

Add a three-direction support within 12 inches of each pressure sensor to minimize operating vibrations at the connections. Add two-direction supports as required to meet maximum span restrictions. Note that no supports exist on this tubing on Engine 2 and that this tubing on Engine 1 is severely crimped and distorted and should be replaced.

General

Instrument tubing routed along the face of the governor end of both engines is not attached to the structure. Two-direction supports mounted to the engine casing should be provided within maximum span intervals. Multi-tube supports should be designed such that each tube is isolated by spacers and protected from becoming disengaged by the use of cover plates.

Tubing runs adjacent to both right and left bank crankcase access covers are insufficiently supported. The condition begins at the interface bulkhead for off-engine tubing and continues throughout each tubing run. This is a result of existing supports being damaged, missing components such as bolts, screws, cover plates and spacers, or not being attached to a rigid support base. It is recommended that all supports be repaired or reworked.

The interface bulkhead between engine and off engine tubing should be reinforced or redesigned to increase vertical load capacity. (Note: Engine 2 bulkhead is missing attachment bolt to engine).

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

Engine Shutdown Equipment  
Tubing/Fittings  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-695A TASK DESCRIPTION NO. DR-09-02-695A-1  
SNPS GPL NO. 03-695A CLASSIFICATION TYPE B

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TASK DESCRIPTIONS

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

---

PRIMARY FUNCTION

Maintain capability to effect engine shutdown.

---

ATTRIBUTE TO BE VERIFIED

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

---

SPECIFIED STANDARDS

IEEE 387  
ANSI B31.1 (1973)

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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.

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COMPONENT DESIGN REVIEW CHECKLIST


Page A2 of 2  
DR-09-02-695A-1

DOCUMENTATION REQUIRED

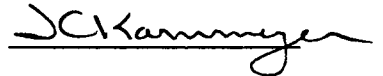
Delaval design documentation (specifications, calculations, drawings, etc.).  
In lieu of information from Delaval, the following information is required:  
verified support sketches and piping isometrics, material specifications, pipe  
size and schedule, and operating parameters (pressure, temperature,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

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

Engine Shutdown Equipment:		Southern California Edison
COMPONENT <u>Tubing and Fittings</u>	UTILITY	<u>San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-695A</u>	REV. NO. <u>2</u>	
SNPS GPL NO. <u>03-695B</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

---

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 tubing and fitting if available from the Owner.

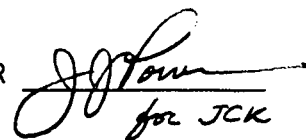
Engine 2

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.

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

Nector A. Paleta

PROGRAM MANAGER

J. J. [Signature]  
for JCK

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

COMPONENT NO. 02-695A

Effective Printout Date: 09/17/84

COMPONENT TYPE: Engine Shutdown Equipment - Tubing/Fittings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Diesel tripped because of high jacket water temperature caused by low lube oil level. Engine ran successfully after oil was added.	North Anna 2 LER 339-83054 830704	Shutdown system worked properly. Does not affect component design or integrity.
Instrument line to cooling jacket water line was leaking. Cause found to be a crack in 1/4" nipple.	Palisades LER 255-77000 770211	This is an isolated event and has not occurred at San Onofre. Does not affect component design or integrity.
Air leak found on pressure gauge sensing line. Fittings were tightened and diesel operated properly.	Zion 2 LER 304-75000 750507	This failure probably resulted from improper tightening of fittings during installation and has not occurred at San Onofre. Does not affect component design or integrity.
Engine tripped because of air leak on line to fuel shut-off pistons.	Zion 1 LER 295-80028 800524	This event probably resulted from improper tightening of fittings during installation and has not occurred at San Onofre. Does not affect component design or integrity.

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

Diesel tripped because of a leak in a line to the master shutdown cylinder. Pipe nipple was replaced.

Zion 2  
LER 304-77000

This probably resulted from inadequately supported piping. The design report for this component concludes that the San Onofre lines are adequately supported.

Engine failed to start because of clogged orifice in air relay system.

Monticello  
NPRDS 770411

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

Diesel tripped because of split pipe nipple in control air system. Pipe nipple replaced.

Zion 2  
LER 304-770691-1

Pipe nipples used at San Onofre are schedule 80, which should preclude this experience.

NON-NUCLEAR

None

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

Engine Shutdown Equipment -  
 COMPONENT Valves, Regulators, Orifices UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-695B TASK DESCRIPTION NO.: DR-09-02-695B-0  
 SNPS GPL NO. 03-695B CLASSIFICATION TYPE A

---

TASK DESCRIPTION

The engine shutdown equipment valves, regulators, and orifices used on San Onofre are identical to Comanche Peak, with regard to manufacturer and application. In addition, the configuration of this equipment on San Onofre in the pneumatic shutdown system to trip on engine overspeed and to propagate the shutdown signal is also identical to Comanche Peak.

There is no non-nuclear industry experience listed in the EDG Component Tracking System for this component. The nuclear industry experience listed does not show any significant problems applicable to San Onofre design.

To minimize fouling of the engine shutdown equipment valves, regulators and orifices, it is recommended that the equipment be inspected and cleaned and the elastomeric parts be replaced during each refueling outage. This recommended maintenance interval should be reassessed depending on the degree of system fouling.

There are no recommended modifications for the engine shutdown equipment valves, regulators and orifices.

Quality revalidation for this component is not deemed necessary.

Based on the above, a design review for the engine shutdown equipment - valves, regulators and orifices is not required for San Onofre.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-695B-0

REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON

J. J. Pauer

PROGRAM MANAGER

J. Kammerer

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

COMPONENT Engine Shutdown Trip SwitchesUTILITY Southern California EdisonGROUP PARTS LIST NO. 02-695CTASK DESCRIPTION NO. DR-09-02-695C-0SNPS GPL NO. 03-695CCLASSIFICATION TYPE ATASK DESCRIPTIONS

The engine shutdown trip switches used on San Onofre are identical to those used on Comanche Peak in regard to switch manufacturer and application. There are, however, a larger number of pressure, vibration and temperature switches on San Onofre to sense turbo oil pressure, front and rear turbo vibration and bearing temperature. The operation of these switches and the resulting engine shutdown is identical to Comanche Peak.

The applicable nuclear and non-nuclear industry experiences listed in the EDG Component Tracking System do not indicate any generic or significant problems with the trip switches.

There are no maintenance or modification recommendations required for the engine shutdown trip switches.

A Quality Revalidation for the engine shutdown trip switches is not deemed necessary.

Based on the above, a design review for the engine shutdown trip switches 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-09-02-695C-0

REFERENCES

Not required

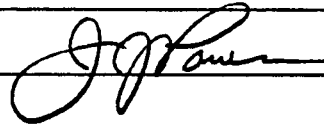
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DOCUMENTATION REQUIRED

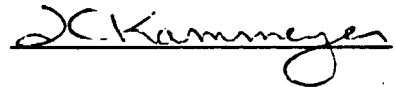
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





**TDI DIESEL GENERATOR**

**DESIGN REVIEW  
AND  
QUALITY REVALIDATION  
REPORT**

**Prepared For**

**SOUTHERN CALIFORNIA EDISON**

**SAN ONOFRE NUCLEAR GENERATING STATION**

**By**

**TDI DIESEL GENERATOR OWNERS GROUP**

**VOLUME 2**

## How To Use This Report

Tabs in this report identify the following categories:

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

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

Within each category tabs identify 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, Intrlr. & 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, Intrlr. & 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 As- sembly & 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 Injection	4
02-450B	Fuel Oil Header: Piping/Tubing	Fuel Oil Injection	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 Instu- 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 Instu- 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

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBOCHARGER  
COMPONENT PART NO. MM19/20

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 turbocharger to ensure the adequacy of the component design. Each diesel engine at San Onofre is equipped with four turbochargers manufactured by Elliott Co. with model number BCO-65G and TDI part number MM19/20. The primary function of the turbocharger is to utilize engine exhaust gas energy to pressurize engine intake manifold air.

II OBJECTIVE

The objective of this review was to evaluate the adequacy of the Elliott turbochargers for their intended service at San Onofre; specifically, to verify sufficient lubrication, proper bearing loading, and adequate rotor dynamics.

III METHODOLOGY

The TDI Emergency Diesel Generator Component Tracking System was reviewed for the experience of the San Onofre site, which has experienced only thrust bearing failures. Nuclear, and non-nuclear industry experience with Elliott 65G turbochargers was also reviewed for potential problems and showed no evidence of problems applicable to San Onofre.

Nuclear stations with Delaval engines, utilizing Elliott turbochargers, were surveyed for any problems similar to those experienced at San Onofre. A correlation between the failures and the type of lubrication systems was established.

San Onofre's pre-operational test logs and TDI factory test logs were reviewed to verify adequate turbocharger performance and to determine gas loading of rotating and non-rotating components. Preventive maintenance and surveillance requirements were reviewed along with specific assembly procedures to verify that all critical turbocharger attributes are properly monitored and maintained.

The thrust bearing axial loads were calculated by summing all the aerodynamic loads imposed by the turbine and the blower operation. The bearing axial loads were in turn combined with a bearing performance analysis to assess the adequacy of the lubrication system for startup, normal operation and testing. The method for cooling of lubrication oil and turbine housing was evaluated.

Material of turbocharger components was reviewed for suitability of service.

A rotor dynamic analysis was performed to determine rotor dynamic modes and the absence of rotor instabilities.

Quality Revalidation Checklist results were reviewed for acceptability.

#### IV RESULTS AND CONCLUSIONS

Based on document reviews and analyses conducted to date (Ref. 1), it is concluded that the Elliott model 65G turbocharger thrust bearings are adequate for nuclear standby service, including pre-operational testing and up to 40 automatic fast starts. To ensure adequate service, the following recommendations are made:

- The auxiliary lube oil pump flow should be initiated prior to engine starting and stopped when full oil pressure is obtained. Additionally, full flow lubrication can be used through roll down.
- The TDI recommended drip lubrication system should be retained for minimizing thrust bearing wear associated with automatic fast starts. The quantity of oil passing through the turbocharger should be at least 0.1 gph.
- For improved confidence in the reliability of the turbocharger, inspections of surfaces of a thrust bearing in a turbocharger for signs of excessive wear should be performed following 100 engine starts from the last satisfactory inspection or at the next refueling outage to verify the adequacy of the prelube system. In addition, the rotor axial clearance should be routinely checked in accordance with the TDI Instruction Manual.
- Since the nuclear standby diesel generator sets may undergo automatic fast starts not associated with pre-operation of the auxiliary lube oil pump, the turbocharger thrust bearings of any San Onofre engine should be inspected for excessive wear and, if necessary, replaced after experiencing no more than 40 such starts from the last satisfactory inspection. This recommendation is applicable to all thrust bearings installed.



- Review of the preventive maintenance program and current TDI recommendations for turbocharger rotor axial clearances has been performed. These procedures will determine whether the clearance is within TDI/Elliott specifications. In addition, since trends of increasing clearance could signify thrust bearing degradation, (even if the total displacement is within specification), any such trends should be reviewed.
- Spectrochemical engine oil analysis should be incorporated into the TDI Instruction Manual. In addition, to further expand the preventive monitoring of the turbocharger thrust bearing, ferrographic engine oil analysis may be performed (Ref. 1). Particular attention should be paid to copper level and particulate size, which could signify thrust bearing degradation.
- There has been a reported case in the non-nuclear industry where core plugs inside the turbocharger nozzle ring hubs backed out and caused damage. To eliminate the possibility of this happening at San Onofre, it is recommended that at the next turbocharger overhaul, but no later than the fourth refueling outage for any turbocharger, the nozzle ring core plugs be staked to prevent any movement.

The thrust bearing axial loads were evaluated across the diesel operating range including startup and rundown. The bearings were found to be adequate for all predicted loading conditions, with proper lubrication. | 1

The dynamic analysis of the turbocharger rotor determined that the turbocharger has no criticals in its operating range and five heavily damped criticals during startup. Because of the rapid turbocharger acceleration during startup, these criticals will not be excited. Very good dynamic stability of the unit has been shown to exist in the operating range, as well as during startup.

The oil filtration maintenance program has been reviewed and found to be in compliance with Elliott 10 micron filter recommendations.

The information provided in TER 09-004 has been reviewed and is consistent with the final conclusions of this report.

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 Elliott 65G turbocharger is acceptable for its intended use at San Onofre, provided the prelubrication procedures are followed.

#### V REFERENCES

1. Design Review of Elliott Model 65G Turbocharger used on Transamerica Delaval DSRV-12-4 and DSRV-20-4 Emergency Diesel Generator Sets. FaAA Report No. 84-6-56.

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

COMPONENT Turbocharger

UTILITY Southern California Edison

GROUP PARTS LIST NO. MM-19/20

TASK DESCRIPTION NO: DR-09-MM-19/20-0

SNPS GPL NO. MP-017

CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Review Elliott 65G history pre-operational test logs, performance data for gas loading of rotating component, material selection, bearing lubrication, bearing and seal clearance and assembly procedure.

Evaluate bearing loads, rotor deflection and instability, auxiliary lube pump configuration and maintenance.

Review adequacy of site lubrication systems and maintenance procedures.

Review impact of startup and test procedures on bearing lubrication.

Review information provided on TERs.

PRIMARY FUNCTION

Utilize engine exhaust gas energy to pressurize engine intake manifold air.

ATTRIBUTE TO BE VERIFIED

Proper bearing loading, and adequate rotor dynamics. Sufficient bearing lubrication.

SPECIFIED STANDARDS

Not applicable.

REFERENCES

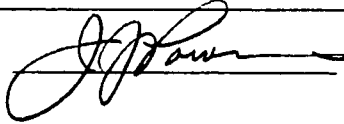
Not applicable.

DOCUMENTATION REQUIRED

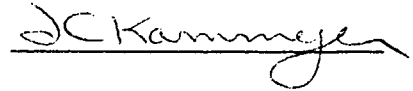
Manufacturer's bulletins, drawings and schematics, material specifications, performance data, inspection results, lube and cooling specifications, engine exhaust data, vibration data.

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Turbocharger</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>MM-19/20</u>	REV. NO. <u>3</u>
SNPS GPL NO. <u>MP-017</u>	

---

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a visual inspection on the bearings for signs of scoring or pitting.
3. Determine the end clearances (Rotor Float).
4. Verify that the proper number of bolts on the turbine inlet casing are installed.
5. Verify that the proper torque loads are applied to the bolts of the turbine inlet casing.
6. Perform a Liquid Penetrant test on the stationary nozzle ring for signs of adverse wear and cracking.
7. Verify that SIM 300 was implemented and perform a Liquid Penetrant test on the welds retaining the nut. In addition, verify that the nut is staked.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package

ATTRIBUTES TO BE VERIFIED (continued)

Engine 1 (continued)

2. Surface integrity of the bearings
3. End clearances are in accordance with Elliot's recommendation.
4. Proper number of bolts on the turbine inlet casing
5. Proper torque loads are applied.
6. Lack of adverse wear and cracking on the stationary nozzle ring
7. Hub nut is tack welded, surface integrity of the tack weld and nut is staked

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. No scoring or pitting on bearings
3. End clearances are in compliance with Elliot's Instruction Manual
4. Number of bolts are in compliance with Elliot's Instruction Manual.
5. Proper bolt torques were applied in accordance with the TDI Instruction Manual.
- 6-7. Review of inspection report by the Design Group

Engine 2

Same as Engine 1

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COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 4  
09-MM-19/20

REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures
3. Table of Clearances, Section 6 of the Elliot's Instruction Manual (Rotor Float)
- 4-6. Approved Site NDE Procedures, Elliot's Instruction Manual, TDI Instruction Manual
7. Approved site NDE Procedures, TER# 99-024

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*Steve N. Schwartz*

PROGRAM MANAGER

*J. Kammerer*

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COMPONENT REVIEW

Engine 1

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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B4 of 4  
09-MM-19/20

COMPONENT REVIEW (continued)

Engine 2

1. No EDGCTS site experience documents have been received from the Owner
2. No inspection report has been received which fulfills this requirement.
3. The rotor end play was determined for all four turbochargers and found satisfactory. This was reported by TER# 09-004.
- 4-7. No inspection reports have been received which fulfill these requirements.

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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

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GROUP CHAIRPERSON Nrita A. Saleto

PROGRAM MANAGER J. Kammerer

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

COMPONENT NO. MM19/20

Effective Printout Dates:  
San Onofre: 10/10/84  
Industry: 10/15/84

COMPONENT TYPE: Turbocharger

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Loud noise in vicinity of erator immediately shut down. Turbocharger replaced and defective unit sent to EMD for inspection and repair.	LER; SURRY 1 280-79044, 791230	Not applicable; different turbocharger (EMD).
During operation, excessive noise and vibration were observed. Diesel generator shutdown. Investigation revealed scavenging air blower was causing problem. Air blower replaced.	LER; HATCH 2 366-801-46,	Gear driven supercharger not applicable to San Onofre.
Diesel engine's turbo-charger failed, resulting in fire within engine exhaust system.	LER: MAINE YANKEE 309-79026-1, 791016	Not applicable; different turbocharger (EMD).
Diesel generator tripped caused by failure of turbo-charger clutch and shaft bearing. Excessive operation of diesel at low leads is probable cause of failure.	LER: DRESDEN 2 237-77051, 771030 EPRI; EPRI-NP-2433, 6/82	Not applicable; different turbocharger (EMD).
Diesel generator tripped due to malfunction turbo-charger clutch.	LER; FITZPATRICK 333-74000, 741018	Not applicable; different turbocharger (EMD).



<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Diesel generator failed to meet starting time requirements caused by failure of the diesel turbo boost system due to improper wiring on one air supply solenoid.	LER; SALEM 2 311-81050, 810625	Not applicable; different turbocharger (ALCO).
During diesel generator operation, an exhaust leak was identified on expansion joint on turbocharger exhaust. Expansion joint was replaced.	LER; COOK 2 316-83012, 830126	Not applicable; different turbocharger (BBC).
During test, diesel generator leaked ethylene glycol from cast steel inlet casing of the turbocharger. Cause was found to be incomplete fusion of weld at a plug in casting.	LER; PILGRIM 1 293-73000, 730822 EPRI; EPRI-NP-2433, 6/82	Not applicable; different turbocharger (ALCO).
Diesel generator failed to accept loads greater than 50%. Cause was seized turbo-charger.	LER; Zion 2 304-83007, 830131	Not applicable; different turbocharger (Cooper - Bessemer).
Defective turbochargers discovered on diesel generators. Turbochargers removed and returned to EMD to determine cause of defects.	LER; Zimmer 358-78000, 781220	Not applicable; different turbocharger (EMD).
During diesel generator operation, unit tripped. Investigation revealed turbo-charger shaft and oil seal had been damaged.	LER; St. Lucie 335-77000, 770118 EPRI; EPRI-NP-2433, 6/82	Not applicable; different turbocharger (EMD).
Diesel generator tripped because of turbocharger seizing, causing loss of combustion air to diesel.	LER; Quad Cities 2-265-73000, 730520	Not applicable; different turbocharger (EMD).
Turbocharger failed during diesel generator operation. Cause undetermined. However, in the week prior to failure, there were approximately 60 engine starts and a great deal of light loading. S02356/2	LER; St. Lucie 1 335-81047, 811010	Not applicable; different turbocharger (EMD).

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Excessive smoke from turbocharger exhaust flange because of loose exhaust flange bolts and broken exhaust flange gasket.	LER; Arkansas Nuclear 1 313-80031, 800827	Not applicable; different turbocharger (EMD).
Engine speed and load insufficient to disengage mechanical drive of turbo-blower.	LER; Surry 1 280-75000, 750430 EPRI; EPRI-NP-2433, 6/82	Not applicable; different turbocharger (EMD).
Excessive exhaust manifold temperatures and fire exiting exhaust due to fuel accumulation in diesel exhaust manifold caused by air leak on turbocharger discharge.	LER; Crystal River 3 302-79069, 790724	Not applicable to San Onofre. Diesel engine (Fairbanks-Morse) has different configuration and uses gear driven supercharger in addition to turbocharger. Air leak improperly diagnosed; fire caused by lube oil accumulation in diesel exhaust manifold due to improper securing procedures.
Fire inside turbocharger due to failure of bearing between air inlet blading and exhaust turbine blading.	LER; Arkansas Nuclear 1 313-78008, 780320 NPRDS; Hit 117, 271	Not applicable; different turbocharger (EMD).
Diesel generator failed to start because of turbocharger failure. Turbocharger sent to manufacturer for evaluation.	LER; Arkansas Nuclear 1 313-82005, 820227	Not applicable; different turbocharger (EMD).
Turbocharger and exhaust gas expansion joint failed. Cause determined to be turbine blade failure. Modification made to turbine unit to improve blade reliability. Design change being investigated for remaining turbochargers.	LER; Salem 1, 272-77080-1, 771202 EPRI; EPRI-NP-2433, 6/82 NPRDS, Hit 18, 84	Not applicable; different turbocharger (ALCO).

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

During loss of power test for Unit 3, E-2 diesel generator failed to attain rated speed and voltage. The scavenging air blower seized causing damage to blower drive gears. Cleaned air intake passage, installed new filters and replaced defective blower and drive gears. Small weld beads entered blower and caused it to seize.

LER; Peach Bottom 2  
277-74000,  
740615  
EPRI; EPRI-NP-2433,  
6/82

Gear driven supercharger.  
Not applicable to  
San Onofre.

Final report during pre-operational test, diesel generator D-Z blower failed because of ingestion of foreign material too large to pass through blower lobe clearances. Blower bound up and overheated.

LER; Prairie  
Island 1,  
282-73000,  
730130  
EPRI; EPRI-NP-2433,  
6/82

Gear driven supercharger  
Not applicable to San Onofre.

During surveillance, "B" diesel generator start time was 11 seconds instead of the required 10. The turbo assist valves malfunctioned. The valves were cleaned and returned to service. ASCO solenoid operated, explosion proof nema type, cat. no. LBX-8210-B-83.

LER; Pilgrim 1  
293-75000,  
751217  
EPRI; EPRI-NP-2433,  
6/82  
NPRDS; Hit 6.

Not applicable; different  
turbocharger (ALCO).

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

When the diesel generators have operated long enough for the lube oil to reach operating temperature, then shut down and then re-started between 15 minutes and 3 hours later, damage could occur to the diesel engine turbocharger thrust bearing. Operating instructions have been changed so that the engines will not be run between 15 minutes and three hours after a shutdown. The turbochargers have been inspected and no damage has been found. EMD is developing a lube oil system which will preclude the test result.

LER: Sequoyah 1,  
327-79000-1,  
790621

Not applicable; different turbocharger (EMD).

While performing switching for a loss of power test, the E-4 diesel generator failed to start. Investigation revealed cooling water from the turbocharger had leaked into the exhaust and intake manifolds preventing proper starting. The turbocharger gaskets failed because the cooling water outlet valve had been left closed from a previous repair. The turbocharger and various engine parts were replaced, the diesel satisfactorily tested and returned to service. The valves were added to the test checkoff list and controls added for turbocharger water detection.

LER; Peach  
Bottom 2  
277-81026,  
810921  
NPRDS; Hit 186

Operator error. Cooling water to turbocharger was cut off warping turbocharger casing. When water was restored, water was able to leak into the turbocharger and diesel. San Onofre diesels have no shutoff valves (i.e. water cannot be shut off).

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
E-3 diesel start time to voltage and reach rated voltage and frequency did not meet surveillance test requirement. The most probable cause was a leaking check valve in the hydraulic system associated with the air booster relay (Fairbanks-Morse Part No. 16-105-974). A new air booster relay was installed. The diesel tested satisfactorily (7.4 sec). The defective air booster relay will be analyzed by manufacturer to determine cause of failure.	LER; Peach Bottom 2 277-78035 780830 NPRDS; Hit 184 EPRI; EPRI-NP-2433 06/82	Not applicable; San Onofre has no air booster relay.
During surveillance test, DG-1A was started and successfully loaded to carry full emergency load. During loading to full design load, smoke began issuing from the 1A2 diesel turbocharger. The diesel was immediately stopped. The damaged unit was analyzed by the vendor to determine the exact cause of failure.	EPRI, St. Lucie 1, 092677, DG1A	Not applicable; different turbocharger (EMD).
During PT, the DG would not load over 2000 kW. Turbocharger seized, reducing capacity.	NPRDS; Zion 1, 830131, Hit 62	Not applicable; different turbocharger (Cooper-Bessemer).
Internal oil fire in turbocharger of DG1-2 caused it to overheat after 23 hrs. Oil was coming through lower casing joint on turbo causing a fire internally.	NPRDS; Davis Besse 1, 800923, Hit 33	Not applicable; different turbocharger (EMD).
Removed turbocharger to check for damage made by loose bolt fragment found in crankcase. Sheared off 5/8-inch bolt found.	NPRDS; Davis Besse 1, 800904, Hit 23	Not applicable; different turbocharger (EMD).

EXPERIENCEREFERENCE DOCUMENTSSAN ONOFRE STATUS

Turbocharger removed from DG1-1 because of noise; installed new turbocharger.

NPRDS; Davis Besse 1, 810414, Hit 25

Not applicable; different turbocharger (EMD).

Over a period of time, diesel subject to broken stay rods and cracked base metal in intercooler, cracked welds on turbocharger jacket water pipe, metal on air header flange. Problems possibly due to faulty turbocharger causing excessive vibration, even though there is no indication of high vibrations from vibration sensors.

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

Problem resulted from turbocharger misalignment. San Onofre has implemented procedures to prevent misalignment.

Oil leak under air inlet to turbocharger. Cause-defective turbocharger.

NPRDS; Arkansas Nuclear 1, 780715, Hit 118

Not applicable; different turbocharger (EMD).

Two turbochargers were replaced because of broken stationary nozzle ring vanes on TDI 8 cylinder engines at Kuosheng, Taiwan.

TELEX from PEI to LILCO 11/28/83

Not applicable (different turbocharger, Elliot 90G); San Onofre has no history of vane or capscrew failures.

Operators noted that after 15 minutes of operation the output power became erratic and exhaust temperatures were indicating high. Cause-turbocharger came in contact with the turbine, severely damaging both.

NPRDS; Peach Bottom 2, 830907, Hit 180

Not applicable; different model turbocharger (Elliott H-54) and two stroke engine.

During test, DG 1-1 was making unusual noises. DG 1-1 was declared inoperable at 1245 hours. Turbocharger was replaced and DG 1-1 declared operable from 121078 at 1420 hours. DG 1-2 and AC-off available at all times.

NPRDS: Hit 22, Hit 89 EPRI; Davis Besse, 020878, DG 1-1

Not applicable; different turbocharger (EMD).

EXPERIENCEREFERENCE DOCUMENTSSAN ONOFRE STATUS

Calvert Cliffs-4/7/83- during a routine inspection of intake air check valve on DG, a sheared check valve holding pin was found and the check valve was loose. Similar cracks on other diesel check valves were discovered in 1982. Check valve diverts air between turbocharger and internal air blower. Internal baffles between check valves and turbocharger made it unlikely to have piece of check valve enter turbocharger. Fairbanks-Morse Model 38TD81/8.

I&amp;E; Notice 83-51

Not applicable; San Onofre has no check valve or air blower (supercharger).

GM identified potential failure mode of turbochargers used on EMD diesels. PBS occurs if engine receives a repeat rapid start within a minimum of 15 minutes and maximum of 3 hours after a shutdown, from a previous run in which engine reached full operating temperature. This causes lack of prime lube oil in system which may result in engine damage.

I&amp;E; Circular 79-12, 6-28-79

Not applicable; different turbocharger (EMD).

Weld core plugs to turbocharger casing and increase number of bolts.

TDI; SIM 300

Plugs to be staked to casing rather than welded at next available overhaul.

Info-procedure for turbo-charger bearing replacement.

TDI; SIM 269

SIM 269 incorporated in San Onofre maintenance procedures.

EXPERIENCE

Two nozzle vanes at the four o'clock position were broken. Nozzle ring was damaged beyond repair. Possibly caused by uneven expansion of material at high exhaust temperatures or by material manufacturing defects.

A turbocharger to inter-cooler adaptor cracked at the flange weld. Caused by a misalignment between the two components.

Two cylinder injectors and a water jacket relief developed leaks on No. 12 diesel generator. The injectors were replaced. The relief was reinstalled with new O-ring. During this corrective maintenance, 8 air blower discharge flange bolts were discovered broken. All 14 bolts and their inserts were replaced. (Added 08/30/84) Manufacturer: Fairbanks-Morse.

NON-NUCLEAR

These units have been removed, repaired and re-installed or renewed a total of 16 times for reasons including leaking oil seals, vibration, abnormal noise, accumulation of foreign matter, rotor damage and a defective bearing seal housing. (M/V Columbia).

REFERENCE DOCUMENTS

Kuosheng 2; service report on Div. II standby D/G turbo-charger of No. 2 TDI generator TPL nuclear plant No. 2, 06/03/83 (File No. T-45)

Catawba - Report "Extended Operation Tests and Inspections of Diesel Generators," 040/5/84 p. 7-3 (File No. T-53)

Calvert Cliffs 1,317-81078-1, 811008

Hunton & Williams (12/29/83) to C. Seaman Letter-W. R. Hudson to D. H. Martini 12/14/76

SAN ONOFRE STATUS

Not applicable (different turbo-charger, Elliot 90G); San Onofre has no history of vane or capscrew failures.

Misalignment problem. Procedures have been implemented to prevent future misalignment.

Not applicable; San Onofre has no air blower.

Vibration testing, inspections for foreign matter and rotor damage, coupled with maintenance procedures are part of the DR/QR program.



<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
A hot side bearing and seals on one turbocharger replaced due to excessive wear. (M/V Columbia).	Hunton & Williams (12/29/83) to C. Seaman Letter - M. E. Zbinden to W. Hudson-02/02/79 Letter - M. E. Zbinden to D. Martini - 03/19/79	Not applicable; M/V Columbia diesels run continuously. The turbocharger had approximately 7000 hours when the thrust bearing was at its maximum allowable limit (not wiped).
Action taken since vessel delivery: modified turbocharger nozzle ring design and bolting configuration; no turbocharger damage since. Changed original turbo with defective bearing support housing; no problems since. Added external turbo air seal system; no problems since. (M/V Columbia).	Hunton & Williams 12/29/83 to C. Seaman Letter to TDI D. Martini-03/24/80 from M. Zbinden (State of Alaska)	Modification to nozzle ring not applicable to the 65G turbochargers used at San Onofre.
Turbochargers have operated in excess of 4000 hours without nozzle ring breaking since revising nozzle ring bolting configuration. Also, no abnormal buildup of deposits or oil seal leakage. (M/V Columbia)	Hunton & Williams 12/29/83 to C. Seaman Letter from M. Zbinden to D. McDavidson-07/25/80	Modification to nozzle ring not applicable to the 65G turbochargers used at San Onofre.
A volute section of one turbocharger was found cracked and was replaced using a spare. (M/V Columbia).	Hunton & Williams 12/29/83 to C. Seaman Memo from M. Zbinden to R. Ward 03/13/81	Isolated incident; does not affect San Onofre.
TDI suggests replacing Elliott turbos with Delaval C-17'S. (M/V Columbia)	Hunton & Williams 12/29/83 to C. Seaman Memo from S. Schumacher to R. Pratt - 07/09/82, Pg. 2	Not applicable for fast start units.

EXPERIENCEREFERENCE DOCUMENTSSAN ONOFRE STATUS

Modifications made to turbos: change nozzle ring openings; did not correct deficient manifold air pressure.  
(M/V Columbia).

Hunton & Williams  
12/29/83 to  
C. Seaman  
Memo from M.  
Zbinden to R.  
Lind - 07/09/82,  
Pg. 2

Not applicable. There is no history of deficient manifold air pressure at San Onofre.

Turbos going into surge may be caused by improperly sized turbos in relation to the engine.  
(M/V Columbia).

SES Report No.  
123-01 dated  
April 1983,  
Pg. 2-23, 4-10

Not applicable; different application; engine runs continuously with variable loading. No history of this problem at San Onofre.

Turbochargers-leaking oil/air seals, bearings, nozzles, rotors/cracked casings.  
(M/V Columbia).

SES Report No.  
123-01 dated  
April 1983,  
Pg. 3-29

Previously addressed. San Onofre does not have defective bearing support housing. Volute cracking was isolated incident.

Design deficiency-if turbos fail, engine must be shut down. Other engines can run under normal aspirated conditions.  
(M/V Columbia).

SES Report No.  
123-01 dated  
April 1983,  
Pg. 4-8

Engines can operate at reduced power if turbo-charger fails.

Serious problems with turbocharger surging.  
(M/V Pride of Texas)

Interoffice memo  
of meeting  
minutes from  
R. Bazzini (TDI)  
to A. Barich,  
C. Winter &  
C. Mathers (TDI)  
date 11/10/83  
(File No. T-37)

Not applicable;  
different turbo-  
charger (Delaval).

Turbocharger seals leaking oil. (M/V Spirit of Texas)

Letter from J.  
McGlashan (Titan  
Navigation Inc.) to  
R. Pratt, T. Kemp  
(TDI) dated 08/16/83.  
(File NO. T-37)

Not applicable; different turbocharger (Delaval).

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Two turbos damaged from large pipe plugs falling into interference with rotating assembly. (11/18/77) Engine No. 19 (City of Homestead, Fla.)

Engine incidence report (Homestead, Fla.) dated 9/30/78 (File No. T-10)

San Onofre will stake plugs on next turbocharger overhaul.

Serious water leak on the cooling water out coupling on the turbocharger. (Qurayat Electric/Saudi Arabia)

Letter from K. Buzek (TDI) to Y. Al-Bassam (Electricity Corp) dated 01/14/79 (File No. T-49)

Not applicable, different turbocharger (BBC).

Turbocharger completely destroyed. Damage was caused by plant personnel overfilling the intake air filter with oil. This was complicated by the fact that the replacement oil was drawn into the suction of the turbocharger which consequently destroyed all the compressor blades, bent the shaft and cracked the casing. (Qurayat Electric/Saudi Arabia)

Letter from K. Buzek (TDI) to U. Al-Bassam (Electricity Corp) dated 01/14/79 (File No. T-49)

Not applicable; human error and also different turbocharger (BBC).

Coast Guard has been experiencing cracking problems with the sheet metal style nozzle rings in turbocharger. A new, superior, profile type nozzle ring is available. (M/V USCG Northwind).

Letter from R. E. Lane (USCG) to G. E. Trussell (TDI) dated 08/07/79

San Onofre has a profile type nozzle ring.

Turbocharger cracked. Failure due to misalignment of the exhaust stack. (M/V USCG Cutter Northwind)

Letter from R. Desrumeaux (TDI) to L. Munson (Holmes Brothers Enterprises Inc.) dated 01/06/80 (File No. T-2)

Not related to turbocharger design.

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

Turbocharger casing badly damaged by intense heat necessitating a replacement of casing. Cause was installation of 3/4 and 3/8 NPT socket head plugs in turbocharger during an overhaul.  
(M/V USCG Cutter Northwind)

Letter from C. L. Munson (Holmes Brothers Enterprises, Inc.) to Mr. Staub (TDI) dated 12/13/79  
(File No. T-2)

Not applicable; human error caused restriction in cooling.

Failure on blower side of turbocharger due to some pieces of the broken exhaust valve guide.  
(Hail/Saudi Arabia)

Failure report dated 06/17/84  
(File No. T-49)

Not applicable; different turbocharger (BBC).

Turbocharger feet broken by Delaval service representative.  
(Rafha/Saudi Arabia)

Telex from Schmitz (TDI) to R. Pratt (TDI) dated 10/30/82  
(File No. T-49)

Not applicable; different turbocharger (BBC).

Damaged turbocharger rotor and diaphragm - damaged by valve spring failure.  
(Rabigh Electric/Saudi Arabia)

Telex from Schmitz (TDI) to R. Pratt (TDI) dated 06/14/83  
(File No. T-29)

Not applicable; different turbocharger (BBC).

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

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

I INTRODUCTION

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

II OBJECTIVE

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

III METHODOLOGY

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

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the 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 tubing and support for this evaluation.

IV RESULTS AND CONCLUSIONS

The tubing and supports, as defined by this Component Design Review, have been evaluated in accordance with Reference 1 and have been found acceptable with 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 conclusion of this report.

Based on the above review and information contained in Reference 2, it is concluded that the tubing and 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:

- Engines 1 and 2:

Two-directional, lateral supports should be added to limit maximum span between supports to 4 feet - 6 inches. Locations of supports should allow for thermal expansion by providing a minimum of a 6-inch offset around bends. Span lengths should be reduced to 3 feet maximum for tubing attached to the turbos to control engine induced vibrations.

- Engine 1:

The riser support located on the engine side of the left generator end turbocharger should be redesigned to provide structural attachment in lieu of the U-bolt to the lube oil crossover line. The tube clamp should provide three-directional restraint.

The riser support located on the engine side of the left governor end turbocharger that is attached to the flange of the intake air header lacks sufficient stiffness to adequately control the tubing and provides minimal vertical support. Redesign to a three-directional restraint is advised.

- Engine 2:

All tubing located around the governor end turbochargers should be resupported utilizing support elements and locations similar to Engine 1.

#### 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

Turbocharger Thrust Bearing Drip Lube System		UTILITY <u>Southern California Edison</u>
COMPONENT	<u>(Small Bore Scope Only)</u>	
GROUP PARTS NO.	<u>02-CFR</u>	TASK DESCRIPTION NO.: <u>DR-09-02-CFR-1</u>
SNPS GPL NO.	<u>03-CFR</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

PRIMARY FUNCTION

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

ATTRIBUTE TO BE VERIFIED

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

SPECIFIED STANDARDS

IEEE 387

ANSI B31.1 (1973)

REFERENCES

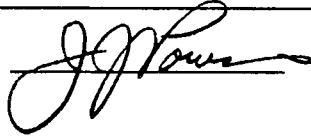
"Engineering Review Criteria Report for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group" Report No. 11600.60-DC-02, Revision 0.

DOCUMENTATION REQUIRED

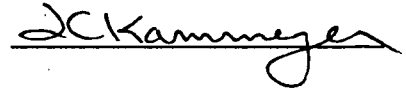
Delaval design documentation (specifications, calculations, drawings, etc.). In lieu of information from Delaval, the following information is required: verified support sketches and piping isometrics, material specifications, pipe size and schedule, and operating parameters (pressure, temperature, load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

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GROUP CHAIRPERSON



PROGRAM MANAGER





COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Turbocharger Thrust Bearing Lubricant System	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	02-CFR	REV. NO.	2
SNPS GPL NO.	03-CFR		

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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

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B2 of 3  
09-02-CFR

ACCEPTANCE CRITERIA

Engine 1

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

Engine 2

Same as Engine 1

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REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

Engine 1

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

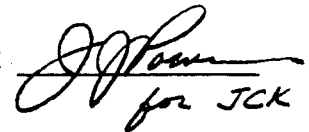
Engine 2

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.

Engine 2

Same as Engine 1

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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

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GROUP CHAIRPERSON

Vita A. Seleta

PROGRAM MANAGER

J. J. Brown  
for JCR

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

COMPONENT NO. 02-CFR

Effective Printout Date 09/17/84

COMPONENT TYPE: Turbocharger Thrust Bearing Lubricant System

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Report concerning possible thrust bearing damage under hot start conditions while lube oil is above 160°F.	St. Lucie 1 LER: 335-79021 790625	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Potential problem with turbo bearing lubrication/ bearing smear if engines receive a repeat rapid start coincident with a loss of ac power.	Pt. Beach 1 LER: 266-79007 790424	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
GM notified VEPCO of potential thrust bearing problems under certain repeat start operating modes.	Surry 1 LER: 280-79017 790502	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
During normal operation the engine may reach operating speed prior to oil pressure being established at thrust.	Monticello LER: 263-79010 790426	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Turbocharger failure; inspections indicated a deteriorated soak back oil pump was not providing sufficient lubrication to turbo.	St. Lucie LER: 335-82024 820616	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
During normal operation the turbocharger failed. Investigation revealed a broken coupling on the soak back oil pump causing insufficient lube oil supply to turbo.	St. Lucie LER: 335-82033 820721	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Inspection of turbo(s) revealed thrust bearing worn from lack of lube oil during prelube while in the standby mode.	San Onofre 1 LER: 206-80039-2 801211	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Under repeat start modes there is a possibility that the turbo thrust bearing could be damaged.	Arkansas Nuc I LER: 313-79006, 790607	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
GM identified potential problem with turbo thrust bearing lube.	Conn. Yankee LER: 213-79009 790831	Lube oil is supplied from the full flow lube oil pump prior to engine start-up, which precludes this problem.
Several repairs were made because of thrust bearing failures and insufficient oil during startup on TDI 8 cylinder engines in Taiwan.	Telex from PEI to LILCO 11/28/83	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Lube oil system supplies oil to turbo bearing during operating mode(s) only. Turbo thrust bearings may experience rapid wear because of this system.	Cleveland Electric (Perry) I & E 83-51 08/05/83	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Distress on the turbine end bearing thrust face and shaft thrust face due to a dry start. Require instant oil flow at start signal.	Taiwan Power So. Calif. Edison letter from E.S. Ncilhattan (Elliott Co.) to A. Fleischer (TDI) 04/06/81 T-33	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Thrust bearing totally burned. Possibly due to lack of lubricant prior to engine start.	Kuosheng 2 TPC Nuc. Plant No.2 06/03/83 File No. T-45	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Turbocharger thrust bearings experienced excessive wear due to lack of prelube oil during multiple fast starts of the diesel.	Catawba 04/05/84 File no. T-53 Pg. 7-2	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Lube oil is not supplied to the turbocharger thrust bearing until lube oil pump initiates upon engine start.	Grand Gulf No. 83-024 10/22/83	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Fast repeat starts of diesels may result in engine reaching operating speed before required oil pressure is reached at turbocharger thrust bearing. Cumulative damage from similar starts would result in turbocharger failure.	Kewaunee LER 305-79024, 790922 I & E 79-12	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.
Turbocharger thrust bearings experienced excessive wear due to lack of prelube oil during multiple fast starts of the diesel.	10CFR50.55E Lilco LTR SNRC-549, 10CFR21 TDI Ltr. to O.I. & E	Lube oil is supplied from the full flow lube oil pump prior to engine startup, which precludes this problem.

NON-NUCLEAR

None.

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

COMPONENT <u>Intake Manifold &amp; Piping (Large Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-375</u>	TASK DESCRIPTION NO. <u>DR-09-02-375-0</u>
SNPS GPL NO. <u>03-375</u>	CLASSIFICATION TYPE <u>B</u>

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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 comparison of the intake manifold and piping spool pieces, fittings and supports for San Onofre with Comanche Peak.
- A review of the lead engine DR/QR report (Comanche Peak)

In order to alleviate problems associated with misalignment, several maintenance options are recommended:

Other castings may be tried in an attempt at a better fit.

Bolt hole diameters on the intake manifold elbows may be increased from 1/16 inch oversize to 1/8 inch oversize. However, under no circumstances shall any component be jacked to fit.

Other options may be acceptable but will require an engineering evaluation to verify structural adequacy.

There are no modifications applicable to this component as a result of the lead engine report.

The following Quality inspections are recommended to be performed for both station engines:

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

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-375-0

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

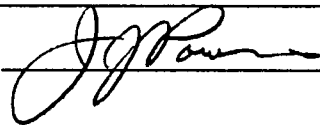
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DOCUMENTATION REQUIRED

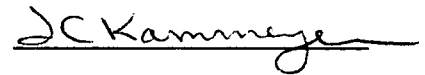
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER





TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

EXHAUST MANIFOLD PIPING  
COMPONENT PART NO. 02-380A

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 exhaust manifold piping for the effects of normal operating and earthquake loadings.

The primary function of the exhaust manifold piping is to carry exhaust gases from the cylinders to the turbocharger.

The scope of piping embraced by this report includes the large bore (greater than 2-inch diameter) piping components. Piping components are defined as piping spool pieces, elbows, tees, flanges, slip joints and the interconnecting welds.

Also included in this scope is the exhaust manifold water jacket, a bolted plate structure that houses the exhaust pipes and provides biological protection from the hot exhaust pipes by circulating moderately pressurized jacket water through the annular space between the two plates.

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 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, "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," was developed, which describes the background and provides the techniques for evaluating the subject piping and supports. These criteria are presented in their entirety in Reference 2.

The evaluation of the exhaust water jacket was performed in accordance with the philosophy and intent of the ASME Code, Section III "Nuclear Power Plant Components"; Subsection ND for Class 3 Components.

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.

Consistent with the intent and philosophy of the ASME Code, the adoption of an inspection program that provides a means for identifying the possible degradation of the exhaust manifold piping components, particularly the welded joints, is recommended. The following maintenance recommendation is required to be performed on the exhaust manifold:

- Perform a visual inspection and a magnetic particle test for a sampling of the circumferential pipe welds and corresponding heat affected zones. This is to be performed during the next refueling outage and alternate outages thereafter. However, diesel operation should not exceed 400 hours between inspections. In lieu of a magnetic particle test, a liquid penetrant test performed to ASME Section V Article 6 is acceptable, with the acceptance criteria per ASME Section III Subsection NB-5350.

Because of the flexibility of the slip joints, especially with respect to seismic considerations, modifications are recommended for the present configuration. Four of the twenty-four slip joints for this component are recommended to be removed and replaced with 150 lb. slip-on flanges with A449 bolts. The remaining twenty slip points were found to be acceptable and will perform their intended design function at San Onofre. In addition, it is recommended that two slip joints be added in order to mitigate thermal loads and stresses.

The exhaust water jacket was evaluated for normal operating loads, earthquake (OBE and SSE), thermal effect, and the effects of all applicable load combinations described in Reference 1. The intent and philosophy of ASME Code Section III, Subsection ND for Class 3 components was used as the acceptable criteria. Based on this review, it is concluded that the exhaust water jacket, with the following recommended modifications, is acceptable for its intended design function at San Onofre. In the event of a SSE, it is recommended that the Nelson studs, which hold the walls of the water jacket together, be inspected at some time subsequent to the SSE event and replaced if the inspection warrants, but the equipment will continue to operate safely after a SSE event.

It is recommended that the 3/8-inch bolts that connect the water jacket shroud to the exhaust manifold assembly support be replaced by 1/2-inch bolts. It is also recommended that adequate clearance between the turbo exhaust pipe support system and water jacket shroud exists during operation.

In addition, it is recommended that one end (either the east or west end) of the 1 x 6 x 255 1/2 - inch flat bar, which connects the shroud to the engine (Ref. 3), be modified to allow for axial (east-west) thermal expansion. This modification is to be performed on both the right and left bank flat bars with the same end being modified.

Further details on the above modifications are summarized in Reference 4.

All pipe loads on the engine block and turbocharger 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, with the above recommended modifications and maintenance items, 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. TDI drawing No. 02-380-10-AT, Rev. A.
4. Letter from R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modification for Validation of Impell's Design Review for Component No. 02-380A, - San Onofre," dated November 12, 1984.

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

COMPONENT	<u>Exhaust Manifold (Large Bore Scope Only)</u>	UTILITY	<u>Southern California Edison Company</u>
GROUP PARTS LIST NO.	<u>02-380A</u>	TASK DESCRIPTION NO.	<u>DR-09-02-380A-0</u>
SNPS GPL NO.	<u>03-380A</u>	CLASSIFICATION TYPE	<u>B</u>

TASK DESCRIPTIONS

Evaluate structural integrity of the exhaust manifold 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

Takes exhaust air from the cylinders and transports it to the turbocharger.

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-09-02-380A-0

REFERENCES

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

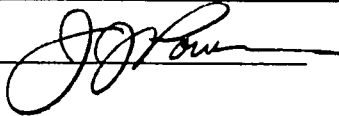
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DOCUMENTATION REQUIRED

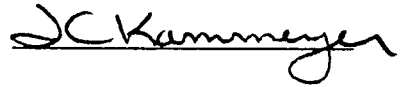
Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Exhaust Manifold - Manifold</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-380A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-380A</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.

Engine 2

Same as Engine 1

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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

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REFERENCES

Engine 1

1. QCI No. 52

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

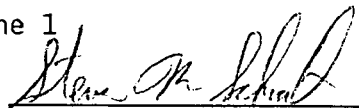
Engine 1

1. Document Summary Sheet

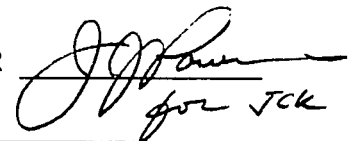
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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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

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09-02-380A

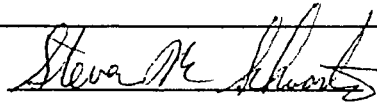
RESULTS AND CONCLUSION (continued)

Engine 2

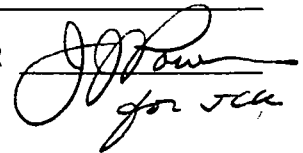
Same as Engine 1

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GROUP CHAIRPERSON



PROGRAM MANAGER





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

COMPONENT NO. 02-380A

Effective Printout Date: 11/05/84

COMPONENT TYPE: Exhaust Manifold-Manifold Piping

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Failure of a bellows support bracket resulted in an exhaust manifold bellows failure. Bracket was repaired and new bellows installed. No previous failures of this type.	LER Palisades 255-75000 750804	Expansion bellows not used on subject exhaust manifold. No applicable.
During surveillance testing of DG 1B, a small fire in the lagging around the manifold occurred and was extinguished. Oil from an inspection cover plate joint leaked on the manifold. Permanent oil deflector pans on the FM unit may be obtained.	LER Three Mile Island 289-74000 741224, EPRI TMI1 12-24-74 DG-1B	Leakage problem, not related to the exhaust manifold. The San Onofre engines do not have any oil lines above the exhaust manifold.
During testing a small fire occurred on the external surface of the diesel generator exhaust manifold. Oil leakage that was not wiped up caused the fire. The procedure did not request personnel to check leakage.	LER Three Mile Island 289-74000 741118 EPRI TMI1 11-18-74 DG	Leakage problem, not related to the exhaust manifold. The San Onofre engines do not have any oil lines above the exhaust manifold.

S02933/1

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

Inspection of seismic supports used for the diesel generator indicated some were missing. This could cause blockage of exhaust gases if pipes were subjected to seismic or tornado loadings. Exhaust system being modified to provide parallel exhaust paths with appropriate supports.

LER North Anna  
339-79000  
790131

There are no seismic supports required on the subject lines at San Onofre.

During full power run for monthly fuel load surveillance test, when smoke and lazy orange flame was observed coming from the turbocharger, DG 1A secured and fire self extinguished. Fire caused by a carbon residue buildup in exhaust path through turbocharger, which is a result of intermittent short duration diesel generator operation. Per vendor recommendation, diesel generator 1A was run for 4 hours at high load fire watch.

LER Kawaunee  
305-77023  
770920

Excessive carbon buildup is a result of less than optimum combustion or the cited intermittent operation, neither of which is related to the structural adequacy of the exhaust manifold.

NON-NUCLEAR

EXPERIENCE

Problem encountered during 1976 season. Exhaust manifolds have been removed and reinstalled on several occasions for reasons of heavy leakage of exhaust gas and soot into the machinery space, caused by frozen expansion joints and resulting cylinder head flange face damage. Removals included shipment of the manifold assemblies to Oakland, California, for redesign and modification. In connection with the exhaust manifolds, it is noted that the manifold water blanket/heat shield assemblies have been modified approximately 3 times.

Cracked exhaust manifold end plates 1978 season and 5/29/80 (M/V Columbia).

REFERENCE DOCUMENTS

Hunton & Williams (12/29/83) to C. Seaman. Letter W. R. Hudson to D. G. Martini (12/14/76)

Hunton & Williams (12/29/83) to C. Seaman. Letter to TDI, D. Martini dated 3/24/80 from M. Zbinden (State of Alaska) M/V Columbia-Repair Parts Status (Starting date 7/27/79).

SAN ONOFRE STATUS

Problem is concerned with slip joint binding on a slip joint of unknown design and application. Subject slip joint design, and application and analytical results were investigated in detail, and the subject slip joint, properly installed, has adequate margins for the relative exhaust line deformations.

Exhaust manifold "end plate" terminology not applicable to subject scope. However, subject exhaust line terminal connections are adequate for normal operating and earthquake loadings.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<p>State of Alaska ordered exhaust manifold conversion kits for installation during maintenance - minor changes in fabrications noted and interior of exhaust gas outlet flanges have several deep cuts from flame cutting. Requires rework. Interior pipe out of round, small fractures in weldment attaching supports. (M/V Columbia)</p>	<p>Hunton &amp; Williams (12/29/83) to C. Seaman. Letter to TDI, D. Martini dated 3/24/80 from M. Zbinden (State of Alaska) M/V Columbia-Repair Parts Status (Starting date 7/27/79).</p>	<p>Fabrication problem. Does not affect design of component.</p>
<p>During operation expansion tank sight glass on SME revealed vapor pressure, assumed to be steam vapor, generated by new exhaust manifold head plates.</p>	<p>Hunton &amp; Williams (12/29/83) to C. Seaman. M/V Columbia repair part status (starting date 7/27/79).</p>	<p>Not a concern at San Onofre; existing exhaust manifold has over 166 hours of operation (on each diesel), without steam generation problems.</p>
<p>Change air/exhaust manifold pressure difference increased by 7.5 times after installation of DE turbos. Turbo response was checked by reversing ship direction engine stalled, turbos squealed. Squealing may result from harmonic or resonant frequency of turbos (M/V Columbia).</p>	<p>SES Report No. 123-01 dated April 1983 Pg. 2-25 through 2-28.</p>	<p>Pressure change was caused by changing the turbocharger; does not affect design of component.</p>

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
Water-blanketed manifold leaked. Pipe supports and head joints caused alignment problems. New style manifolds installed.	Report by Georange G. Sharp, Inc. "Overview of Reports, Analysis, and Recommendation regarding Main Propulsion Engines M/V Columbia" by July 26, 1983.	Installation concern. No effect on subject structural evaluation.
Exhaust manifold joints have started to leak.	Interoffice Memo from B. Bailey (TDI) to G. King (TDI) dated May 21, 1981.	No cause referenced. Appears to be an installation concern. Not applicable.
Flexible joints in exhaust piping cracked .	Ltr. May 13, 1982 from City Homestead, Fla., to TDI (Oakland & New York) Units 18 & 19.	Problem is concerned with slip joint binding. Subject slip joint design, application, and analytical results were investigated in detail and the subject slip joint, properly installed, has adequate margins for the relative exhaust line deformations.
Exhaust pipe manifold seal leaked from start.	Rafha Electricity Co. & Suburbs Saudi Co. Ltd., Saudi Arabia date 7/12/81.	Problem is concerned with manifold seals of unknown design and application. Subject design has no significant history of leaks.
Numerous reports on leaking manifolds.	Chronological summary of Glencoe Events-4 pages Dated 2/20/80.	Problem is concerned with manifold seals of unknown design and has no significant history of leaks.

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

Exhaust Manifold:  
COMPONENT Gasket & Bolting UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-380B TASK DESCRIPTION NO. DR-09-02-380B-0  
SNPS GPL NO. 03-380B CLASSIFICATION TYPE B

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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.

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

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

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-380B-0

REFERENCES

Not required


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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Turbocharger Bracket, Bolting and Gaskets</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-475A&amp;D</u>	TASK DESCRIPTION NO. <u>DR-09-02-475A&amp;D-0</u>
SNPS GPL NO. <u>03-475A&amp;D</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTIONS

A design review report for this component is not required for San Onofre based on the following:

- The seismic analysis report for the turbocharger bracket, prepared by SDRC, was reviewed. The SDRC seismic analysis report adequately modeled the turbocharger bracket; however, loads were only based upon seismic inertia loads and dead weight, and the SDRC analysis did not consider the effects of the attached exhaust silencer support strut and the jacket water support strut. Previous analyses of turbocharger brackets have indicated that pipe thermal loads and engine vibration loads may be the most significant loads experienced by the bracket and bolts. Based on assumed vibration loads, and no thermal loads from the inlet manifold, the turbocharger bracket and bolting, including the bolt pretension, have been found acceptable.
- The bracket is similar to that used for the V-16 engines, the turbochargers at San Onofre are smaller, and there is additional mass supported by the bracket. The net effect is that the bolt loads and bracket stresses are comparable between San Onofre and the V-16's if the inlet manifold thermal loads are ignored. The manifold loads are expected to be lower for San Onofre's V-20 because there is a slip joint in the middle of the manifold that will relieve some of the thermal loads, and the bracket and bolting may be considered acceptable pending finalization of nozzle loads and engine vibration loads.
- Based on a review of the EDG Component Tracking System, the turbocharger bracket to engine block capscrews have not exhibited any gross failures. There has been site specific experience at other plants of loose and missing bolts. It is recommended that the bolts be inspected for correct material, thread engagement, and torque. As most of these bolts are readily accessible, this inspection should be done as soon as is convenient.
- Leaking gaskets have been reported at other plants but tightening of the joints eliminated these problems. The gaskets used in the turbocharger bracket assembly are judged acceptable for use at San Onofre.



COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-475A&D-0

There are no maintenance or modification recommendations for this component based on the lead engine report (Comanche Peak).

Quality Revalidation is not deemed necessary for this component.

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PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

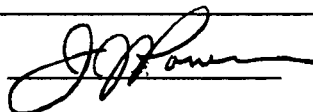
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DOCUMENTATION REQUIRED

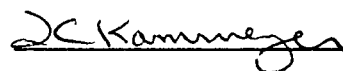
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Air Butterfly Valve Assembly UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-475B TASK DESCRIPTION NO. DR-09-02-475B-0  
SNPS GPL NO. 03-475B CLASSIFICATION TYPE A

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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 for both Shoreham and Comanche Peak.
- Similarity between San Onofre component and lead engine components.

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

- Check operation of air butterfly valve and actuator monthly
- Verify locking devices on air butterfly valve are snug monthly

The following modification should be made:

- Addition of grease fittings per TDI SIM 322

The following Quality inspections are recommended:

- Inspect butterfly to shaft attachment pins for signs of distress
  - Inspect shaft condition for signs of proper lubrication, wear and distress
  - Verify installation and a alignment of butterfly valve for freedom of movement
  - Determine shaft hardness
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-475B-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

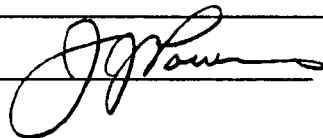
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DOCUMENTATION REQUIRED

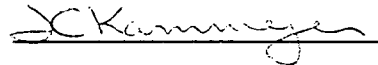
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBOCHARGER BRACKET - AIR INTAKE PIPING

(LARGE BORE SCOPE ONLY)

COMPONENT PART NO. 02-475C

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 piping components of the turbocharger bracket-air intake piping for the effects of normal operating and earthquake loadings.

The primary function of the turbocharger bracket-air intake piping is to carry air from the turbocharger to the intercooler.

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, 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 for normal operating and earthquake loadings.

III METHODOLOGY

The evaluation of the piping 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, "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," was developed, which describes the background and provides the techniques for evaluating the subject piping. These criteria are presented in their 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.

In the original configuration, the relative end movements at the Dresser couplings exceed the manufacturer's end movement requirements (Ref. 3). In order to mitigate these movements, the following recommendation is made:

- Each of the six crossover piping systems are to be supported by two flexible anchors only (total of twelve (12) flexible anchors). These anchors are to be attached to the engine. This requires the removal of all existing U-bolts and strap supports on the crossover piping system.

There are no service life constraints (Ref. 4) because this style of coupling has 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 coupling is adequate with respect to manufacturer's service condition limits.

All in-line equipment loadings 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 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 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. 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 J. J. Ahrens (Impell) to J. Kammeyer (SWEC), "Required Modifications for Validation of Impell's Design Review for Component No. 02-475C - San Onofre," dated February 4, 1985 (letter No. 0630-037-NY-142).

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

Turbocharger Bracket Air Intake Piping	
COMPONENT <u>Turbocharger Bracket Air Intake Piping (Large Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-475C</u>	TASK DESCRIPTION NO: <u>DR-09-02-475C-0</u>
SNPS GPL NO. <u>03-475C</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

Evaluate structural integrity of the turbocharger bracket air intake 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

To carry air from the turbocharger to the intercooler.

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

REFERENCES

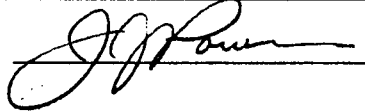
"Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," Impell Report No. 02-0630-1282, Rev. 0, November 1984

DOCUMENTATION REQUIRED

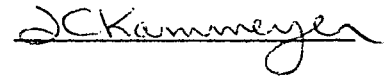
Verified piping isometric, material specification, size and schedule, design parameters (temperature, pressure), contents, and insulation.

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Turbocharger - Bracket Air Intake Piping</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-475C</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-475C</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.

Engine 2

Same as Engine 1

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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

---



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 Victoria A. Saleta

PROGRAM MANAGER J. Kammejer

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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  
09-02-475C

RESULTS AND CONCLUSION (continued)

Engine 2

Same as Engine 1

---

GROUP CHAIRPERSON Nita A. Saleta

PROGRAM MANAGER J. Kammerer

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

COMPONENT NO. 02-475C

Effective Printout Date: 10/17/84

COMPONENT TYPE: Turbocharger Bracket - Air Intake Piping

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Two cylinder injectors and a water jacket relief develop leaks on No. 12 diesel generator. The injectors were replaced. The relief was reinstalled with new O-ring. During this corrective maintenance, 8 air blower discharge flange bolts were discovered broken. All 14 bolts and their inserts were replaced.	Calvert Cliffs 1 LER 317-81078 811008	This addresses small bore jacket water and crankcase ventilation piping, which is out of large bore scope of work.
<u>NON-NUCLEAR</u>		
None		

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Turbocharger - Bracket

COMPONENT PART NO.: 02-475D

See Component Part No.: 02-475A

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

Turbocharger Bracket  
 Pipe Supports  
 COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-475E TASK DESCRIPTION NO. DR-09-02-475E-0  
 SNPS GPL NO. 03-475E CLASSIFICATION TYPE B

---

TASK DESCRIPTIONS

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

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

Based on previous experience, supports appear to be adequate provided that the analysis of the corresponding piping Component No. 02-475C, does not mandate modifications. If the piping analysis warrants modifications to the supports, these modifications will be addressed in the DR/QR Report for Component No. 02-475C.

There are no maintenance recommendations associated with this component.

Quality Revalidation for this component is not required.

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-475E-0

REFERENCES

Not required

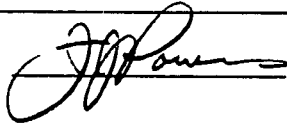
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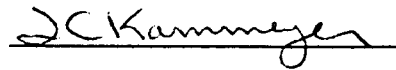
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Intake Air Filter

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-805B

TASK DESCRIPTION NO. DR-09-02-805B-0

SNPS GPL NO. 10-114

CLASSIFICATION TYPE B

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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.
- Unlike the lead engines, San Onofre uses an oil bath type air intake filter. This type of filter has been successfully used throughout industry.

The following maintenance should be performed:

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

No modifications are 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-09-02-805B-0

REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

---

GROUP CHAIRPERSON

*J. Row*

PROGRAM MANAGER

*J. Kammerer*



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

COMPONENT Flex Connections UTILITY Southern California Edison Company  
GROUP PARTS LIST NO. 02-805C TASK DESCRIPTION NO. DR-09-02-805C-0  
SNPS GPL NO. 10-109 CLASSIFICATION TYPE C

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TASK DESCRIPTIONS

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

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

The exhaust flex connection resides downstream of the turbocharger. A failure of the exhaust flex connection would result in exhaust gasses penetrating the boundary and escaping into the diesel room. This would not impair the diesels operability.

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

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-09-02-805C-0

REFERENCES

Not required

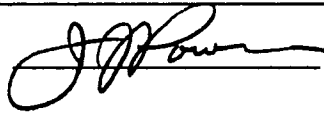
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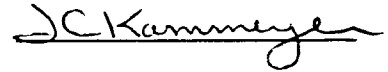
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Intake Air Silencer</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-805D</u>	REV. NO. <u>1</u>
SNPS GPL NO. <u>99-805</u>	

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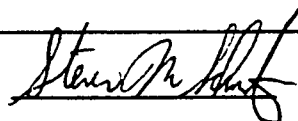
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TASK DESCRIPTIONS

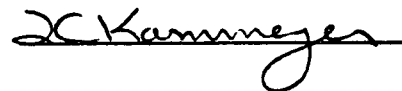
No further review of component 02-805D is required for the following reasons:

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

GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Intercooler</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>41-127A</u>	TASK DESCRIPTION NO. <u>DR-09-41-127A-0</u>
SNPS GPL NO. <u>F-068</u>	CLASSIFICATION TYPE <u>B</u>

TASK DESCRIPTIONS

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

- A review of the EDG Component Tracking System indicated that nuclear and non-nuclear industry experience shows a number of intercooler problems mainly caused by engine vibration. TDI has issued SIM No. 365, which contains suggested modifications to prevent intercooler problems such as these, and it is recommended that this SIM be reviewed for applicability and implementation at San Onofre:
- A review of the lead engine DR/QR report (Comanche Peak)

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

- The intercooler should be inspected for external leaks every month.
- The intercooler should be disassembled and cleaned as necessary every refueling outage.
- The drain connection on the intercooler inlet plenum should be verified open and cleaned daily.

Quality Revalidation is not required for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-41-127A-0

ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

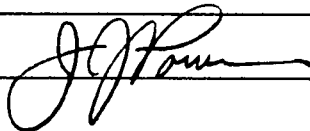
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DOCUMENTATION REQUIRED

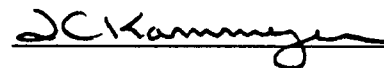
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

INTERCOOLER PIPING AND PIPING COUPLINGS, GASKETS AND BOLTING  
(LARGE BORE SCOPE ONLY)  
COMPONENT PART NO. 41-127B&C

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 intercooler piping, couplings, gaskets and bolting for the effects of normal operating and earthquake loadings.

The primary function of the intercooler piping is to supply jacket water to and from the intercooler.

The primary function of the intercooler piping couplings, gaskets and bolting 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).

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, and also, to verify that the couplings have sufficient strength for sealing parameters and resistance to aging.

III METHODOLOGY

The evaluation of the piping 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, "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. These criteria are presented in their 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 Dresser couplings were evaluated against the manufacturer's selection and service requirements. These include the design service conditions, relative end displacements from both translation and rotation of the joined pipes, and shelf and service life. The movements at the Dresser couplings are within the manufacturer's allowables (Ref. 3). There are no service life constraints (Ref. 4) because this style of coupling has 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 coupling is adequate with respect to manufacturer's service condition limits.

In order to mitigate seismic stresses and loads, it is recommended that supports be added. In addition, it is recommended that supports be modified to accommodate total support loads. These modifications involve the reinforcement of support members to provide adequate restraint in the intended directions. Further details on these additions and modifications are summarized in Reference 5 and 6. | 1

All pipe loads on the intercooler were 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, with the above recommended additions and modifications, 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 R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modifications for Validation of Impell's Design Review for Component No. 41-127B&C, San Onofre," dated November 19, 1984.
6. Letter from J. Ahrens (Impell) to J. Kammeyer (SWEC), "Required Modification for Validation of Impell's Design Review of Component 41-127-BC-San Onofre", Letter No. 0630-037-NY-141, dated February 4, 1985. | 1



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

Intercooler: Piping  
 COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 41-127B&C TASK DESCRIPTION NO: DR-09-41-127B&C-0  
 SNPS GPL NO. 99-436A&B CLASSIFICATION TYPE B

TASK DESCRIPTIONS

Evaluate structural integrity of the Intercooler 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

To supply jacket water to and from the intercooler.

ATTRIBUTES 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

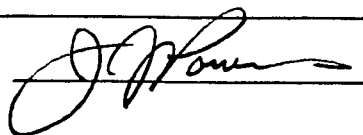
REFERENCES

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

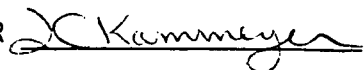
DOCUMENTATION REQUIRED

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

GROUP CHAIRPERSON



PROGRAM MANAGER



S02712/1

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Intercooler Piping: Pipe</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>41-127B</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>99-436A</u>		

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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

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

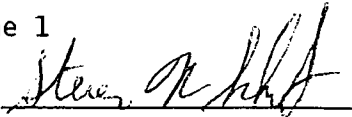
Engine 1

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

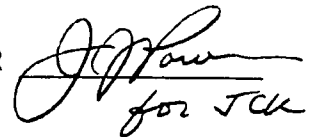
Engine 2

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 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

*Steven M. Khat*

PROGRAM MANAGER

*J. J. Brown*  
for JCK

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

COMPONENT NO. 41-127A&B

Effective Printout Date: 11/05/84

COMPONENT TYPE: Intercooler Piping-Pipe, Couplings, Gaskets and Bolting

<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		

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Intercooler Piping: Coupling, Gaskets, and Bolting

COMPONENT PART NO. 041-127C

See Component Part No.: 041-127B

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

COMPONENT Lube Oil Full  
Pressure Strainer

UTILITY Southern California Edison

GROUP PARTS LIST NO. SE-014

TASK DESCRIPTION NO.: DR-09-SE-014-0

SNPS GPL NO. 04-000

CLASSIFICATION TYPE A

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---

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 from the lead engine DR/QR report should be implemented:

- In order to reduce the possibility of strainer plugging, the differential pressure should be checked during each engine operation and the strainer element should be inspected and cleaned at any significant increase in differential pressure and at each refueling outage.

There are no modifications recommended for this component.

No Quality Revalidation is required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-SE-014-0

REFERENCES

Not required

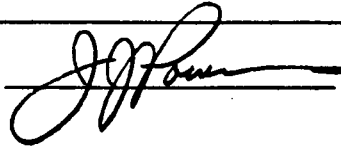
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DOCUMENTATION REQUIRED

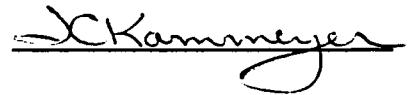
Not required

---

GROUP CHAIRPERSON



PROGRAM MANAGER





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

COMPONENT	<u>Lube Oil Pressure Regulating Valve</u>	UTILITY	<u>Southern California Edison</u>
GROUP PARTS LIST NO.	<u>00-420</u>	TASK DESCRIPTION NO:	<u>DR-09-00-420-0</u>
SNPS GPL NO.	<u>00-420</u>	CLASSIFICATION TYPE	<u>A</u>

---

TASK DESCRIPTIONS

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

- A review of the 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 recommendation from the lead engine DR/QR report should be implemented:

- Disassemble and clean the valve annually or at each refueling outage. If valve plugging becomes a problem, it is further recommended that the dimensions of the valve internal parts be checked to ensure proper clearance and that the frequency of disassembly and cleaning be increased.

There are no modifications recommended for this component.

No Quality Revalidation is required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

REFERENCES

Not required

---

DOCUMENTATION REQUIRED

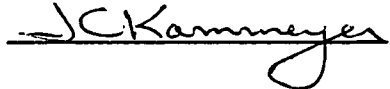
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

LUBE OIL FITTINGS - INTERNAL HEADERS

(LARGE BORE SCOPE ONLY)

COMPONENT PART NO. 02-307A

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 lube oil internal headers for the effects of normal operating and earthquake loadings.

The primary function of the internal headers is to provide lube oil to the main crankshaft bearings, camshaft, and gear case.

The scope of piping embraced by this report includes the large bore (greater than 2-inch diameter) piping components as noted on the design isometrics transmitted to Impell (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. These criteria are presented in their 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.

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 Support," 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.

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

Lube Oil Fittings  
Internal Headers  
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison Company  
GROUP PARTS LIST NO. 02-307A TASK DESCRIPTION NO. DR-09-02-307A-0  
SNPS GPL NO. 03-307A CLASSIFICATION TYPE A

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TASK DESCRIPTIONS

Evaluate structural integrity of the lube oil fittings - internal headers and 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

To provide lube oil to the main crankshaft bearings, camshaft, and gear case.

---

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-09-02-307A-0

REFERENCES

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

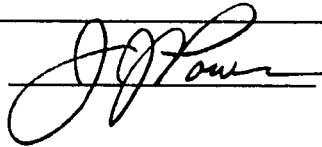
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DOCUMENTATION REQUIRED

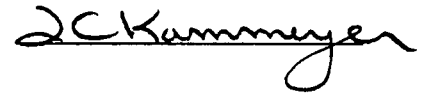
Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Lube Oil Fittings: <u>Internal Headers</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-307A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-307A</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

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 internal headers if available from the Owner.

Engine 2

Same as Engine 1

GROUP CHAIRPERSON *mls*

PROGRAM MANAGER *J. Jones*  
*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 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

Nick A. Saleta

PROGRAM MANAGER

J. J. [Signature]  
for JCK

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

COMPONENT NO. 02-307A

Effective Printout Date: 10/17/84

COMPONENT TYPE: Lube Oil Fittings - Internal Headers

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
No. 2 diesel generator hose from the lube oil header to camshaft tensioner broke. The hose failed because of its proximity to the cam chain and tensioner sprocket. The hose was replaced and clamped away from the cam chain.	LER Cooper 298-79034, 791107	Refers to small bore scope of work under Component No. 02-307A.
While preventive maintenance was being performed, it was found that the lower main bearing was scored. The bearing was damaged because it did not receive proper lubrication upon starting prior to reaching operating speed. A lube oil line that provides oil to the bearing was disconnected. The bearing was replaced, the oil line was connected, and proper operation will be verified prior to placing the diesel in service.	LER No. Anna #2 339-82016, 820323	Refers to small bore scope of work under Component No. 02-307A
<u>NON-NUCLEAR</u>		
None		

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

Lube Oil Fittings - Internal:  
Headers

COMPONENT <u>(Small Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-307A</u>	TASK DESCRIPTION NO.: <u>DR-09-02-307A-1</u>
SNPS GPL NO. <u>02-307A</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

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

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

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

Quality revalidation for this component is not required.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

---

COMPONENT DESIGN REVIEW CHECKLIST

DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON

J. J. Law

PROGRAM MANAGER

J. C. Kammerer

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

<p style="text-align: center;">Lube Oil Fittings Internal Tube and Fittings</p> <p>COMPONENT <u>(Small Bore Scope Only)</u></p> <p>GROUP PARTS LIST NO. <u>02-307B</u></p> <p>SNPS GPL NO. <u>03-307B</u></p>	<p>UTILITY <u>Southern California Edison</u></p> <p>TASK DESCRIPTION NO. <u>DR-09-02-307B-0</u></p> <p>CLASSIFICATION TYPE <u>A</u></p>
---	---

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 or support modifications for this component.

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

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


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DOCUMENTATION REQUIRED

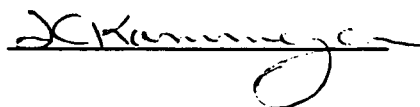
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

LUBE OIL FITTING INTERNAL - SUPPORTS

(SMALL BORE SCOPE ONLY)

COMPONENT PART NO. 02-307D

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 lube oil fitting internal - 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 and tubing in the intended support load direction.

II OBJECTIVE

The objective of this review was to perform an engineering evaluation of the small bore pipe and 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 for this evaluation.

IV RESULTS AND CONCLUSIONS

The supports for small bore pipe and tubing, 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 and 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 on the auxiliary internal lube oil header, as detailed in Reference 3:

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

NOTE: This recommendation is based on the DR/QR reports for the Comanche Peak and Grand Gulf Stations and on Reference 4, as a walkdown review at the San Onofre Nuclear Generating Station was not possible because of component inaccessibility.

Additional supports to control seismic stresses are not required based on the results obtained from a review of comparable components on other engines and the fact that a review of all nuclear and non-nuclear industry experience does not indicate any design problems affecting the structural integrity of this component.

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-ZB.
3. Memo No. 6425 from C. Malovrh/SWEC to J. Kammeyer/SWEC dated 10/19/84.
4. Parts list for San Onofre RV20 Engine No. 02-307-03-03.



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

Lube Oil Fitting  
Internal - Supports  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-307D TASK DESCRIPTION NO. DR-09-02-307D-1  
SNPS GPL NO. 03-307D CLASSIFICATION TYPE B

---

---

TASK DESCRIPTIONS

Perform an engineering review of the small bore pipe and 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 and tubing system, in the intended support load direction.

---

ATTRIBUTE TO BE VERIFIED

Structural adequacy of the pipe and 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.

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COMPONENT DESIGN REVIEW CHECKLIST

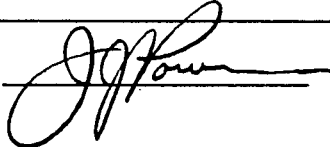
Page A2 of 2  
DR-09-02-307D-1

DOCUMENTATION REQUIRED

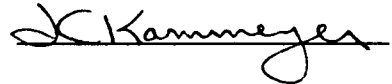
Delaval design documentation (specifications, calculations, drawings, etc.).  
In lieu of information from Delaval, the following information is required:  
verified support sketches and piping isometrics, material specifications, pipe  
size and schedule, and operating parameters (pressure, temperature,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

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil Fitting Internal- Supports</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-307D</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-307D</u>		

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---

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

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 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 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. Sabela

PROGRAM MANAGER

J. J. Howe  
for JCK

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

COMPONENT NO. 02-307D

Effective Printout Date 09/17/84

COMPONENT TYPE: Lube Oil Fittings Internal-Supports

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
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SAN ONOFRE

None

NUCLEAR

None

NON-NUCLEAR

None

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

COMPONENT <u>Engine Driven Lube Oil Pump</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-420</u>	TASK DESCRIPTION NO. <u>DR-09-02-420-0</u>
SNPS GPL NO. <u>03-420</u>	CLASSIFICATION TYPE <u>A</u>

---

TASK DESCRIPTIONS

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

- A review of the component tracking system indicated that there was no significant applicable industry experience.
- A review of the lead engine DR/QR Report (Comanche Peak).
- This component is similiar in design function to the component used in the lead engine. Although IMO pumps are used on all other engines, a larger pump was required than IMO could supply. This pump was supplied by Roper Co.

There are no modifications or maintenance recommendations for this component as a result of lead engine design reviews.

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-09-02-420-0

REFERENCES

Not required


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DOCUMENTATION REQUIRED

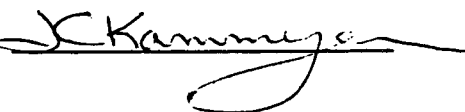
Not required

---

GROUP CHAIRPERSON



PROGRAM MANAGER





TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

LUBE OIL LINES EXTERNAL: TUBING, FITTINGS AND COUPLINGS  
(LARGE BORE SCOPE ONLY)  
COMPONENT PART NO. 02-465A

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 lube oil external tubing, fittings and couplings for the effects of normal operating and earthquake loadings.

The primary function of the lube oil external tubing, fittings and couplings is to carry lube oil from the engine drain to the lube oil sump tank and from the strainer to the internal header.

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, 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 the ASME Code Section III, for Class 3 Nuclear Piping. Towards this end, a criteria document, "Criteria for Diesel Generator Large Diameter Piping for San Onofre," was developed, which describes the background and provides the techniques for evaluating the subject piping and supports. These criteria are presented in their 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 8-inch Dresser coupling are within the manufacturer's end movement requirements (Ref. 3). However, it is recommended that a minimum installation gap between the pipe ends of 0.171 inch be utilized in order to avoid contact of the pipe ends. | 1

There are no service life constraints (Ref. 4) because this style of coupling has 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 coupling is marginal with respect to manufacturer's service condition limits and will be replaced by an upgraded model if leaks develop, per Reference 5.

It is recommended that a support be added to provide a stiffer load path and to relieve seismic stresses on the external header. This support modification is summarized in Reference 6 and 7. | 1

All pipe loads on the engine, pump, and sump tank were 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, with the above recommended modifications, 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. Telecon 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 11/12/84.
6. Letter from R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modification For Validation of Impell's Design Review for Component No. 02-465A - San Onofre," dated November 8, 1984.
7. Letter from J. Ahrens (Impell) to J. Kammeyer (SWEC), "Required Modification for Validation of Impell's Design Review of Component 02-465A-San Onofre", Letter No. 0630-037-NY-140, dated February 4, 1985.

1

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

Turbocharger-Lube Oil Fitting Piping	
COMPONENT <u>(Large Bore Scope Only)</u>	UTILITY <u>Southern California Edison Company</u>
GROUP PARTS LIST NO. <u>02-467A</u>	TASK DESCRIPTION NO. <u>DR-09-02-467A-1</u>
SNPS GPL NO. <u>03-467A</u>	CLASSIFICATION TYPE <u>B</u>

| 1

TASK DESCRIPTIONS

Evaluate structural integrity of the turbocharger - lube oil 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.

| 1

Review information provided on TERs.

PRIMARY FUNCTION

To carry lube oil from the turbocharger to the sump tank.

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-09-02-465A-0

REFERENCES

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

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DOCUMENTATION REQUIRED

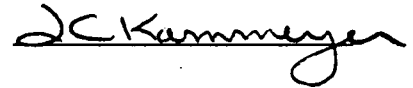
Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil Lines External: Tubing, Fittings and Couplings</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-465A</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-465A</u>		

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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

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ACCEPTANCE CRITERIA

Engine 1

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

ACCEPTANCE CRITERIA (continued)

Engine 2

Same as Engine 1

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REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

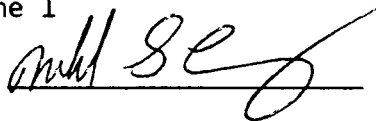
Engine 1

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

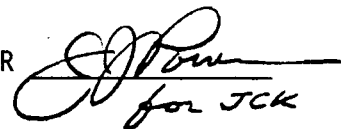
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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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 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

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GROUP CHAIRPERSON

Nuta A. Saleta

PROGRAM MANAGER

J. J. Brown  
for JCK



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

COMPONENT NO. 02-465A

Effective Printout Date: 10/17/84

COMPONENT TYPE: Lube Oil Lines External: Tubing, Fittings, Couplings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
During full power operation a non-isolatable lube oil leak was discovered. The diesel generator lube oil sample line failure was apparently caused by long-term vibration stresses. The copper tubing was replaced by stainless steel.	LER Kewaunee 305-79025, 790922	Refer to small bore scope of work.
Lube oil spraying from a cracked instrument line caused a fire. Instrument line cracked because of fatigue failure caused by vibrating pressure gauge.	LER San Onofre 1, 206-81017-1, 810714, NPRDS Hit 75	Refer to small bore scope of work.

EXPERIENCEREFERENCE  
DOCUMENTSSAN ONOFRE  
STATUSNUCLEAR (continued)

Smoke detector in the diesel generator 1B cubicle alarmed. Investigation revealed smoke coming from the diesel generator 1B turbocharger area. Investigation revealed no specific mechanical failure. Traces of lubricating oil were noted on a portion of the exhaust piping. The source of the oil could not be positively identified.

LER Maine Yankee  
309-83024,  
830615

Not applicable to subject evaluation because subject configuration has no oil lines above the exhaust manifold.

Diesel generator No. 1 sustained fire damage when fitting for a low lube oil pressure indicator failed. Lube oil ignited. Repairs made.

SER San Onofre,  
55-81, 07/14/81  
SOER 83-1

Refer to small bore scope of work.

Oil leaking on exhaust manifold caused fire. Cleaned seal gland nuts and replaced oil gaskets.

NPRDS Robinson 2  
830523, Hit 165

Not applicable to subject evaluation because subject configuration has no oil lines above the exhaust manifold.

Emergency diesel generator 1J developed an oil leak and was declared inoperable. This event was caused by an oil leak on the diesel engine. A gasket was replaced and the engine operated for 4 hours to vaporize any oil remaining in the exhaust port as per the manufacturer's recommendations.

LER North Anna 1,  
338-81027, 810421

Concern is for an isolated gasket failure. Not applicable.

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

NUCLEAR (continued)

At 1026 and 05/05/81 and 0915 on 05/06/81, diesel generator 2B was declared inoperable because of a lube oil leak. Cause for first event was a leaking O-ring on lube oil strainer. O-ring was replaced. Cause for second event was a fatigue failure, due to vibration, of compression fitting on a copper line. Line was replaced with stainless steel and re-routed to reduce vibration.

LER Farley 2  
346-81013, 810505

For first event, refer to lube oil strainer evaluation. For second event, there are no copper lines in the subject scope of evaluation.

NON-NUCLEAR

None

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

<p>Lube Oil Lines-External Tubings Fittings, Couplings COMPONENT <u>(Small Bore Scope Only)</u></p>	<p>UTILITY <u>Southern California Edison</u></p>
GROUP PARTS LIST NO. <u>02-465A</u>	TASK DESCRIPTION NO. <u>DR-09-02-465A-2</u>
SNPS GPL NO. <u>03-465A</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTION

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 modifications/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 and tubing criteria document (Ref 1) and concluded that this component will perform its intended function for all normal and earthquake loadings provided the supports are modified/added as indicated in DR/QR report 02-465B.

Quality revalidation for this component is not required.

PRIMARY FUNCTION

Not required

ATTRIBUTES TO BE VERIFIED

Not required

SPECIFIED STANDARDS

Not required

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-465A-2

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.

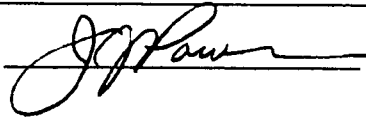
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DOCUMENTATION REQUIRED

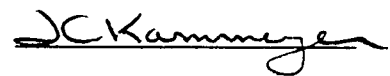
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Lube Oil Lines-External Supports</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-465B</u>	TASK DESCRIPTION NO. <u>DR-09-02-465B-0</u>
SNPS GPL NO. <u>03-465B</u>	CLASSIFICATION TYPE <u>B</u>

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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. 02-465A, 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. 02-465A.

There are no maintenance recommendations for this component.

Quality revalidation is not required for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-465B-0

REFERENCES

Not required

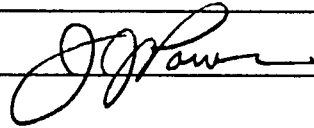
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DOCUMENTATION REQUIRED

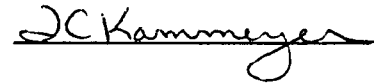
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

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

I INTRODUCTION

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

II OBJECTIVE

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

III METHODOLOGY

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

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the 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 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 if the following recommended modifications are implemented, as detailed in Reference 3:

- Lube oil supply piping to gearcase fittings

Engine 1: Add support to riser similar to Engine 2.

Engine 2: Replace 1/4-inch diameter U-bolt on riser with 3/8-inch diameter U-bolt and tighten to snug fit. Nuts should have locking device installed.

- Rear turbo lube oil header, both engines -

Modify middle support to a three-directional restraint to reduce seismic stresses. Remaining supports should have U-bolt size increased to 3/8-inch diameter and installed to provide lateral restraint while not limiting axial line growth. All nuts should have suitable locking devices installed.

- Left and right rocker arm header, both engines -

Modify one existing two-directional support approximately mid-engine on each header to a three-directional restraint, thus limiting axial motion. The remaining two-directional restraints should be replaced or shimmed to provide proper sliding fit.

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

Lube Oil Lines -  
External: Supports  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-465B TASK DESCRIPTION NO.: DR-09-02-465B-0  
SNPS GPL No. 03-465B CLASSIFICATION TYPE A

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TASK DESCRIPTIONS

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

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PRIMARY FUNCTION

Provide adequate restraint to the external lube oil small bore piping/tubing in the intended support load direction.

---

ATTRIBUTE TO BE VERIFIED

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

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SPECIFIED STANDARDS

IEEE 387

ANSI B31.1 (1973)

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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.

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COMPONENT DESIGN REIVEW CHECKLIST

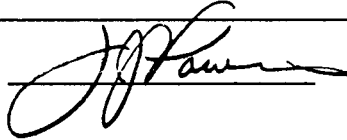
Page A2 of 2  
DR-09-02-465B-0

DOCUMENTATION REQUIRED

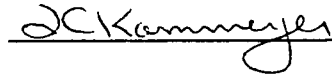
Delaval design documentation (specifications, calculations, drawings, etc.). In lieu of information from Delaval, the following information is required: verified support sketches and piping isometrics, material specifications, pipe size and schedule, and operating parameters (pressure, temperature, load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

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil Lines</u> <u>External - Supports</u>	UTILITY	<u>Southern California Edison</u> <u>San Onofre Nuclear Generating</u> <u>Station - Unit 1</u>
GPL NO.	<u>02-465B</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-465B</u>		

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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

---

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.

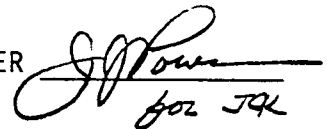
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER

  
for JPK

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

---

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

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GROUP CHAIRPERSON

Victor A. Seleta

PROGRAM MANAGER

J. J. Powers  
for JCK

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

COMPONENT NO. 02-465B

Effective Printout Date 09/17/84

COMPONENT TYPE: Lube Oil Lines External: 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		

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBOCHARGER - LUBE OIL FITTING - PIPE, TUBING & FLEXIBLE COUPLINGS  
(LARGE BORE SCOPE ONLY)  
COMPONENT PART NO. 02-467A

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 turbocharger - lube oil fittings and piping for the effects of normal operating and earthquake loadings.

The primary function of the piping is to carry lube oil from the turbocharger to the sump tank.

The primary function of the Dresser couplings is to seal lube oil 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) and TDI assembly details 100890 and 100902.

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 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, "Design Criteria for Diesel Generator Large Diameter Piping for San Onofre," was developed, which describes the background and provides the techniques for evaluating the subject piping. These criteria are presented in their 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 Dresser couplings were evaluated against the manufacturer's selection and service requirements. These include the design service conditions, relative end displacements from both translation and rotation of the joined pipes, and shelf and service life. The movements at the Dresser couplings are within the manufacturer's allowables (Ref. 3). There are no service life constraints (Ref. 4) because this style of coupling has 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 coupling is adequate with respect to manufacturer's service condition limits.

In order to relieve thermal expansion loads and stresses, it is recommended that supports be removed. Also, a 2-inch style 38 Dresser coupling with a VITON gasket is recommended to be added.

In addition, it is recommended that supports be added and support members be reinforced to mitigate seismic loading stresses.

Furhter details on these modifications and additions are summarized in Reference 5.

Since the water jacket shroud encases a portion of the subject component, evaluation of this portion was performed per TDI assembly details 100890 and 100902. It is recommended that, at the utilities' earliest convenience, a comparison of the as-built configuration with the assembly details be performed.

All pipe loads on the turbocharger and sump tank were 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, with the above recommended comparison and modifications, 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 R. Markovich/G. Shears (Impell) to J. Kammeyer (SWEC), "Required Modification for Validation of Impell's Design Review for Component No. 02-380A, San Onofre," dated November 12, 1984.

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

Turbocharger-Lube Oil  
Fitting Piping  
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison Company  
GROUP PARTS LIST NO. 02-467A TASK DESCRIPTION NO. DR-09-02-467A-0  
SNPS GPL NO. 03-467A CLASSIFICATION TYPE A

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TASK DESCRIPTIONS

Evaluate structural integrity of the lube oil lines-external 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

To carry lube oil from the turbocharger to the sump tank.

---

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-09-02-467A-0

REFERENCES

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

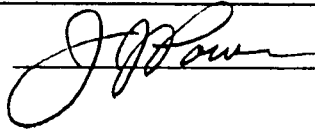
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DOCUMENTATION REQUIRED

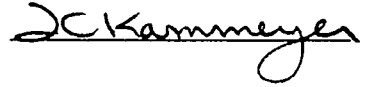
Verify piping isometric, material specification, size and schedule, design parameters (temp., pressure), contents, and insulation.

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Turbocharger - Lube Oil Fittings - Piping, Tubing, Fittings & Flexible Coupling	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	<u>02-467A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>03-467A</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

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

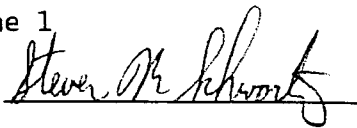
Engine 1

1. Document Summary Sheet
2. Quality verified as-built isometric drawing for the piping, tubing, fittings and flexible coupling if available from the Owner.

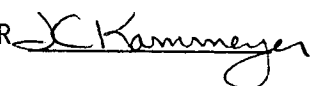
Engine 2

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  
09-02-467A

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. Saletta

PROGRAM MANAGER J. Kammejer

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

COMPONENT NO. 02-467AEffective Printout Date: 11/05/84COMPONENT TYPE: Turbocharger - Lube Oil Fitting-Pipe, Tubing,  
and Flexible Couplings

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
During a 24-hour continuous test run, the lube oil line of the turbocharger broke. A stainless steel oil line was used for replacement and a line support was added.	Maanshan Service Report TPC Nuclear Plant No. 3 dated Dec. 9, 1983 (File No. T-45)	The subject turbocharger lube oil lines meet the ASME III rules for design and will perform their intended design function.
Two turbocharger prelube oil line failures occurred at the ferrule of a compression fitting during a diesel 1A extended run test. Both failures are considered to result from improper installation (overtightening) of the tubing compression nut and excessive vibration. Additional clamps and an approved nut tightening procedure have been implemented.	Catawba Report "Extended Operation Tests and Inspections of Diesel Generators" dated 4/5/84, p. 7-3 (File No. T-53)	Refer to small bore scope of work.



EXPERIENCE

A temporary turbocharger lube oil drain line leaked on diesel 1A. This temporary modification was made because the original drain line fatigued and failed prior to completion of the extended run test. This situation would not have adversely affected the engine's operation in an emergency condition. The drain was replaced. In addition, an improved permanent design will be installed by May, 1984.

REFERENCE DOCUMENTS

Catawba Report "Extended Operation Tests and Inspections of Diesel Generators" dated 04/05/84

SAN ONOFRE STATUS

Isolated design problem. The subject lube oil lines meet the ASME III rules for design and will perform their intended design function.

NON-NUCLEAR

Lube oil piping between engine and turbocharger breaks.

Letter 05/13/82 from City of Homestead, Fla., to TDI (Oakland & New York) Units 18 & 19

The subject lube oil lines to turbocharger meet the ASME III rules for design and will perform their intended function.

Lube oil supply line to the turbocharger broken 1/2-inch nipple (twice) (02/17/77) engine No. 19.

Engine-Incidence Report (City of Homestead, Fla.) dated 09/30/84 (File No. T-10)

Refer to small bore scope of work for this component.

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

Turbocharger Lube Oil Fitting:  
Pipe, Tubing, Fittings, and  
Flexible Coupling

COMPONENT <u>(Small Bore Scope Only)</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-467A</u>	TASK DESCRIPTION NO. <u>DR-09-02-467A-0</u>
SNPS GPL NO. <u>03-467A</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 02-467B.

Quality revalidation for this component is not required.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

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

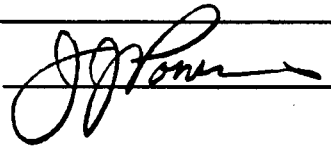
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DOCUMENTATION REQUIRED

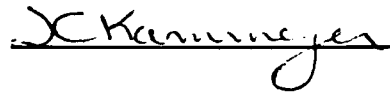
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Turbocharger-Lube Oil  
Fitting: Supports  
COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison  
GROUP PARTS LIST NO. 02-467B TASK DESCRIPTION NO. DR-09-02-467B-0  
SNPS GPL NO. 03-467B CLASSIFICATION TYPE B

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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. 02-467A, 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. 02-467A.

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-09-02-467B-0

DOCUMENTATION REQUIRED

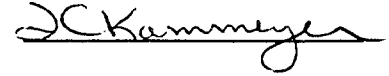
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

TURBOCHARGER - LUBE OIL FITTINGS: SUPPORTS

(SMALL BORE SCOPE ONLY)

COMPONENT PART NO. 02-467B

I INTRODUCTION

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

II OBJECTIVE

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

III METHODOLOGY

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

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for the 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 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 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:

- On the front turbo lube oil crossover header, modify the support nearest mid-engine of both engines to a three-direction restraint to reduce seismic stresses. Remaining supports should have U-bolts increased to 3/8-inch diameter and installed to provide lateral restraint while not limiting axial line growth. All nuts should have suitable locking devices installed. Interference between the crossover header on the left bank governor end of Engine 2 and a support for the exhaust system should be eliminated.
- Replace U-bolt on riser to crossover header with one 3/8-inch diameter U-bolt. Installation should be such that axial pipe movement is not limited while providing lateral restraint. Nuts should have locking devices installed.

In order to adequately support the tubing of component 02-467A it is recommended that the following supports be added:

- A two-direction support on the riser between the turbo bearing connection and pressure switch DLS-PY-106 is recommended on the right front turbocharger on Engine 1.
- A two-direction support on the interconnecting 1/4-inch tubing approximately midway between pressure switches DLS-PY-106 and DLS-PY-107 is recommended on Engine 1.
- The following supports are recommended for the right rear turbocharger 3/8-inch lube oil tubing on Engine 1:

A two-direction support in the horizontal run along the top of the turbocharger at approximately midspan.

A two-direction support in the vertical riser above pressure switch DLS-PY-105.

Two-direction restraints as required to maintain a maximum span length of 4 feet-6 inches below pressure switch DLS-PY-105.

- A two-direction support on the 3/4-inch lube oil supply line near the threaded coupling to the left front turbo of Engine 2 is recommended to minimize the observed high frequency vibration.

- The following supports are recommended for the left rear turbocharger 3/8-inch lube oil tubing on Engine 2:
  - A two-direction support near the tee located below the turbo bearing lube oil inlet.
  - A two-direction support on the horizontal run near the riser going to pressure switch DLN-PY-145.
- A two-direction support on the interconnecting 1/4-inch tubing approximately midway between pressure switches DLS-PY-146 and DLS-PY-147 is recommended on Engine 2.
- The following supports are recommended for the front turbocharger 3/8-inch lube oil tubing on Engine 2.
  - A two-direction support in the horizontal run near the riser above pressure switch DLS-PY-147.
  - A two-direction support in the horizontal run near the riser above pressure switch DLS-PY-146.
- A two-direction support should be added on the left front crossover header near the reducer on Engine 2 to minimize loads and movements at the flexible couplings (similar to Engine 1).

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-ZB.
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

Turbocharger - Lube Oil  
Fittings/Supports  
COMPONENT (Small Bore Scope Only) UTILITY Southern California Edison  
COMPONENT PART NO. 02-467B TASK DESCRIPTION NO: DR-09-02-467B-3  
SNPS GPL NO. 03-467B CLASSIFICATION TYPE B

---

TASK DESCRIPTIONS

Perform an engineering review of the and tubing supports to provide additional assurances that the component will perform its intended design function during normal operating and earthquake loading. Small bore turbo drain pipe forms the continuation of the large bore portion of this component and as such is addressed as part of the large bore review.

---

PRIMARY FUNCTION

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

---

ATTRIBUTE TO BE VERIFIED

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

---

SPECIFIED STANDARDS

IEEE-387

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.

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COMPONENT DESIGN REVIEW CHECKLIST

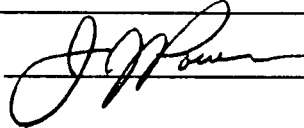
Page A2 of 2  
DR-09-02-467B-3

DOCUMENTATION REQUIRED:

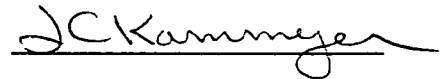
Delaval design documentation (specifications, calculations, drawings, etc.).  
In lieu of information from Delaval, the following information is required:  
verified support sketches and piping isometrics, material specifications, pipe  
size and schedule, and operating parameters (pressure, temperature,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

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Turbocharger-Lube Oil Fittings: Supports	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	02-467B	REV. NO.	1
SNPS GPL NO.	03-467B		

---

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

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

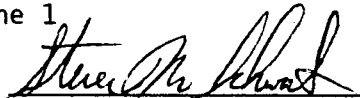
Engine 1

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

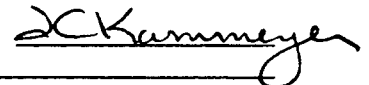
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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 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

*Stan R. Schief*

PROGRAM MANAGER

*J. Kammerer*

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

COMPONENT NO. 02-467B

Effective Printout Date 09/17/84

COMPONENT TYPE: Turbocharger - Lube Oil Fittings: 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		

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

LUBE OIL SUMP TANK WITH STRAINER ASSEMBLY AND MOUNTING HARDWARE  
COMPONENT PART NO. 02-540A AND 02-540C

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 lube oil sump tank with internal strainer assembly and mounting hardware. This tank serves as a reservoir for engine lubricating oil. It houses the lube oil heater, which maintains oil temperature at the normal engine running temperature after shut-down, and it houses a lube oil strainer. The tank is a rectangular flat sided steel tank which is mounted on the auxiliary skid. It is a non-code atmospheric tank made of 3/16-inch plate, reinforced with angles and channels.

Lube oil pump suction draws the oil from the tank and pumps it to the engine oil header. Return flow is by gravity flow from the engine crankcase to the sump tank.

This component is made up of parts as listed below (Ref. 4):

<u>Name</u>	<u>TDI Part No.</u>	<u>Manufacturer</u>
Tank Assembly	1A-5967 (for Engine No. 75041) (Ref. 6)	TDI
	1A-5968 (for Engine No. 75042)	TDI
Tank Weldment	02-540-05-AK (for Engine No. 75041) (Ref. 5)	TDI
	02-540-05-AL (for Engine No. 75042)	TDI
Strainer	1A-2608	TDI
Mounting Bolts	GB-036-064, and 12480	Various Vendors

II OBJECTIVE

The objective of this review was to verify the adequacy of the lube oil sump tank, strainer and mounting hardware for normal loads including hydrostatic pressure, piping loads, thermal expansion loads, and seismic inertia loads. Also, the acceptability of seismic qualifications should be reviewed.

### III METHODOLOGY

The following methods were used to meet the stated objectives:

- The TDI Emergency Diesel Generator Component Tracking System was reviewed for San Onofre, nuclear and non-nuclear industry experience. See Appendix C for results.
- The SDRC seismic analysis (Ref. 1) for the lube oil sump tank was reviewed by performing calculations that included the consideration of the effects of flat plate flexibility on frequencies, and static analysis of the sump tank mounting bolt loads.
- Nozzle load effects were considered by comparison of nozzle structural details with the sump tank nozzle details at Grand Gulf.
- Stresses due to the hydrostatic head in the tank were evaluated using standard engineering texts (Ref. 9).
- A review of the tank hold-down provisions was performed by comparison to Grand Gulf and Shoreham designs along with a review of the SDRC analysis.
- The strainer assembly was reviewed for significant loads which might affect the structural integrity of the tank.
- A review of the Quality Revalidation Checklist results was performed for acceptability.

### IV RESULTS AND CONCLUSIONS

The SDRC seismic analysis was reviewed. It quotes frequencies for modes involving vertically attached pipe and tank swaying. It also reports the higher modes involving gross tank motion. The report, however, did not address sidewall flexure modes.

In order to verify the accuracy of the results, hand calculations based on large displacement effects of the sidewall plate frequencies were performed. These calculations indicate that rigid range seismic response of the tank is expected, but also indicated that the high tank frequency reported by SDRC was not reasonable.

However, with rigid range accelerations applied and taking credit for large displacements, the seismic stresses have been found acceptable. Plate bend stresses may be above yield in some locations for the Design Basis Earthquake (DBE) case, but this is considered acceptable given the strength of the tank as a membrane.



The integrity of plate edge assembly welds is important in developing the membrane strength of the tank. A review of the Shoreham and Grand Gulf design reports reveals a history of weld omissions and quality problems for these rectangular tanks. It is recommended that at the next refueling outage, a sample of the tank seam and assembly welds be visually inspected. The inspection can be limited to welds accessible through the strainer opening and on the tank exterior. The inspection should be expanded if there are indications of weld omissions, undercuts, or lack of fusion, etc. The faulty welds should be repaired.

The San Onofre Sump Tank nozzle details are similar to those at Grand Gulf. Trunnion-type nozzle stress calculations were performed for the Grand Gulf tank and stress levels were found acceptable. While nozzle stress calculations specific to San Onofre have not been performed, San Onofre's nozzles are considered acceptable based on the stress margins calculated for Grand Gulf (Ref. 7).

The stresses in the tank due to hydrostatic head are acceptable.

The tank hold-down provisions for the San Onofre tank are superior to those used for Shoreham's and Grand Gulf's rectangular tanks which have also been determined to be acceptable. An 8-inch channel runs along the length of the tank on either side. This channel is drilled for the 10 mounting bolts used to secure the tank to the auxiliary skid. The bolt pattern shown in the SDRC Analysis was not the same as that shown on the drawings and the bolt reactions reported in the SDRC Analysis were non-conservative. A more conservative calculation of bolt loads is contained in Reference 8, and bolts and tank attachments have still been determined to be acceptable.

The strainer assembly is internal to the tank and was assumed not to develop any significant loads that might affect the structural integrity of the tank.

There are no TERs or Quality Revalidation Checklist results for this component. It is therefore recommended that the proper bolt torque be verified as outlined in Appendix B for Component 02-540C.

Based on the above review, it is concluded that the lube oil sump tank with strainer assembly and mounting hardware is acceptable for its intended design function provided the tank welds are inspected.

#### V REFERENCES

1. Specification E-73001, "Diesel Driven Electrical Generating Sets for San Onofre Nuclear Generating Station, Unit 1, Standby Power Addition," through Rev. 6 dated 02/13/1976.
2. 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.

3. "Formulas for Stress and Strain," Fifth Ed. Roark and Young, McGraw Hill, 1975, and "Formulas for Stress and Strain," Fourth Ed. R. J. Roark McGraw Hill, 1965.
4. TDI Instruction Manual, Volume I, for San Onofre Nuclear Station.
5. TDI Drawing No. 02-540-05-AK, "Tank, Lube Oil Sump, R. Hand 2000 Gallon."
6. TDI Drawing No. 02-540-5967, "Tank assembly, Lube Oil Sump-2000 Gallon."
7. Calculation Number 11600.60 NM(B) 002 CZC-030, "Design Review of the Lube Oil Sump Tank - Grand Gulf."
8. Calculation Number 11600.60 NM(B) 004 CZC-030, "Design Review of the Lube Oil Sump Tank - San Onofre."

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

Lube Oil Sump Tank With  
Strainer Assembly and  
COMPONENT Mounting Hardware

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-540A&C

TASK DESCRIPTION NO. DR-09-02-540A&C-0

SNPS GPL NO. 03-540A&C

CLASSIFICATION TYPE B

TASK DESCRIPTIONS

- Verify structural integrity of the tank and mounting hardware for normal operating and seismic loads, and review existing qualification documentation.
- Review information in applicable TERs.

PRIMARY FUNCTION

The tank is a sump for the collection of engine lubricating oil. The engine driven lube oil pump takes suction from this tank.

ATTRIBUTE TO BE VERIFIED

Structural adequacy and acceptability of seismic qualification.

SPECIFIED STANDARDS

None per Ref. 1

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 Generating Station Unit No. 1, Southern California Edison Company, Submitted by TDI, prepared by Structural Dynamics Research Corporation, Project No. 7416.

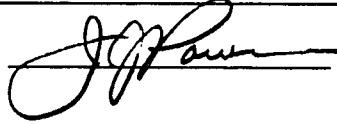
COMPONENT DESIGN REVIEW CHECKLIST

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DR-09-02-540A&C-0

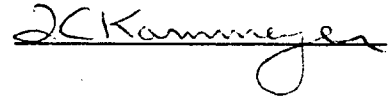
DOCUMENTATION REQUIRED

Received.

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Lube Oil Sump Tank -  
Tank W/ Strainer Assembly UTILITY Southern California Edison  
San Onofre Nuclear Generating  
Station - Unit 1  
GPL NO. 02-540A REV. NO. 1  
SNPS GPL NO. 03-540A

---

---

TASK DESCRIPTIONS

No further review of component 02-540A 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 reported for this component.

GROUP CHAIRPERSON *Steven A. Kraft*

PROGRAM MANAGER *J. P. [Signature]*  
*for JCK*

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Lube Oil Sump Tank - UTILITY Southern California Edison  
Mounting Hardware San Onofre Nuclear Generating  
Station - Unit 1

GPL NO. 02-540C REV. NO. 1

SNPS GPL NO. 03-540C

---

---

TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documention.
2. Verify that the proper torque was applied to the bolting by reviewing existing documentation.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper bolt torque

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Bolts were torqued in accordance with the TDI Instruction Manual

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1

1. QCI No. 52
2. Site Documentation, TDI Instruction 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 Nate A. Salete

PROGRAM MANAGER J. Kammerer

---

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. No documentation was available to verify the torque values.

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  
09-02-540C

RESULTS AND CONCLUSION (continued)

Engine 2

Same as Engine 1

---

GROUP CHAIRPERSON Nita A. Seleta

PROGRAM MANAGER JC Kammerer



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

COMPONENT NO. 02-540A&C

Effective Printout Date 10/31/84

COMPONENT TYPE: Lube Oil Sump Tank with Strainer  
Assembly and Mounting Hardware

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
At Dresden, a high temperature condition was caused by a partially clogged strainer in the lube oil circulation pump.	LER Dresden 3 249-76000 760921	Strainer clogs are normal maintenance problems especially for recently assembled engines.
Rag found in strainer at Zion prior to testing.	LER Zion 1 295-79018 790315 EPRI-NP 2433 6182	Isolated incident; does not affect component design.
<u>NON-NUCLEAR</u>		
State of Alaska M/V Columbia lube oil filter is increasingly contaminated by carbon soot and water; and crankcase vacuum fluctuating.	Hunton & Williams (12/29/83) to C. Seaman. Memo from M. Zbinden (State of Alaska) to R. Ward, dated 11/06/80	The sump tank strainer is evidently working properly; carbon and soot is caused by problem in other than the sump tanks. Water in the tanks is probably due to tank (bilge?) leakage or jacket water to lube oil leaks. San Onofre tanks do not leak, and jacket water to lube oil leaks cannot occur in the sump tank. Crankcase vacuum fluctuation has not been reported at San Onofre.

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

<p>Lube Oil Sump Tank Misc. Fittings, Gaskets, Blt, Matrl. COMPONENT <u>Valves (Small Bore Scope Only)</u></p>	<p>UTILITY <u>Southern California Edison</u></p>
GROUP PARTS LIST NO. <u>02-540B</u>	TASK DESCRIPTION NO. <u>DR-09-02-540B-1</u>
SNPS GPL NO. <u>03-540B</u>	CLASSIFICATION TYPE <u>B</u>

---

TASK DESCRIPTIONS

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

There are no maintenance 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

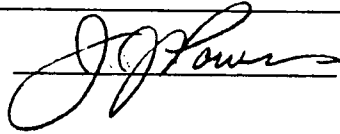
"Engineering Review Criteria Document for the Design Review of TDI Diesel Small Bore Piping, Tubing, and Supports for the TDI Owners' Group," report No. 11600.60-DC-02, Revision 0.

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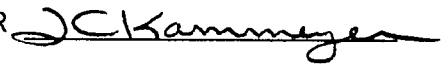
DOCUMENTATION REQUIRED

Not required

GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION

Lube Oil Sump Tank: Mounting Hardware

COMPONENT PART NO.: 02-540C

See Component Part No.: 02-540A

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Lube Oil System Aux. L. O. Pump</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-545</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>99-820A</u>		

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---

TASK DESCRIPTIONS

No further review of component 02-545 is required for the following reasons:

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

---

GROUP CHAIRPERSON *Storck* PROGRAM MANAGER *2C Kammerer*

TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

AUXILIARY SUB-BASE AND OIL AND WATER PIPING-  
LUBE OIL: PIPE/FITTINGS  
(SMALL BORE SCOPE ONLY)  
COMPONENT PART NO. 02-717F

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 and oil and water piping - lube oil: pipe/tubing and fittings components to withstand the effects of normal operating and earthquake loadings. The primary function of this small bore piping and tubing is to provide drain capabilities to the prelube filter and lube oil heat exchanger and to provide a cross connect between the duplex filters. The tubing provides continuous venting capabilities for the lube oil filters, strainers, prelube filter and prelube strainer and also pressure indication for the lube oil sump, filter - inlet and discharge, prelube filter discharge and keepwarm pump discharge.

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 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 and tubing, 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 and tubing 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:

- Two-directional lateral supports should be added to the following lines such that the support spans are limited to a maximum of 3 feet - 6 inches for 1/4-inch tubing and 4 feet - 6 inches for 3/8-inch tubing:

Vent lines from full flow duplex filters.

Vent lines from prelube filter.

Vent lines from prelube strainer.

Pressure indicator tubing to pressure gauges.  
(Three-directional supports are recommended near pressure gauges.)

Three-eighth-inch tube from strainer outlet to pressure regulating valve on lube oil discharge (engine driven pump) on Engine 2.

- A three-directional support at the hose coupling end and a two-directional support at a 6 foot - 6 inch maximum span interval is recommended on the 3/4 IPS prelube strainer drain line on Engine 1.
- A three-directional support on the lower horizontal run near the 19-inch riser is recommended on the 2-inch lube oil supply line from the strainer outlet to the rocker arm headers on Engine 1.
- It is recommended that the welded attachment to the jacket water piping be eliminated for the two-directional U-bolt support located on the horizontal run near the governor of Engine 2. This support should be installed as a three-directional restraint with a structural attachment.

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 1160.60-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

COMPONENT <u>Auxiliary Sub Base and Water Piping - Lube Oil: Pipe and Fittings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-717F</u>	TASK DESCRIPTION NO. <u>DR-09-02-717F-1</u>
SNPS GPL NO. <u>03-717H</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

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

PRIMARY FUNCTION

The small bore pipe provides drain capabilities for the prelube filter and lube oil heat exchanger and provides a cross connect between the duplex filters. The tubing provides continuous venting capabilities for the lube oil filters strainers, prelube filter and prelube strainer and also pressure indication for the lube oil sump filter - inlet/discharge, prelube filter discharge and keepwarm pump discharge.

ATTRIBUTE TO BE VERIFIED

Structural adequacy of the piping/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

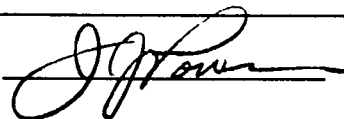
Page A2 of 2  
DR-09-02-717F-0

DOCUMENTATION REQUIRED

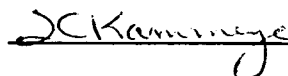
Delaval design documentation (specifications, calculations, drawings, etc.).  
In lieu of information from Delaval, the following information is required:  
verified support sketches and piping isometrics, material specifications, pipe  
size and schedule, and operating parameters (pressure, temperature,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

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

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

---

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

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

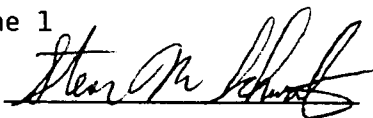
Engine 1

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

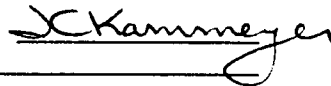
Engine 2

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 REVIEW (continued)

Engine 2

Same as Engine 1

---

RESULTS AND CONCLUSION

Engine 1

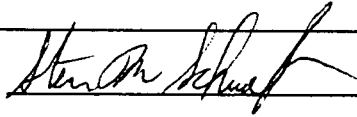
The Quality Revalidation effort with respect to this component, as outlined above, is complete. The results have been forwarded to the Design Review Group for their evaluation and conclusions in support of the final report.

Engine 2

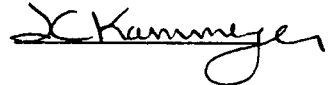
Same as Engine 1

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT NO. 02-717F

Effective Printout Date 09/17/84

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

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Info-procedure for pipe pickling.	TDI SIM 133A	Procedure for installation of new lube oil piping; any new lube oil piping shall be pickled per Instruction Manual.
Info - precautions cleaning of lube oil piping.	TDI SIM 133	Maintenance item, does not affect component design or integrity.
10CFR50.55E filed after inspection revealed that ASME III Code requirements for welding and pipe cleanliness were violated.	Cleveland Electric 10CFR50.55E DAR No. 89 03/05/82	This report concludes that components will perform their intended design function during normal operating and earthquake loadings provided that the recommended modifications are implemented.
High differential pressure across the lube oil strainer. Strainer cleaned.	Farley 1-348-81024	Maintenance item; does not affect component design or integrity.
<u>NON-NUCLEAR</u>		
None		

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

COMPONENT <u>Aux. Sub Base &amp; Oil &amp; Water Piping: Lube Oil Valves</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-717G</u>	TASK DESCRIPTION NO. <u>DR-09-02-717G-0</u>
SNPS GPL NO. <u>03-717I</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 (Comanche Peak).

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

- Inspect and clean valves at each refueling outage.
- Check relief valve lift pressure at 5-year intervals.

There are no recommended modifications for this component however, an inspection should be performed to verify that the relief valves have been installed in a vertical position per the manufacturer's recommendation.

No Quality Revalidation is required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

S01990/1

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

Auxiliary Sub Base & Oil and Water Piping: Lube Oil: COMPONENT <u>Gaskets and Bolting</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-717H</u>	TASK DESCRIPTION NO. <u>DR-09-02-717H-0</u>
SNPS GPL NO. <u>03-717J</u>	CLASSIFICATION TYPE <u>B</u>

---

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-09-02-717G-0

REFERENCES

Not required

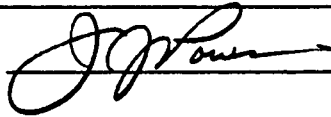
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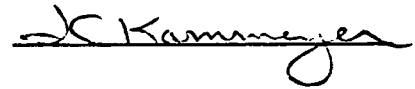
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT DESIGN REVIEW CHECKLIST

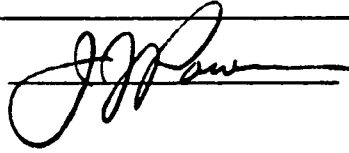
Page 2 of 2  
DR-09-02-717H-0

DOCUMENTATION REQUIRED

Not required

---

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT Misc. Equipment-Heater,  
Lube Oil Sump Tank UTILITY Southern California Edison  
San Onofre Nuclear Generating Station  
GPL NO. 02-820A REV. NO. 1  
SNPS GPL NO. 03-800B

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---

TASK DESCRIPTIONS

No further review of component 02-820A 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 accomplished during the lube oil sump cleaning. Inspections scheduled at 18-month intervals should consist of the following.

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

---

GROUP CHAIRPERSON Nilton A. Sclata

PROGRAM MANAGER J. J. Powell  
for JCK

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

COMPONENT Lube Oil Heat Exchanger UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-820B TASK DESCRIPTION NO. DR-09-02-820B-0  
 SNPS GPL NO. 10-104 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/Comanche Peak)

The following preventative maintenance should be implemented:

- Remove exchanger channel covers and inspect tube side. Clean as necessary at each outage.
- Replace gaskets and packing at each outage.
- Spectrochemical analysis of lube oil samples should be performed approximately every three months to monitor the condition of the diesel engine.

No modifications to this component are required.

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

S01985/1

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-820B-0

DOCUMENTATION REQUIRED

Not required

---

GROUP CHARIPERSON

JJ Power

PROGRAM MANAGER

JC Kammerer

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

COMPONENT Full Flow Lube Oil Filter

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-820C

TASK DESCRIPTION NO. DR-09-02-820C-0

SNPS GPL NO. 10-106

CLASSIFICATION TYPE A

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---

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 recommendations based on the lead engine DR/QR report should be implemented:

- The filter differential pressure should be checked monthly or at each engine operation and procedures should be established for replacing the filter cartridges at or before the recommended maximum differential pressure.
- Proper bolt tightening torque values/procedures specified in the TDI Associated Publications Manual must be utilized.
- Air should be purged from the filters after 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-09-02-820C-0

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

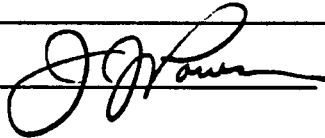
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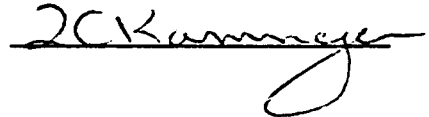
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Prelube Oil Pump

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-820D

TASK DESCRIPTION NO. DR-09-02-820D-0

SNPS GPL NO. 10-113

CLASSIFICATION TYPE A

---

TASK DESCRIPTIONS

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

- A review of the Component Tracking System indicated that there was no significant applicable industry experience.
- A review of the lead engine DR/QR Report (Comanche Peak).
- This component, although not manufactured by IMO Pumps, has the benefit of a flooded suction, thus requiring no priming aids such as foot valves.

No modification or maintenance recommendations are needed based on the lead engine DR report for this component.

No Quality Revalidation is required for this component.

---

PRIMARY FUNCTION

Not required

---

ATTRIBUTES TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required



COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-820D-0

REFERENCES

Not required

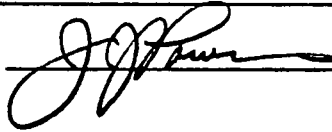
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DOCUMENTATION REQUIRED

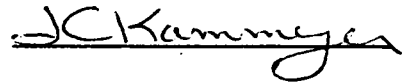
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Oil Prelube Filter</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-820E</u>	TASK DESCRIPTION NO. <u>DR-09-02-820E-0</u>
SNPS GPL NO. <u>10-117</u>	CLASSIFICATION TYPE <u>A</u>

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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 recommendations based on the lead engine DR/QR report should be implemented:

- While the engine is in the standby mode, the filter differential pressure should be checked daily and procedures should be established for replacing the filter cartridges at or below the manufacturers recommended maximum differential pressure. Proper bolt tightening torque values/procedures specified in the TDI Associated Parts Manual must be utilized. Air should be purged from the filters after maintenance.

There are no modifications recommended for this component.

No Quality Revalidation is required for this component.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-820E-0

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON

*J. J. Power*

PROGRAM MANAGER

*J. C. Kammerer*

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

<p>Base and Bearing Caps - Base Assembly, Main Bearing Studs and Nuts, and COMPONENT <u>Main Bearing Caps</u></p>	<p>UTILITY <u>Southern California Edison</u></p>
<p>GROUP PARTS LIST NO. <u>02-305A,C,D</u></p>	<p>TASK DESCRIPTION NO. <u>DR-09-02-305A,C,D -0</u></p>
<p>SNPS GPL NO. <u>03-305A,C,D</u></p>	<p>CLASSIFICATION TYPE <u>A</u></p>

TASK DESCRIPTIONS

Design review is not required for these components based on a comparison review of the load conditions and structural similarities between the V-20 and V-16 (Comanche Peak) base assemblies. The factors of safety for the V-20 base assembly parts will be identical to or larger than the factors of safety for the V-16 base assembly parts.

A review of the EDG Component Tracking System indicates no significant applicable industry experience.

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

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

There are no modification recommendations for these components.

The Quality inspections listed below are recommended to be performed:

- Perform a liquid penetrant test on the middle main bearing saddle area of Engine 1. See sketch attached to CQRC 09-02-305A.
- Visually inspect the bearing cap mating surfaces for evidence of fretting on Engine 1. Sample middle cap.
- Verify that the preload torque requirements are applied to the main bearing caps during engine installation, Engines 1 and 2.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-305A,C,D-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

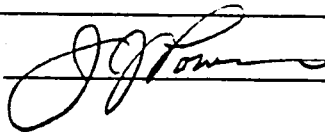
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DOCUMENTATION REQUIRED

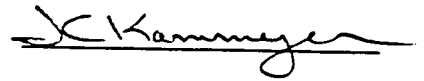
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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Base and Bearing Caps - Base Assembly, Main Bearing Studs and Nuts, and COMPONENT <u>Main Bearing Caps</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-305A,C,D</u>	TASK DESCRIPTION NO. <u>DR-09-02-305A,C,D -0</u>
SNPS GPL NO. <u>03-305A,C,D</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTIONS

Design review is not required for these components based on a comparison review of the load conditions and structural similarities between the V-20 and V-16 (Comanche Peak) base assemblies. The factors of safety for the V-20 base assembly parts will be identical to or larger than the factors of safety for the V-16 base assembly parts.

A review of the EDG Component Tracking System indicates no significant applicable industry experience.

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

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

There are no modification recommendations for these components.

The Quality inspections listed below are recommended to be performed:

- Perform a liquid penetrant test on the middle main bearing saddle area of Engine 1. See sketch attached to CQRC 09-02-305A.
- Visually inspect the bearing cap mating surfaces for evidence of fretting on Engine 1. Sample middle cap.
- Verify that the preload torque requirements are applied to the main bearing caps during engine installation, Engines 1 and 2.

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-305A,C,D-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

---

REFERENCES

Not required

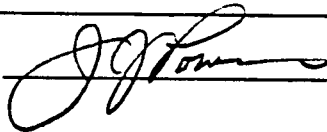
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DOCUMENTATION REQUIRED

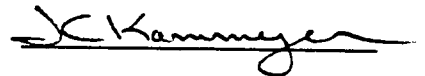
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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Base and Bearing Caps -  
Base Assembly, Main Bearing  
Studs and Nuts, and

COMPONENT Main Bearing Caps UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-305A,C,D TASK DESCRIPTION NO. DR-09-02-305A,C,D -0

SNPS GPL NO. 03-305A,C,D CLASSIFICATION TYPE A

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TASK DESCRIPTIONS

Design review is not required for these components based on a comparison review of the load conditions and structural similarities between the V-20 and V-16 (Comanche Peak) base assemblies. The factors of safety for the V-20 base assembly parts will be identical to or larger than the factors of safety for the V-16 base assembly parts.

A review of the EDG Component Tracking System indicates no significant applicable industry experience.

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

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

There are no modification recommendations for these components.

The Quality inspections listed below are recommended to be performed:

- Perform a liquid penetrant test on the middle main bearing saddle area of Engine 1. See sketch attached to CQRC 09-02-305A.
- Visually inspect the bearing cap mating surfaces for evidence of fretting on Engine 1. Sample middle cap.
- Verify that the preload torque requirements are applied to the main bearing caps during engine installation, Engines 1 and 2.



COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-305A,C,D-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

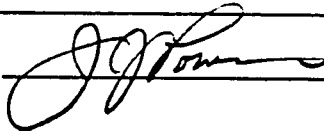
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DOCUMENTATION REQUIRED

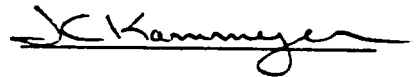
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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

CRANKSHAFT  
COMPONENT PART NO. 02-310A

I INTRODUCTION

The TDI Emergency Diesel Generator Owners Group Program for the San Onofre Nuclear Generating Station requires Design and Quality Revalidation reviews to determine the adequacy of the crankshafts for their intended service at San Onofre. The primary function of the crankshaft is to convert reciprocating motion of the piston to rotary motion, and to transfer the resulting torque to the generator rotor. The manufacturer's part number for the crankshafts at San Onofre is 02-310-05-AJ. The crankshafts in Engine Nos. 75041 and 75042 were forged and machined by Elwood City Forge Corporation.

II OBJECTIVE

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

III METHODOLOGY

The Emergency Diesel Generator Component Tracking System records were reviewed to determine the nuclear, non-nuclear, and San Onofre site experience of the crankshafts. San Onofre Task Evaluation Reports (TERs), and pertinent literature specified on the Component Tracking System records were examined for information on the performance of the crankshafts. See Appendix C for results.

A torsionograph test was performed on Engine No. 75041 to determine the torsional response of the front end of the engine. A modal superposition analysis of the crankshaft to determine steady-state response at full speed was performed (Ref. 1). The pressure loading was obtained from the dynamic test at Shoreham Nuclear Power Station (Ref. 1). This analysis calculates the nominal shear stresses at each crank pin and main journal location. The TDI Holzer calculations (Ref. 2) were reviewed by comparing the results with results obtained from the vibrational analysis.

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

The Quality Revalidation Checklist Results were reviewed for acceptability.

IV RESULTS AND CONCLUSIONS

The modal superposition analysis was originally performed using the pressure curve at 100 percent load from the dynamic test at Shoreham Nuclear Power Station (Ref.1) corresponding to a load of 8750 kW. This is above the 6000 kW rated load for San Onofre. This analysis determined the maximum amplitude of nominal stress during steady-state operation to be 4018 psi between cylinder numbers 8 and 9 (Ref. 1). It was requested that a steady-state analysis be performed at the 6000 kW rated load. Only additional pressure data from the Shoreham pressure test at 80 percent load (corresponding to a 7000 kW load at San Onofre) was available. The results from this analysis determined the maximum amplitude of nominal stress to be 3518 psi between cylinders 8 and 9 (Ref. 3). For both load conditions, the nominal stresses were found to satisfy the requirements of DEMA, and are less than 5000 psi for a single order and less than 7000 psi for combined orders (Ref. 4). The TDI Holzer calculations were found to be in agreement with the vibrational analysis.

Torsional test results from diesel generator No. 1 at San Onofre showed that steady-state results confirmed the analysis which showed that the crankshaft is acceptable for its intended use under the steady-state operating conditions at San Onofre (Ref. 7). Evaluation of crankshaft torsional response under startup and coastdown conditions and resulting stresses in the crankshaft is being done to confirm the adequacy of this component. Results of the transient response will be presented in a separate report.

The material certification reports for the crankshafts at San Onofre indicate that the tensile strengths for the crankshaft material in Engine Nos. 75041 and 75042 are within the original design specifications (Refs. 5 and 6). The factor of safety against fatigue failure in the main journal oil holes under steady-state conditions at 7000 kW load was found to be 2.0 based on a minimum ultimate tensile strength of 94.5 ksi for Unit 1, engine No. 75042.

During recent oil hole inspections, cracking was discovered in three oil holes in the crankshaft in engine No. 75041. To eliminate these cracks, the oil hole diameter and/or the oil hole blend radii have been increased. The dimensions after repair are acceptable for steady-state operating conditions based on calculations of the new stress concentration factors and resulting stress ranges in the most highly stressed regions. Inspection of oil holes 8, 9, and 10 on engine 75042 showed two small crack indications at No. 9 oil hole which were removed and polished to blend the affected area. The resulting modified geometry is acceptable for steady-state operating conditions. A very small eddy current indication was recorded at No. 10 oil hole, which was not detectable by dye penetrant inspection. After polishing, its removal was verified by eddy current inspection.

The information on TERs 09-002, 09-003, 09-005, and 09-017 has been reviewed and is consistent with the final conclusions of this report.

Results of the Quality Revalidation inspections performed to date have been reviewed and considered in the performance of this design review.

Based on the above review it is concluded that the crankshafts are acceptable for their intended use during steady-state operation. Effects of transient operating conditions will be presented in a separate report.

V REFERENCES

1. "Evaluation of Emergency Diesel Generator Crankshafts at Midland and San Onofre Nuclear Generating Stations," Report No. FaAA-84-6-54, Failure Analysis Associates, Palo Alto, California, June 1984.
2. Yang, Roland, "Torsional and Lateral Critical Speed Analysis: Engine Numbers 75041/42 Delaval Enterprise Engine Model DSRV-20-4 6000 kW, 8303 BHP at 450 RPM for Southern California Edison Company," Transamerica Delaval Inc., Engine and Compressor Division, Oakland, California, October 22, 1975 updated.
3. FaAA Support Package SP 84-6-10(e)
4. Standard Practices for Low and Medium Speed Stationery Diesel and Gas Engines, Diesel Engine Manufacturers Association, 6th ed., 1972.
5. Elwood City Forge Cooperation Test Report, dates 2-14-74 for Engine 75042.
6. American Bureau of Shipping, Report on Castings or Forgings, Report No. 74-PH32165-288, dated 3-14-78 for Engine Nos. 75041 and 75042.
7. FaAA Report 84-10-9 "Steady State Torsiographic Tests of Emergency Diesel Generator #1 at San Onofre Nuclear Generating Stations," October, 1984.

COMPONENT DESIGN REVIEW CHECKLIST  
SAN ONOFRE NUCLEAR GENERATING STATION

COMPONENT Crankshaft

UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-310A

TASK DESCRIPTION NO. DR-09-02-310A-0

SNPS GPL NO. 03-310A

CLASSIFICATION TYPE A

TASK DESCRIPTIONS:

Review of San Onofre site, nuclear and non-nuclear experience.

Review of TDI Holzer calculations and torsion graph tests.

Perform modal superposition of the crankshaft.

Investigate stress levels during transient conditions.

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

Review Quality Revalidation Checklist for acceptability.

Review information provided on TERs.

PRIMARY FUNCTION:

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

ATTRIBUTES TO BE VERIFIED:

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

SPECIFIED STANDARDS:

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

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2  
DR-09-02-310A-0

REFERENCES:

None

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DOCUMENTATION REQUIRED:

TDI drawings, test reports, experimental pressure vs. time curves, Holzer calculations for DSRV 20-4 engine.

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DR CHAIRPERSON:

DR/QR PROGRAM MANAGER:

COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	Crankshaft & Bearings - Crankshaft & Turning Gear	UTILITY	Southern California Edison San Onofre Nuclear Generating Station - Unit 1
GPL NO.	<u>02-310A</u>	REV.NO.	<u>1</u>
SNPS GPL NO.	<u>03-310A</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a visual inspection of all crankpin and main journal surfaces for signs of scoring, wear or damage. Document with photographs.
3. Perform an Eddy Current test on the main journal oil holes located between cylinders 8 and 9, and 9 and 10.
4. Perform a torsionograph on the crankshaft.

Engine 2

1. Assemble and review existing documentation.
  2. Perform a visual inspection of all crankpin and main journal surfaces for signs of scoring, wear or damage. Document with photographs.
  3. Perform an Eddy Current test on the main journal oil holes located between cylinders 8 and 9, and 9 and 10.
- 

ATTRIBUTES TO BE VERIFIED

Engine 1

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

ATTRIBUTES TO BE VERIFIED (continued)

Engine 2

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

ACCEPTANCE CRITERIA

Engine 1

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

Engine 2

1. Satisfactory document package
  - 2-3. Review of inspection report by the Design Group
- 

REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures
3. Approved Site NDE Procedures, TER# 09-001
4. Approved Site NDE Procedures

Engine 2

1. QCI No. 52
  2. Approved Site NDE Procedures
  3. Approved site NDE Procedures, TER# 09-001
-



DOCUMENTATION REQUIRED

Engine 1

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

Engine 2

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

GROUP CHAIRPERSON

*Steve A. Howard*

PROGRAM MANAGER

*JC Kammezer*

COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.
3. Eddy current tests were performed on main journal oil holes 3, 4, 8, 9 and 10. The results were reported by TER# 09-003. Liquid Penetrant tests were performed on all main journals oil holes. The results were reported by TER# 09-002 and 09-003.
4. The results of the torsigraph were transmitted in the FaAA report entitled, "Steady State torsigraph test of Emergency Diesel Generator #1 at San Onofre Nuclear Generating Station."

NOTE: A visual inspection, Magnetic Particle examination and Ultrasonic tests were performed on connecting rod throws 1, 6 and 10 with satisfactory results. This was reported by TER# 09-005.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.

COMPONENT REVIEW (continued)  
Engine 2 (continued)

3. An Eddy Current and Liquid Penetrant tests were performed on main journal oil hole #9 after polishing with satisfactory results. This was reported by TER# 09-017.

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

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GROUP CHAIRPERSON Nita A. Saleta PROGRAM MANAGER JC Kammerer

The recommended acceptance criteria for eddy current inspections of main journal oil holes are shown in Table 1. Crack indications with magnitude less than the specified notches are acceptable.

TABLE 1

Main Journal Oil Hole Inspections for San Onofre

Journal Location	Depth of Notch* (mils)		
	0" to 1" from Journal Surface	1" to 2" from Journal Surface	2" to 3" from Journal Surface
Between Cylinders 8 & 9	20	30	40
Between Cylinders 9 & 10	20	30	40

\* Width of notch is twice the depth.

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

COMPONENT NO. 02-310A

Effective Printout Date: 10/01/84

COMPONENT TYPE: CRANKSHAFT

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
While feeding steam generators with the diesel driven auxiliary feed pump, the diesel tripped on low lube oil pressure. Steam generator level was maintained by using the steam driven auxiliary feed pump. The diesel failure was due to a broken crankshaft. Inspection of the engine did not reveal a cause for the failure. A metallurgical analysis of the crankshaft is being conducted. Manufacturer: Electro-Motive Div. of GM.	LER, Trojan; 344-7700, 770324	Insufficient information in reference document for evaluation.
During performance of surveillance procedures, 2303-N16 "Emergency Diesel Generator and Cooling Water Valve Operability Test," the "B" diesel generator failed to start. The redundant emergency diesel generator was operable. Cause was attributed to improper material in vertical shaft between upper and lower crankshaft. Manufacturer: Fairbanks-Morse S02757/1	EPRI TMI. 2, 052078, DG-2B	Insufficient information in reference document for evaluation.

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
A Delaval diesel generator at Shoreham fractured its crankshaft at the crankpin and crankarm. Examination of 2 other diesels showed cracks on the crankshaft and crankpin bearing failure. Manufacturer: TDI	I&E Shoreham notice 83-58, 08/30/83	Problem associated with inadequate design. San Onofre crank pins are adequately designed.
Cylinder No. 4 had excessive threading (radial grooves) on the crankshaft bearing. The crankpin was discolored and the cylinder liner was grooved in 3 places, 10 inches long by 1/16 inch deep. Manufacturer: TDI	10CFR50.55E MP&L, Grand Gulf 12/10/81, 04/15/82	Problem not related to design. Problem caused by deposits on crankshaft bearing.
Info-procedure to measure crankshaft thrust clearance. Manufacturer: TDI	TDI SIM 283	No impact on adequacy of crankshafts.
Crankshaft overall lengths have increased and therefore require a modified inspection cover. Installation is prevented because of interference with the lube oil strainer. Interference may be eliminated by effecting reduction in the length of the cover by reducing the flange thickness and facing the end plate from 11/16 inch to 1/4 inch thickness.	TDI Letter to LILCO 01/10/84 S/N 74010/12 to Mike Herlihy (LILCO)	No impact on adequacy of crankshafts.
Info-instructions for flushing lube oil header.	TDI SIM 141	No impact on adequacy of crankshafts.

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

NON-NUCLEAR

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

Titan Navigation, Inc., Letter dated July 22, 1982; pg. 11.

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

Experienced engine vibration at crankshaft due to vibration damper coupling failure. (M/V Columbia)

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

Not applicable since engines at San Onofre do not have vibration dampers.

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

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

Insufficient information in reference documents for evaluation.

During normal operation engine experienced a low lube oil pressure alarm. Engine was shut down for inspection and two cracks were found at the No. 5 crankpin. (M/V Glenco Minnesota)

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

Crankshafts used in this engine had smaller crankpins than San Onofre. San Onofre crankpins are adequately designed.

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

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

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

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

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

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

No indication of a bent crankshaft at San Onofre.

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

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

Resulted from failure of another component.

The original crankshaft was bent during the overspeed.

Sales Order No. W-25354 07/13/81. Rafha Electric Co. Eng. No. 79003. Model DSR-48 (File T-57).

No indication of a bent crankshaft at San Onofre.

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

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

Not relevant to design considerations at San Onofre.

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

COMPONENT <u>Main Bearings</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-310B</u>	TASK DESCRIPTION NO. <u>DR-09-02-310B-0</u>
SNPS GPL NO. <u>03-310B</u>	CLASSIFICATION TYPE <u>A</u>

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TASK DESCRIPTION

Design review for this component is not required based on:

- The base and bearing loads for the DSRV-20 diesel at San Onofre at 70 percent load were calculated and compared to those of TDI DSRV-16 diesel engines at 100 percent load. In addition, a journal orbit analysis was performed on selected bearings.
- Peak oil film pressures calculated for the V-20 diesel are less than those for the V-16 diesels, and the minimum oil thickness is greater than for the V-16 diesels.
- The engines at Comanche Peak and San Onofre use the same bearing shells (TDI Part numbers R-3303, R-3315 and R-3317). A comparison of operating characteristics indicate that the main bearing shells are acceptable for use at San Onofre.

At the next fuel outage it is recommended that the bearings be inspected for evidence of misalignment. If harmful misalignment is discovered, corrective alignment procedures should be implemented.

There are no modification recommendations for this component.

The following quality inspections are recommended to be performed:

- Perform a dimensional check of the bearing shell to verify that thickness is within TDI specifications.
  - Visually examine (if left in place) sample bearings for excessive wear or cracking. Minimum sample shall be middle main bearing shell. If the shells are removed, then perform a liquid penetrant inspection.
-



COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-310B-0

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

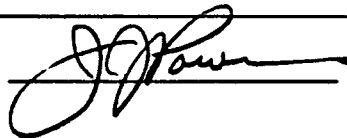
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DOCUMENTATION REQUIRED

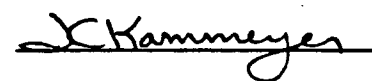
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Crankshaft &amp; Bearings: Thrust Bearing Ring</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-310C</u>	TASK DESCRIPTION NO. <u>DR-09-02-310C-0</u>
SNPS GPL NO. <u>03-310C</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

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

- A review of the Comanche Peak and Shoreham DR/QR reports which establishes the acceptability of the thrust bearing ring assembly for its intended purpose.
- A review of the Component Tracking System indicates that there was no significant applicable nuclear or non-nuclear experience.
- Stresses imposed by engine operation are less at San Onofre than at Shoreham due to lower peak cylinder firing pressure and reduced BMEP at full load.

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

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

There are no modification recommendations for this component.

PRIMARY FUNCTION

Not required

COMPONENT DESIGN REVIEW CHECKLIST

ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

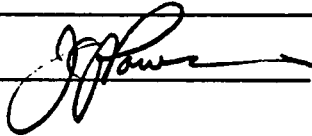
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DOCUMENTATION REQUIRED

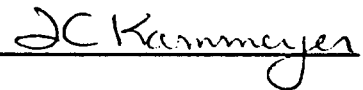
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT Crankcase: Crankcase Assembly UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-311A TASK DESCRIPTION NO. DR-09-02-311A-0  
 SNPS GPL NO. 99-311A CLASSIFICATION TYPE A

---

TASK DESCRIPTIONS

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

The routine maintenance for this component should consist of inspecting the region between the crankcase vertical arch wall and the nut pocket for cracking. This inspection should take place during each refueling outage. The first inspections after 185 hours at or near full load may be used to justify discontinuation of future inspections.

There are no modification recommendations for this component.

It is recommended that the following Quality inspections be performed on both stations:

- 1) Verify the material of the crankcase based on foundry records;
- 2) Perform a visual inspection on the vertical portion of the casting arch wall of the crankcase for machined surfaces with sharp corners in the surface configuration.

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

SPECIFIED STANDARDS

Not required

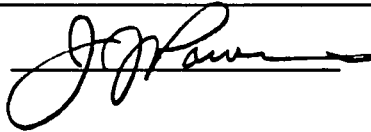
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REFERENCES

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER

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COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Crankcase - Crankcase Assembly</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-311A</u>	REV. NO.	<u>1</u>
SNPS GPL NO.	<u>99-311A</u>		

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TASK DESCRIPTIONS

Engine 1

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

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

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

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

Engine 1

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

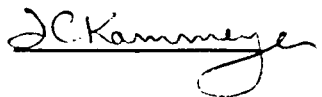
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT REVIEW

Engine 1A

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

Engine 1B

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

NOTE: Both crankcases were visually inspected for any damage to the connecting rods or bearings with satisfactory results. This was reported by TER# 09-006.

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RESULTS AND CONCLUSION

Engine 1A

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 1B

Same as Engine 1A

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GROUP CHAIRPERSON

Nita A. Saleta

PROGRAM MANAGER

J. Kammerer



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

COMPONENT <u>Crankcase: Crankcase Mounting Hardware</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-311D</u>	TASK DESCRIPTION NO. <u>DR-09-02-311D-0</u>
SNPS GPL NO. <u>99-311C</u>	CLASSIFICATION TYPE <u>A</u>

TASK DESCRIPTIONS

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

The crankcase mounting hardware used at San Onofre is identical to Comanche Peak, with the exception of the nut for the crankcase upper bolt, (P/N 97143). The use of a different nut is not of concern since a conservative analytical modeling of the bolting at Comanche Peak found the bolt to be the critical element in the fastener system. This analysis also showed a significant factor of safety against yielding and bolt fatigue.

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-09-02-311D-0

REFERENCES

Not required

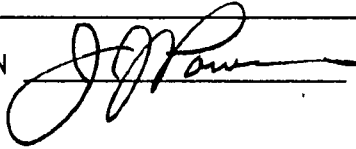
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DOCUMENTATION REQUIRED

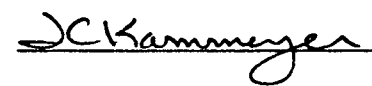
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

Crankcase: Crankcase Gaskets COMPONENT <u>and Mounting Hardware</u>	UTILITY <u>Southern California Edison</u>
COMPONENT PART NUMBER <u>02-386B</u>	TASK DESCRIPTION NO. <u>DR-09-02-386B-0</u>
SNPS GPL NO. <u>99-386B</u>	CLASSIFICATION TYPE <u>C</u>

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

There are no maintenance or modification recommendations for this component.

Quality inspections performed to date for engine 1A have been reviewed and found satisfactory.

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

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

PRIMARY FUNCTION

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-386B-0

ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

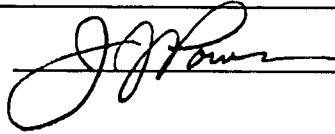
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DOCUMENTATION REQUIRED

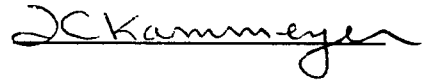
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



TDI OWNERS GROUP

for

SAN ONOFRE NUCLEAR GENERATING STATION - UNIT 1

CYLINDER BLOCK  
COMPONENT PART NO. 02-315A

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 cylinder blocks to determine their adequacy of design for the intended use at San Onofre. The blocks are manufactured by TDI and are supplied under their part number 02-315-03-AE. The cylinder block forms the framework of the liquid cooled engine and provides passage for coolant and support for the cylinder liners and cylinder heads.

II OBJECTIVE

The objective of this review was to evaluate the structural adequacy of the cylinder block for its intended use at San Onofre Nuclear Generating Station.

III METHODOLOGY

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

- Review of engine operating conditions at San Onofre and identification of any differences from those at Shoreham.
- Performance of dimensional check and evaluation of cylinder liner/block interaction.
- Evaluation of steady state stresses, alternating stresses and stiffness in key portions for the cylinder block.
- Evaluation of postulated crack growth from cylinder block landing and counterbore diameter by comparison with conservative Shoreham data and analysis.
- Review of liquid penetrant inspections of San Onofre RV-20-4 engines No. 1 and No. 2 engine blocks.
- Review of metallurgical/microstructure analysis of cylinder block top material.
- Review of San Onofre site, nuclear and non-nuclear experiences (see Appendix C).
- Review of Quality Revalidation Checklist results for acceptability.

IV RESULTS AND CONCLUSIONS

Emergency diesel generator operation at San Onofre is at a reduced level of 6000 kW (100 percent load). This load capacity represents only 69 percent of the nameplate capacity of DSRV-20-4 diesel engine (8750 kW). The engine operation conditions at San Onofre were compared to those at Shoreham and Comanche Peak. No differences were found that would adversely affect the structural integrity assessment of the San Onofre blocks.

Diesel generators (DG) No. 1 and No. 2 have completed substantial operational experience. DG-1 has completed 732.5 hours of operation as of August 6, 1984. The load breakdown for this service is: 478 hours at zero load; 2 hours at 25 percent; 102 hours at 50 percent; 119 hours at 75 percent; 1.5 hours at 83.3 percent; 26 hours at 100 percent; and 4 hours at 110 percent load. DG-2 has completed 632.5 hours of operation as of August 6, 1984 with a load breakdown of: 471 hours at zero load; 2 hours at 25 percent, 2 hours at 50 percent; 126 hours at 75 percent; 1.5 hours at 83.3 percent; 26 hours at 100 percent; and 4 hours at 110 percent load.

Microstructural evaluations of the left and right blocks of DG-1 and DG-2 have been performed and indicate that the right block of DG-1 contains degenerate Widmanstätten graphite. The other three engine blocks DG-1-Left, DG-2-Left and DG-2-Right are characteristic of typical ASTM A48 Class 40 gray cast iron.

It is recommended that cylinder liner bore and mating block dimensions be checked in order to evaluate the interaction of the block and cylinder liner. For the purpose of analyzing the steady state and alternating stresses present, the cylinder liner/bore interaction is assumed to be similar to that present at Shoreham. This assumption must be verified for engines No. 1 and No. 2 during the next refueling outage. This assumption enables the use of the cumulative damage analysis. The cumulative damage analysis is explained in Reference 2. However, if block top inspections recommended to be conducted at the next refueling outage indicate that no ligament, stud-to-stud or stud-to-end cracks are present then dimensional checks can be waived until the next major engine disassembly.

Evaluation of steady state stresses, alternating stresses and stiffness in key portions of the cylinder block was accomplished as part of the strain gage testing at Shoreham and the results were included in the cumulative damage and crack growth analyses (Ref. 2). The power output for this engine is 6000 kW at 100 percent load. Power output required for LOOP/LOCA is 4500 kW for 1 hour and 2000 kW for 167 hours.

Strain gage testing of the original Shoreham EDG 103 block, block top inspection for crack size before and after extensive engine testing, and materials testing were used as a basis to predict the maximum crack extension in the cylinder blocks of other EDGs. The rate of propagation of cracks between stud holes in the original Shoreham EDG 103 block top during testing at high load levels was compared with the San Onofre LOOP/LOCA requirements; results show that even if the San Onofre blocks DG-1-Left, DG-2-Right and DG-2-Left should develop ligament and stud-to-stud cracks up to 1.5 inches in depth, these blocks are predicted to withstand, with sufficient margin, a LOOP/LOCA event (Ref. 2).

To date block top inspections have been performed only on Engine DG-2 (3 cylinders from each block) resulting in no detectable ligament, stud-to-stud or stud-to-end cracks. Even without relying upon these sample inspections, application of the cumulative damage analysis (Ref. 2) indicates that the blocks of DG-2 can operate for 603 full power (6000 kW) hours (or variable power operation resulting in equivalent cumulative damage) without block top inspection.

Engine block DG-1-Right, which has been shown to contain degenerate Widmanstätten graphite, can operate with sufficient margin to withstand a LOOP/LOCA event provided no stud-to-stud or stud-to-end cracks are present.

To date, complete block top inspections of DG-1 have not been performed. Provided Engine 1 blocks do not have block top cracks, continued engine operation at full power (6000 kW) without inspection is justified for 80 hours for block DG-1-Right and 603 hours for block DG-1-Left (or variable power operation resulting in equivalent cumulative damage for the corresponding block).

If block top cracks are detected, continued engine operation with blocks DG-1-Left, DG-2-Right and DG-2-Left is justified with implementation of block top inspections as outlined in Figure 5.1 of Reference 1. For engine block DG-1-Right continued engine operation is also justified with ligament cracks, so long as eddy current inspections are performed at cylinder stud locations where ligament cracks are present at least monthly and after any period of engine operation above 2950 kW. Continued operation will maintain sufficient margin should a LOOP/LOCA occur based on the reduced San Onofre LOOP/LOCA power requirements in comparison with Shoreham experience used to benchmark the cumulative damage analysis (Ref. 2).

If stud-to-stud or stud-to-end cracks are detected in DG-1-Right there is currently no analytical basis to assure suitability of that block for its intended function.

Additional operation without continual eddy current inspections is justified after reinspection of the block top if no ligament, stud-to-stud, and stud-to-end cracks are present. If none are found, then additional engine operation without inspection may be performed until the corresponding additional fatigue damage index equals the allowable fatigue damage index (AFDI) at the time of the last complete block top inspection. This process may be repeated after each complete block top inspection throughout the life of the engines.

The information provided on the following TER's has been reviewed and is consistent with the final conclusions of this report: 09-018.

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, the blocks of DG-2 are acceptable for their intended use at San Onofre.

Based on the above review and implementation of block top inspections specified herein and in Ref. 1, it is concluded that the cylinder blocks of DG-1 are acceptable for their intended use at San Onofre.

#### IV REFERENCES

1. Design Review of TDI-R4 and RV-4 Series Emergency Diesel Generator Cylinder Blocks and Liners. FaAA-84-9-11.1.
2. FaAA Support Package Number SP-6-12(e)



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

Cylinder Block-Liners  
and Water Manifold:  
 COMPONENT Cylinder Block UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-315A TASK DESCRIPTION NO. DR-09-02-315A-1  
 SNPS GPL NO. 03-315A CLASSIFICATION TYPE A

TASK DESCRIPTIONS

Review liquid penetrant inspections of San Onofre RV-20 engine block tops and review engine operating experience.

Review engine operating conditions of San Onofre and identification of any differences from those at Comanche Peak.

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

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

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

Review metallurgical/microstructural analysis of cylinder block top material.

Review of San Onofre site, nuclear and non-nuclear experiences. (See Appendix C).

Review of Quality Revalidation Checklist results for acceptability.

Review information provided on TERs.

PRIMARY FUNCTION

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

ATTRIBUTE TO BE VERIFIED

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

COMPONENT DESIGN REVIEW CHECKLIST

Page A2 of 2  
DR-09-02-315A-1

SPECIFIED STANDARDS

None

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REFERENCES

None

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DOCUMENTATION REQUIRED

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

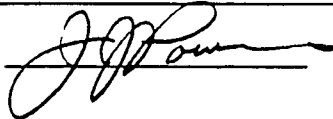
Engine operating history (time vs. load) for operation prior to block top inspection, and for total engine hours.

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

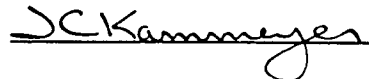
Engine factory test logs that report firing pressures and exhaust temperatures for each cylinder.

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Cylinder Block</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-315A</u>	REV. NO. <u>4</u>
SNPS GPL NO. <u>03-315A</u>	

TASK DESCRIPTIONSEngine 1

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

TASK DESCRIPTIONS (continued)

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

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

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Review of inspection report by Design Group
- 3-4. See Attachment A
- 5-6. Review of inspection report by the Design Group

Engine 2

Same as Engine 1

---

COMPONENT QUALITY REVALIDATION CHECKLIST

Page B3 of 6  
09-02-315A

REFERENCES

Engine 1

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

Engine 2

Same as Engine 1

---

DOCUMENTATION REQUIRED

Engine 1

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

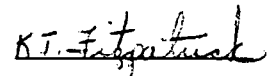
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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COMPONENT REVIEW

Engine 1

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

COMPONENT REVIEW (continued)

Engine 1 (continued)

- 2-5. No inspection reports have been received which fulfill these requirements.
- 6. Results of the block sample analysis was given in TER# 09-022.

Engine 2

- 1. No EDGCTS site experience documents have been received from the Owner.
- 2-3. No inspection reports have been received which fulfill these requirements.
- 4. A Liquid Penetrant test was performed on top of the cylinder block for cylinders 2L, 6L, 10L, 2R, 6R and 10R with satisfactory results. This was reported by TER# 09-018.
- 5-5. No inspection reports has been received which fulfills this requirement.
- 6. Results of the block sample analysis was given in TER# 09-022.

---

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

Nick A. Seletka

PROGRAM MANAGER

K.T. Fitzpatrick

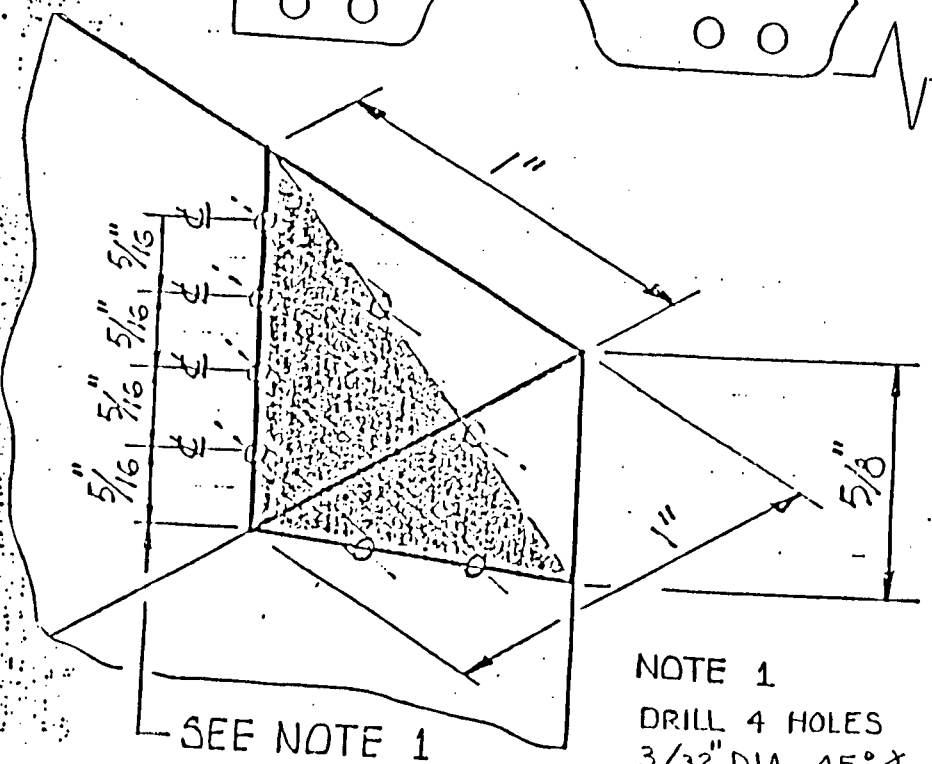
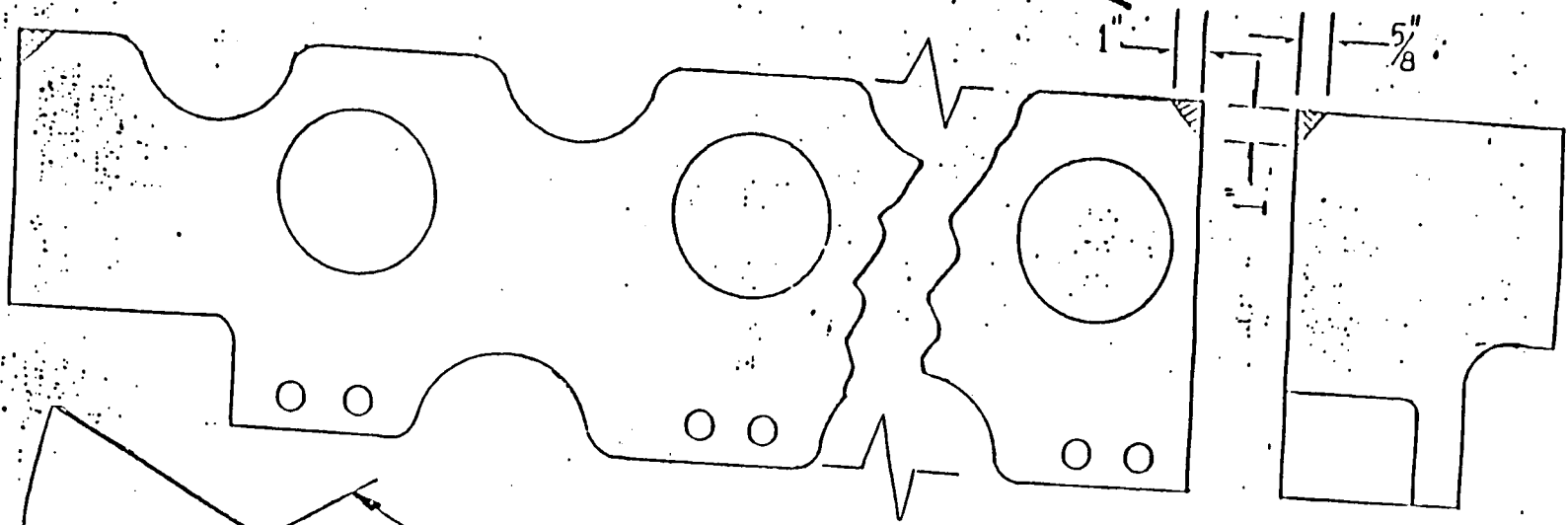
COMPONENT QUALITY REVALIDATION CHECKLIST

ACCEPTABLE CRITERIA

- A) Area to be inspected
  - 1. Top of Block
  - 2. Liner counterbore
- B) Reference Standard ASTM E125
- C) Evaluation of indications
  - 1. Relevant indications are:
    - a) Hot tears and cracks, linear indications that exceed ASTM E125 Class I-2
    - b) Shrink that exceeds ASTM E125 Class II-3
    - c) Inclusions that exceed ASTM E125 Class III-3
    - d) Porosity that exceeds ASTM E125 Class V-1
  - 2. All indications exceeding the specification listed above shall be documented and submitted to the Design Group.
  - 3. Indications that do not exceed the ASTM E125 reference regardless of size and quantity are acceptable.
- D) Non Relevant Indication
  - 1. The indications referenced below shall be considered non relevant.
    - a) Magnetic writing
    - b) Linear grain boundaries (carbon, ferrite, or graphite induced)
    - c) Rounded grain boundaries (carbon, ferrite, or graphite induced)

SEE ISOMETRIC DETAIL A-A

TYP. EITHER END



NOTE 1  
DRILL 4 HOLES  
3/32" DIA. 45°  
CUT OUT PIECE

SEE NOTE 1

ISOMETRIC DETAIL A-A  
(DARKENED AREA INDICATES  
CUTTING PLANE)



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

COMPONENT NO. 02-315A

Effective Printout Date 10/15/84

COMPONENT TYPE: Cylinder Block

<u>EXPERIENCE</u>	<u>REFERENCE DOCUMENTS</u>	<u>SAN ONOFRE STATUS</u>
<u>SAN ONOFRE</u>		
None		
<u>NUCLEAR</u>		
Cylinder block repair for corrosion.	SIM 247	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at San Onofre.
Gasket groove of 7R cylinder was cracked.	Service Report TPC Nuclear Plant No. 3 Maanshan Dec. 9, 1983 (File No. T-45)	Inspection of block tops at intervals governed by inspection results and accumulated operation will confirm block reliability at San Onofre.
<u>NON-NUCLEAR</u>		
The forward outboard cylinder block of the starboard main engine of the vessel cracked because of the entry of water from the cooling system into the air intake system of the engine.	Letter 04/21/83 J. Blain to W. Busch; Complaint C.A. No. H-83-2420 filed U.S. District Ct. 52, p.4.; U.S. Salv. Assoc. Rpt. 52-15573, 07/01/82; Amer. Bur. Ship. Rpt. HA-81-2539, 12/16/81; Salv. Assoc. Rpt. CH0830, 04/01/82.	No impact on San Onofre. Reference intercooler report.

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Block cylinder bores were found egg shaped.

Hunton & Williams to C. Seaman 12/29/83; Memo M. Zbinden to R. Ward 01/16/81

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

Extensive cracking of cylinder block.

Hunton & Williams to C. Seaman 12/29/83; Memo M. Zbinden to R. Ward 03/13/81

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

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

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to File 04/29/81

No impact on San Onofre. Isolated initial assembly problem.

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

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to File 04/09/81; M. Zbinden to R. Ward 03/13/81

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

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

Hunton & Williams to C. Seaman 12/29/83; M. Zbinden to R. Lind 06/17/81

No impact on San Onofre.

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

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

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

Engine derating will lessen thermal stresses of cylinder block.

SES Report 123-01, pp. 4-6, 4-7

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

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

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

SES Report 123-01, 04/83, pp. 3-14, 3-28, 6-3

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

Deformation of counterbore lip of cylinder liner block caused by metallic fatigue.

Engine Rebuild Report for Alaska 03/31/81, pp. I, I-10

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

Block deformation caused by cracks, metallic fatigue creep, overload of counterbore lip, close proximity of cooling water holes, close proximity of head retaining studs, and thread termination for studs level with counterbore depth is causing high stress concentration area.

Engine Rebuild Report for Alaska 03/31/81, pp. I-9, V, V-10, VI, VIII and Summary pp. 26, 27

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

Engine crankshaft out of alignment; possibly from engine block misalignment.

Engine Rebuild Report for Alaska 03/31/81, pp. V-10, V-12, VI

Reference crankshaft report for San Onofre. No impact on San Onofre.

Reported cracks between heads and liner bores.

Memo from E. Sigrist (TDI) to G.E. Trussell (TDI) dated 11/08/82 (File No. T-10) City of Homestead, Fla.

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

Reported cracks between the head stud holes and liner bores.

Letter from R. Pratt (TDI) to John Smith, City of Homestead, Fla. dated 06/17/82 (File No. T-2) City of Homestead, Fla.

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

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Engine block cracked from improper placing and tightening of head gaskets.

Memo from E. Sigrist (TDI) to G.E. Trussell (TDI) dated 11/08/82 (File No. T-10) City of Homestead, Fla.

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

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

Letter from R.C. Grindeland (BIEHL) to C. Mathews (TDI) 03/16/81 (File No. T-14)

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

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

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

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

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

Letter from M. Lowrey (TDI) to H. Blanding (American Bureau of Shipping) dated 12/30/83 (File No. T-30).  
Letter from M. Lowrey (TDI) to H. Taylor (American Bureau of Shipping) dated 10/28/83 (File No. T-30).  
Minutes of meeting between TDI and USSGLF on 12/20, 21, 1983 (File No. T-30).  
Letter from R. Bertz (USSGLF) to A. Barich (TDI) dated 04/07/83 (File No. T-30).  
Letter from R. Bertz (USSGLF) to M. Lowrey (TDI) dated 07/14/83 (File No. T-30).  
Minutes of meeting between TDI and USSGLF dated 06/17/83 (File No. T-30).

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

EXPERIENCE

REFERENCE DOCUMENTS

SAN ONOFRE STATUS

Cracks in the engine block at a point between the cylinder head hold-down studs and the cylinder liner bore. These cracks were repaired in Unit 18 but the same type of block cracks have reappeared in both Units 18 and 19 in several stud locations on each.

Letter from A. Muxo (City of Homestead) to C.S. Mathews and R. J. Bazzini (TDI) dated 05/31/82 (File No. T-10).  
Letter from A. Muxo (City of Homestead) to C. S. Mathews dated 12/13/82 (File No. T-10).  
Letter from J. A. Smith (City of Homestead) to G.E. Trussell (TDI) 06/14/77 (File No. T-10).  
Comments by City of Homestead, Fla. on the observations of R.A. Pratt and G.E. Trussell tested in the Transamerica Delaval Survey Report, 08/10/82 (File T-10)

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

Cylinder block cracking.

Minutes of meeting between USS Great Lakes Fleet Service Inc. and TDI dated 04/13/84 (File No. T-46).  
Telex from G. Trussell (TDI) to R. Bertz (USS-GLF) dated 04/08/83 (File No. T-46).  
Letter from R. Bertz (USS-GLF) to A. Barich (TDI) dated 04/07/83 (File No. T-46).  
Agenda TDI and USS-GLF dated 04/13/83 (File No. T-46)  
American Bureau of Shipping Report by D.W. Johnson Report No. DL4702 dated 03/22/83. (File No. T-46)

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

EXPERIENCEREFERENCE DOCUMENTSSAN ONOFRE STATUS

Cracks in engine block.  
Florida

Letter 05/13/82 from  
City of Homestead,  
Fla. to TDI (Oakland  
and New York) Units  
18 and 19 (File T-64)

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

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

TDI Letter to  
Metalok International  
05/12/81 (File No.  
T-50), Greg Beshouri  
(TDI), D. Venning  
(Metalok Int. Assn.  
Ltd). Enterprise  
Oak (Geoff King) to  
Beshouri 05/28/81-2  
(File T-50). Photocopy  
of preliminary report  
on crack on left  
cylinder (4th) by G.K.  
Rao (Bhel). Memo dated  
05/11/81 Bob Bailey  
(Riyadh) to G. King  
(Oakland) (File T-50)

Isolated incident. Not a  
design related problem.  
No impact on San Onofre.

Cracked block on Unit  
No. 19.

Letter from John A.  
Smith (City of  
Homestead) to G.E.  
Trussell (TDI)  
06/17/77.  
(File No. T-55)

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

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

Rafha Electricity Co.  
and Suburbs, Saudi Co.  
Ltd., Saudi Arabia  
dated 07/12/81.  
No addressee or  
transmittal letter  
available. No. 3  
gen. (File No. T-57)

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

EXPERIENCE

REFERENCE  
DOCUMENTS

SAN ONOFRE  
STATUS

Cylinder block fracture caused by high compressive stresses on the counter-bore lip. Localized stress condition from the combinations of sharp internal corner for lip (1/32 inch radius), nearby drilling for water jacket or stud. Termination of stud threading at the same level, creep deformation, and fatigue. (M/V Columbia)

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

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

Cylinder block repaired by Metalok.

Telex 05/28/81 G. King (TDI) to Desrumeax/Wilder/Beshouri-Jizan 77036 TDI File No. T-50

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

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

Cylinder Block Lines & Water  
 COMPONENT Manifold - Cylinder Liners UTILITY Southern California Edison  
 GROUP PARTS LIST NO. 02-315C TASK DESCRIPTION NO. DR-09-02-315C-1  
 SNPS GPL NO. 03-315C CLASSIFICATION TYPE A

---

TASK DESCRIPTIONS

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

The following is recommended as a maintenance item:

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

There are no modification recommendations for this component.

The following Quality inspections are recommended to be performed on both station engines:

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

PRIMARY FUNCTION

Not required

ATTRIBUTE TO BE VERIFIED

Not required



COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-315C-1

SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

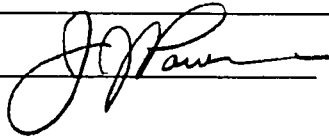
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DOCUMENTATION REQUIRED

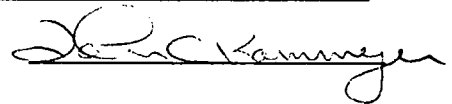
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT <u>Cylinder Liner</u>	UTILITY <u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO. <u>02-315C</u>	REV. NO. <u>4</u>
SNPS GPL NO. <u>03-315C</u>	

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Verify liner dimensions including bore, length, height, O.D. and shoulder height.
3. Visually inspect the outside pilot diameter where it contacts the cylinder block.
4. Visually inspect the cylinder liner over the zone of piston travel.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper cylinder liner dimensions
3. Indications of contact spalling
4. Indications of scuffing and scoring

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package
2. Liner dimensions are in accordance with the TDI Instruction Manual.
- 3-4. Review of inspection report by Design Group

Engine 2

Same as Engine 1

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REFERENCES

Engine 1

1. QCI No. 52
2. Approved Site NDE Procedures, TDI Instruction Manual
- 3-4. Approved Site NDE Procedures

Engine 2

Same as Engine 1

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DOCUMENTATION REQUIRED

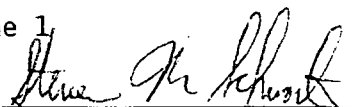
Engine 1

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

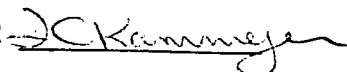
Engine 2

Same as Engine 1

GROUP CHAIRPERSON



PROGRAM MANAGER



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COMPONENT REVIEW

Engine 1

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.
3. Cylinder liner bore measurements were taken during the piston modification work done in 1982. The results were reported by TER# 09-018.

Engine 2

1. No EDGCTS site experience documents have been received from the Owner.
2. No inspection report has been received which fulfills this requirement.
3. Cylinder liner bore measurements were taken during the piston modification work done in 1982. The results were reported by TER# 09-018.
4. No inspection report has been received which fulfills this requirement.

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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

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GROUP CHAIRPERSON

Nilda A. Salata

PROGRAM MANAGER

JC Kammerer

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

Jacket Water Manifold  
Piping

COMPONENT (Large Bore Scope Only) UTILITY Southern California Edison

GROUP PARTS LIST NO. 02-315D TASK DESCRIPTION NO. DR-09-02-315D-0

SNPS GPL NO. 03-315D CLASSIFICATION TYPE B

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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 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.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-315D-0

REFERENCES

Not required

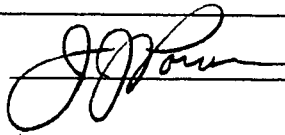
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DOCUMENTATION REQUIRED

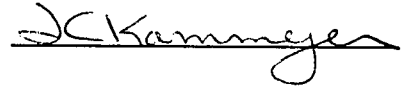
Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



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

COMPONENT <u>Cylinder Block Liners</u> & <u>Water Manifold: Studs</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-315E</u>	TASK DESCRIPTION NO: <u>DR-09-02-315E-0</u>
SNPS GPL NO. <u>02-315E</u>	CLASSIFICATION TYPE <u>B</u>

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TASK DESCRIPTIONS

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

The following modifications to the head stud installation procedure is recommended to lower the stresses in the cylinder block stud boss area (Ref. 1).

- Lubricate the cylinder head stud blockside threads with engine oil.
- Torque the studs into the block to 80-120 ft-lbs. Use the necessary lockwashers (shims) to obtain a stud free length of 15"  $\pm$  1/16". (Caution: Do not use impact type tools to tighten the studs). The free length is measured from the block top to the end of the cylinder head stud.

Care should be taken not to further tighten the headstuds during installation of the heads and torquing of the head stud nuts to 3600 ft-lbs.

There are no maintenance recommendations for this component.

The following Quality inspections are recommended to be performed on all station engines:

- Perform a visual inspection of head studs for signs of distress. Examine four cylinders per engine.
  - Determine the material of four studs.
  - Determine the hardness of one stud.
  - Verify the proper torque loads were applied by a review of existing documentation.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-315E-0

PRIMARY FUNCTION

Not required

---

ATTRIBUTE TO BE VERIFIED

Not required

---

SPECIFIED STANDARDS

Not required

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REFERENCES

1. TDI Diesel Generator Owners Group letter (DGTP-296-0-156) File: MTS-4086 (dated 09/24/84) cylinder head stud modification and revised installation procedure.
- 

DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER

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

COMPONENT <u>Cylinder Block Liner &amp; Water Manifold - Cylinder Head Nuts</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-315F</u>	TASK DESCRIPTION NO. <u>DR-09-02-315F-1</u>
SNPS GPL NO. <u>02-315F</u>	CLASSIFICATION TYPE <u>B</u>

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TASK DESCRIPTION

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

- A review of the Comanche Peak and Shoreham DR/QR Reports which establish the acceptability of the cylinder head nuts for their intended purpose.
- A review of nuclear and non-nuclear industry experience indicated there had been no design related failures associated with this component. The cylinder head nuts are identical on all the Owner's Group TDI Diesel Engines (TDI Part No. F-090-021).
- Stresses imposed by engine operation are less at San Onofre than at Shoreham because of lower peak cylinder firing pressure and reduced BMEP at full load.

The only adverse experience occurred at Shoreham and involved a cracked nut attributed to a forging lap during manufacturing, and did not impair engine operation.

There are no maintenance or modification recommendations for this component.

Quality inspections performed to date have been reviewed and found satisfactory.

The following Quality Revalidation inspection recommendations are made to ensure component quality:

- Visually examine all nuts for identification markings.
  - Verify the proper installation and torquing of remaining nuts.
  - Perform a visual inspection of the nuts for signs of forging laps.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-315F-1

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

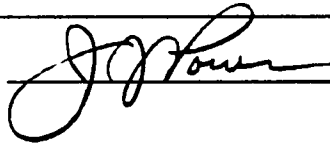
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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER



COMPONENT QUALITY REVALIDATION CHECKLIST

COMPONENT	<u>Cylinder Block Liner &amp; Water Manifold - Nuts</u>	UTILITY	<u>Southern California Edison San Onofre Nuclear Generating Station - Unit 1</u>
GPL NO.	<u>02-315F</u>	REV. NO.	<u>2</u>
SNPS GPL NO.	<u>03-315F</u>		

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TASK DESCRIPTIONS

Engine 1

1. Assemble and review existing documentation.
2. Perform a visual examination of all nuts for identification markings.
3. Verify the proper installation and torquing of the nuts.
4. Perform a visual inspection of the nuts for signs of forging laps.

Engine 2

Same as Engine 1

---

ATTRIBUTES TO BE VERIFIED

Engine 1

1. Quality status of Component Document Package
2. Proper identification markings on nuts
3. Proper installation and torque loads are applied to the cylinder head stud manifold nuts.
4. Nuts are free from forging laps.

Engine 2

Same as Engine 1

---

ACCEPTANCE CRITERIA

Engine 1

1. Satisfactory Document Package.
2. Identification markings of all nuts are recorded.
3. Torque values applied to the nuts are in compliance with TDI Instruction Manual.
4. Nuts are free from forging laps.

Engine 2

Same as Engine 1

---

REFERENCES

Engine 1A

1. QCI No. 52
2. Approved Site NDE Procedures
3. Approved Site NDE Procedures, TDI Instruction Manual
4. Approved Site NDE Procedures

Engine 2

Same as Engine 1

---

DOCUMENTATION REQUIRED

Engine 1

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

DOCUMENTATION REQUIRED: (continued)

Engine 2

Same as Engine 1

GROUP CHAIRPERSON

*Steve R. Schmitt*

PROGRAM MANAGER

*J. Kammerer*

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COMPONENT REVIEW

Engine 1A

1. No EDGCTS site experience documents are in evidence.
2. No inspection report has been received which fulfills this requirement.
3. The nuts were torqued to 3600 ft-lbs for cylinders 1R, 1L, 6R, 6L, 10R and 10L in accordance with the TDI Instruction Manual. This was reported by TER# 09-007.
4. No inspection report has been received which fulfills this requirement.

Engine 1B

1. No EDGCTS site experience documents are in evidence.
2. No inspection report has been received which fulfills this requirement.
3. The nuts were torqued to 3600 ft-lbs for cylinders 2R, 2L, 6R, 6L, 10R and 10L in accordance with the TDI Instruction Manual. This was reported by TER# 09-007.
4. No inspection report has been received which fulfills this requirement.

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RESULTS AND CONCLUSION

Engine 1A

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 4 of 4  
09-02-315F

RESULTS AND CONCLUSION (continued)

Engine 1B

Same as Engine 1A

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GROUP CHAIRPERSON Nita A. Saleta

PROGRAM MANAGER J. Kammerer

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

Cylinder Block-Liners and Water Manifold: COMPONENT <u>Seals and Gaskets</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-315G</u>	TASK DESCRIPTION NO. <u>DR-09-02-315G-0</u>
SNPS GPL NO. <u>03-315G</u>	CLASSIFICATION TYPE <u>B</u>

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TASK DESCRIPTIONS

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

Per TDI SIM 315 all major engine elastomeric sealing pieces should be changed from Buna-N/ethylene propylene/silicon materials to cured E-60c viton seals. Therefore a review of the applicable site documentation should be performed to verify that the proper cylinder liner seals (TDI P/N JF-019-000) have been installed in the diesel generators.

There are no maintenance recommendations for this component.

Quality revalidation for this component is not required.

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PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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COMPONENT DESIGN REVIEW CHECKLIST

REFERENCES

Not required

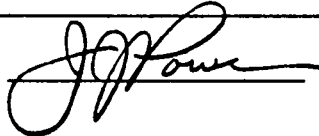
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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER

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

COMPONENT <u>Cylinder Block</u> <u>Covers: Gaskets &amp; Bolts</u>	UTILITY <u>Southern California Edison</u>
GROUP PARTS LIST NO. <u>02-385B</u>	TASK DESCRIPTION NO. <u>DR-09-02-385B-0</u>
SNPS GPL NO. <u>03-385B</u>	CLASSIFICATION TYPE <u>C</u>

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TASK DESCRIPTIONS

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

There have been cases of fastener failures on the cylinder block covers, however, these failures are not attributed to design deficiencies of this component. Based on the lead engine DR/QR report, the recommended torque value of 30 ft-lbs is appropriate and the specified bolting and stud materials (SAE GR 5 and SAE GR 1120 respectively) are acceptable for their intended function of holding the covers onto the cylinder block. Isolated failures can occur when the torque is not applied properly or a lesser grade material is substituted. Barring any deviations as mentioned above the bolting is acceptable for use on the diesel engines.

To verify that the proper torque is applied and the specified material is installed, plant personnel should review site documentation or perform the necessary inspection to make these determinations.

There are no modifications recommended for this component.

The following Quality inspections are recommended to be performed on all station engines:

- Visually inspect gaskets for signs of elastomeric compound breakdown and cracking;
  - Verify that the proper bolt torque loads are applied by reviewing the existing documentation.
-

COMPONENT DESIGN REVIEW CHECKLIST

Page 2 of 2  
DR-09-02-385B-0

PRIMARY FUNCTION

Not required

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ATTRIBUTE TO BE VERIFIED

Not required

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SPECIFIED STANDARDS

Not required

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REFERENCES

Not required

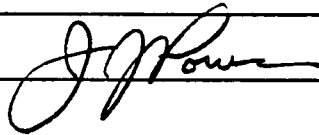
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DOCUMENTATION REQUIRED

Not required

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GROUP CHAIRPERSON



PROGRAM MANAGER

