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June 20, 1986

Director, Office of Nuclear Reactor Regulation
Attention. G. E. Lear, Director
PWR Project Directorate No. 1
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-206
Inspection Report on Emergency Diesel Generator No. 2
San Onofre Nuclear Generating Station
Unit 1

Reference: (A) Letter, M. O. Medford (SCE) to G. E. Lear (NRC), dated May 19, 1986, Inspection Report on Emergency Diesel Generator No. 1

Enclosed for your review are the results of inspections performed on emergency diesel generator no. 2 at the San Onofre Nuclear Generating Station, Unit 1. These inspections were performed during the current Unit 1 refueling outage in order to comply with the recommendations of the TDI Diesel Generator Owners Group, as contained in the San Onofre Unit 1 Design Review and Quality Revalidation (DR/QR) Report dated February 1985.

The inspection results for diesel generator no. 1 were submitted to you by the referenced letter.

If you have any questions, please call me.

Very truly yours,

M. O. Medford

Enclosure

cc: R. Dudley, NRC/NRR San Onofre Unit 1 Project Manager
F. R. Huey, NRC Senior Resident Inspector, Units 1, 2 and 3
J. B. Martin, NRC Region V, Regional Administrator
D. E. Broeils, Duke Power Co., TDI DG Owners Group

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INSPECTION REPORT
EMERGENCY DIESEL GENERATOR NO. 2
SAN ONOFRE NUCLEAR GENERATING STATION
UNIT NO. 1

INTRODUCTION:

SCE has performed a major inspection on the emergency diesel generator no. 2 at San Onofre Nuclear Generating Station, Unit 1. The inspection occurred from March 1986 to May 1986. This inspection was performed to comply with the recommendations of the TDI Diesel Generator Owners Group Design Review/Quality Revalidation (DR/QR) report. The DR/QR report was submitted to the NRC on September 3, 1985.

Major 16 Components/Phase I

Sixteen components were originally identified as the most significant affecting the safety function of the diesel generators. The following work was performed to meet all of the DR/QR report recommendations:

Air Start Capscrews

Dimensional checks were performed on all air start capscrews. Material and hardness checks were made on four capscrews. Torque (cold and hot) was verified on reassembly. Service Information Memo (SIM) 329 was implemented during the previous outage and SIM 360 performed during the current outage. All inspections were satisfactory.

Auxiliary Module Wiring and Terminations

Wiring and terminations were replaced during a previous outage in accordance with TDI's SIM 361 and 10 CFR 21 notification. No work was performed during the current inspection.

Connecting Rods

An NDE of all connecting rod assemblies was performed. No linear indications were found. All bushings and pins were dimensionally checked and are satisfactory.

A sample of four connecting rods was checked for material and hardness and found to be satisfactory.

An eddy current test was performed on all rod box female threads with no defects found. NDE was performed on all connecting rod bolts with satisfactory results. Inspection of link rod alignment was performed in accordance with SIM 349. Alignment was found to be satisfactory.

Connecting Rod Bearing Shells

All connecting rod bearing shells were visually inspected and were satisfactory. All shell dimensions were checked satisfactorily.

Crankshaft

Main bearing journal holes #1 through #12 were examined by penetrant test (PT) and no cracks were found. All main and crank pin journal fillets and crank pin oil holes were NDE inspected with no indications found. Crankshaft connecting rod pins were dimensionally checked and visually inspected and main journals were visually inspected with satisfactory results. Web hot and cold deflection measurements were performed satisfactorily.

All cross-drilling oil hole plugs were inspected in accordance with 10 CFR 21 notification dated 3/18/85. 16 gauge plugs were found and no deficiency noted.

Engine Base and Bearing Caps

The entire base and bearing caps were visually inspected. No indications were found.

Fuel Oil Injection Tubing

100% eddy current examination was performed by our consultant Failure Analysis Associates. A visual exterior inspection was also performed. The results were satisfactory and met SCE's commitment to the NRC in letter dated June 29, 1984.

Jacket Water Pump

Dimensional, material, hardness and PT checks were performed on the shaft and gear. The shaft was found to be 410 stainless steel instead of 303 stainless steel, as assumed by the DR/QR report revalidation criteria. The shaft was accepted as is based on TDI's recommendation.

Cylinder Liners

All cylinder liners were visually inspected and found satisfactory. All liner diameters except 1L, 2L, 3L, 7L are slightly less than the acceptance criteria of 17.000" to 17.080". The average undersize is 0.001", which provides for a slightly tighter fit. Cross hatch and ring wear are normal. There is no effect on function and the liners are acceptable.

Liner 7R was removed due to a water leak from the lower "O" ring seals. The liner was visually inspected and its dimensions checked. Results were satisfactory.

Piston Skirts

75% of the pistons were disassembled and inspected (25% done during a previous outage). The break away torque of the crown nuts could not be measured due to castle nut lock pin not being removable. Piston skirt outside diameters (OD) and pin clearances were measured and are satisfactory.

Piston 4R skirt spot face depths (3 of 4) are insignificantly out of tolerance and are acceptable, based on SCE's engineering evaluation.

Cylinder Block

NDE was performed on the liner landing with liner 7R removed. NDE was performed between adjacent studs and the stud to liner areas on both block tops. No indications were found. Liner landing dimensions were not fully checked due to no indication of overstress on the liner landing.

Cylinder Heads

The following inspections were performed on all heads:

1. Visual
2. Liquid penetrant of valve seating surfaces
3. Ultrasonic to determine fire deck thickness.
4. Magnetic particle examination of fire deck surfaces.
5. Maintenance matrix recommendations were performed satisfactorily during post maintenance testing.

13 heads were found by magnetic particle examination to have linear indications on the firing deck. Two of these heads had additional visual cracks in the air start valve assembly opening. Three heads were repaired by grinding to remove indications and were reused. Ten new heads qualified to Group III standards were obtained from TDI and installed to replace heads not repairable onsite.

The current status of all installed heads is as follows:

50% (10) heads have been qualified to current standards for Group III heads.

35% (7) are original heads that satisfactorily met all DR/QR inspections.

15% (3) are repaired heads that satisfactorily met all DR/QR inspections.

The 10 heads not qualified to Group III standards will be replaced in subsequent outages, as committed to in SCE's letter to the NRC dated December 19, 1984.

Cylinder Head Studs

Visually inspected head studs for signs of distress for cylinders 4R, 4L, 6R and 6L. Material analysis identification tests were performed on four randomly selected studs. Hardness test was performed on 2L#4. All studs were found satisfactory.

Push Rods

Liquid penetrant examination was performed on all pushrod ends. Visual inspection for full insertion of forged head into tubes was performed. Four push rods which had linear indications were replaced with spares. Previous work had replaced all ball head push rods with friction welded push rods. Future purchases will include sample radiograph inspection or destructive examination.

Rocker Arm Capscrews

Performed magnetic particle test of the thread root area of all capscrews for linear indications. Also performed material comparator and hardness test on four capscrews. All capscrews were found to be satisfactory. A visual inspection on the drive studs was performed for signs of irregularity. Torquing was verified on reassembly.

Turbochargers

Performed turbocharger rotor end play inspection on all four turbochargers with satisfactory results.

All four turbochargers were fully disassembled for an internal inspection. This inspection included:

1) visual inspection,
2) verification of proper number of bolts on the turbine inlet casing,
3) verification of proper torques, and
4) PT on stationary nozzle ring for signs of adverse wear and cracking.

The right front turbocharger was found to have blade damage on the turbine disc. The rotor assembly was replaced by a qualified in kind spare. The rotor blade damage is believed to have been caused by a foreign object. The right rear turbocharger shaft seal diameter was found out of tolerance. The shaft seal was replaced with a qualified in kind spare.

Right rear, left rear and left front turbochargers were found to have worn bearings, cracks and some other surface indications on the shaft thrust collar face. The shaft is made from 4140 carburized steel. The thrust collar face is finish ground and has a Rockwell hardness of 55-60 RC. The cracks were radial, approximately 1/4 inch long and located on the outer edge of the

pressure face, adjacent to the seal groove. The other indications were approximately 1/2 inch in diameter and 0.002 inch deep and were located on the pressure face, extending from approximately halfway out on the diameter to the outer edge.

The bearing wear was most likely caused by lack of lubrication (a service condition which no longer exists). A meeting with the turbocharger manufacturer (Elliot Company) failed to clarify the specific cause of the thrust collar cracks or of the other indications. No discoloration typical of metal overheating was observed.

Two of the above turbochargers were replaced with qualified in kind spares. One was rebuilt by the manufacturer and then re-installed.

Base line vibration data were taken on all four turbochargers.

Balance of Reviewed Components/Phase II

The balance of the components reviewed by the Owners Group (Phase II) is tabulated by major categories with summaries of the recommended actions and the work performed during the current outage.

IAA:6889F

PHASE II REVIEW

Component	Owners Group Recommended Action	Summary of Work Performed
TURBO, INTAKE, INTERCOOLER AND EXHAUST		
Turbocharger (MM 19/20)	Additional maintenance and inspection recommendations. Prelubrication procedures should be followed.	See Phase I.
Turbocharger Thrust Bearing Drip Lube System (Small Bore Scope Only) (02-CFR)	Addition/modification of supports. Refer to DR/QR report 02-CFR for details.	Modification not required.[1] Flow orifice was cracked during reassembly and was replaced with an in kind qualified spare.
Intake Manifold and Piping (Large Bore Scope Only) (02-375)	Additional maintenance recommendations. Additional Quality inspections recommended.	Visually inspected air intake manifold elbow flange faces and increased bolt hole size to 1/8" oversize (5/8" ID) in accordance with design review recommendations. Install intake manifolds drain lines. Inspection and modification completed satisfactorily.
Exhaust Manifold Piping (02-380A)	Flat bar which connects the shroud to the engine should be modified to allow for axial thermal-expansion. Addition of slip joints. Additional maintenance recommendations. Inspections of cap screws recommended. Replace 3/8-inch bolts that connect the water jacket shroud to the manifold assembly with 1/2-inch bolts.	Modifications not required.[1] Visually inspected. NDE of a sampling of pipe welds was performed. Results acceptable.
Exhaust Manifold: Gasket and Bolting (02-380B)	Additional Quality inspections recommended.	Verified torque on exhaust manifold bolting. Performed visual inspection of exhaust manifold to verify freedom from binding and flange fillet welds are free from cracks. All found satisfactory.
Turbocharger Bracket, Bolting and Gaskets (02-475A&D)	Additional design review inspection recommended.	Inspected turbocharger brackets mounting bolts to verify torque and thread engagement.
Air Butterfly Valve Assembly (02-475B)	Addition of grease fittings per TDI SIM 322. Additional maintenance requirements. Additional Quality Revalidation inspections recommended.	Disassembled and performed inspection on air strangulation valves. All satisfactory. SIM 322 was implemented previously.
Turbocharger Bracket-Air Intake Piping (02-475C)	Each crossover piping system should be supported by two flexible anchors only. Remove all U-bolts and strap supports.	None required.[1]
Turbocharger Bracket Pipe Supports (Large Bore Scope Only) (02-475E)	None	None required.
Flex Connections (02-805C)	Additional maintenance recommendation.	Visually inspected.
Intake Air Silencer (02-805D)	None	Inspected interior of each silencer to ensure both ends of centerline "bullet" are welded on. Inspected for end cap using mirrors in accordance with 10 CFR 21 dated 11/10/85. All end caps welded.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Intercooler (41-127A)	Additional maintenance recommendations.	Inspected condition of tubes and shell for scaling, sediment or corrosion and cleaned as required. Pressure tested all intercoolers.
Intercooler Piping and Piping Couplings, Gaskets and Bolting (041-127B&C)	Addition/modification of supports. Refer to DR/QR report 041-127B&C for details.	None required.[1]
	LUBE OIL	
Lube Oil Full Pressure Strainer (SE-014)	Inspect and clean the strainer element at any significant increase in differential pressure and at each refueling outage. Check differential pressure during each engine operation.	Cleaned and inspected strainer for holes or physical damage.
Lube Oil Pressure Regulating Valve (00-420)	Disassemble and clean the valve annually or at each refueling outage. To ensure proper clearance, the dimensions of the valve internal parts should be checked.	Disassembled, cleaned and inspected two valves. Spool spring compression retainer on one valve was found cracked and was replaced with qualified in kind spare.
Lube Oil Fittings - Internal Headers (Large Bore Scope Only) (02-307A-LB)	None	None required.
Lube Oil Fittings - Internal: Headers (02-307A-SB)	Modify supports. Refer to DR/QR report 02-307D for details.	Refer to item 02-307D.
Lube Oil Fittings Internal Tube and Fittings (Small Bore Scope Only) (02-307B)	Check tubing for dents or crimps. Perform gear train spray check.	Checked tubing for dents and crimps. Cam bearing lube oil supply line was dented during the overhaul and was NDE'd and pressure tested and reused. Performed gear train spray check. All inspections were satisfactory.
Lube Oil Fittings Internal - Supports (Small Bore Scope Only) (02-307D)	Replacement of all 1/4-inch U-bolts with 3/8-inch U-bolts on the auxiliary internal lube oil header. Installation of suitable locking devices on nuts.	None required.[1]
Engine Driven Lube Oil Pump (02-420)	None	Disassembled and inspected with satisfactory results.
Lube Oil Lines External: Tubing, Fittings and Couplings (Large Bore Scope Only) (02-465A-LB)	Addition of support to provide a stiffer load path and to relieve seismic stresses on the external header. Recommendation for a minimum installation gap between the pipe ends of 0.1/1 inch.	None required.[1]
Lube Oil Lines - External Tubings, Fittings, Couplings (02-465A-SB)	Modify supports. Refer to DR/QR report 02-465B for details.	None required.[1]

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Lube Oil Lines - External Supports (Large Bore Scope Only) (02-465B-LB)	None	None required.
Lube Oil Lines External: Supports (Small Bore Scope Only) (02-465B-SB)	Modify supports, U-bolts and locking devices. Refer to DR/QR report 02-465B for details.	None required.[1]
Turbocharger - Lube Oil Fitting - Pipe, Tubing and Flexible Coupling (Large Bore Scope Only) (02-467A-LB)	Perform a comparison of the as-built configuration with the assembly details.	None required.[1]
Turbocharger Lube Oil Fitting: Pipe, Tubing, Fittings and Flexible Coupling (Small Bore Scope Only) (02-467A-SB)	Addition/modification of supports. Refer to DR/QR report 02-467B for details.	None required.[1]
Turbocharger - Lube Oil Fitting and Supports (Large Bore Scope Only) (02-467B-LB)	None	None required.
Turbocharger - Lube Oil Fittings: Supports (Small Bore Scope Only) (02-467B-SB)	Addition/modification of supports. Modification of U-bolts. Installation of locking devices. Refer to DR/QR report 02-467B for details.	None required.[1]
Lube Oil Sump Tank with Strainer Assembly and Mounting Hardware (02-540A&C)	Visual inspection of the tank seam and assembly welds recommended. Recommendation to measure engine, tank and pipe displacement at next refueling outage. Verify proper bolt torque.	L.O. System Inspection: 1. Sump a. Interior for rust, corrosion and weld seam integrity b. Suction strainer c. Sump cover gaskets Verified lube oil sump tank mounting bolt torque.
Lube Oil Sump Tank Misc. Fittings, Gaskets, Bolting Material, Valves (Small Bore Scope Only) (02-540B)	None	None required.
Lube Oil System Auxiliary Lube Oil Pump (02-545)	None	None required.
Auxiliary Sub Base and Oil and Water Piping Lube Oil: Pipe/Fittings (Small Bore Scope Only) (02-717F)	Addition/modification of supports. Refer to DR/QR report 02-717F for details.	Modification not required.[1] Keep warm pump suction strainer inspected and cleaned.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Auxiliary Sub Base and Oil and Water Piping: Lube Oil Valves (02-717G)	Additional maintenance requirements.	Relief valves 200 and 201 were tested and reinstalled.
Auxiliary Sub Base and Oil and Water Piping: Lube Oil: Gaskets & Bolting (02-717H)	The auxiliary piping should be walked down daily to verify the leak tightness of the lube oil piping flanges.	Performed routinely.
Intake Air Filter (02-805B)	Additional maintenance requirements.	Inspected distribution plates and changed oil.
Miscellaneous Equipment - Heater, Lube Oil Sump Tank (02-820A)	Additional maintenance recommendations.	Inspection and work included: 1. Measuring heater insulation resistance. 2. Replacing heater elements. 3. Checking calibration and inspecting condition of thermostat.
Lube Oil Heat Exchanger (02-820B)	Additional maintenance recommendations.	Disassembled, cleaned and inspected L.O. heat exchanger.
Full Flow Lube Oil Filter (02-820C)	Additional maintenance requirements	Changed filters.
Prelube Oil Pump (02-820D)	Additional maintenance recommendation.	Overhauled.
Oil Prelube Filter (02-820E)	Additional maintenance recommendations.	Changed filters.
	ENGINE BASE AND BEARING CAPS	
Base and Bearing Caps - Base Assembly, Main Bearing Studs and Nuts and Main Bearing Caps (02-305A,C,D)	Additional maintenance recommendations. Additional Quality inspections recommended.	See Phase I.
	CRANKSHAFT AND BEARINGS	
Crankshaft (02-310A)		See Phase I.
Main Bearings (02-310B)	Additional Quality inspections recommended.	Measured all main bearing shell thicknesses. PT performed on all main bearing shells. Indications were noted in three bearing halves due to babbit flaking. The affected bearing halves were replaced.
Crankshaft and Bearings: Thrust Bearing Ring (02-310C)	Additional maintenance recommendations.	Performed thrust check and visually inspected thrust bearing ring.
Crankcase: Crankcase Assembly (02-311A)	Additional Quality inspections recommended.	Visually inspected crankcase. Insignificant casting flaws noted.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Crankcase: Crankcase Mounting Hardware (02-311D)	None	None required.
Crankcase: Crankcase Gaskets and Mounting Hardware (02-386B)	Additional Quality inspections recommended.	Inspected bolt holes on crankcase covers for cracks. No deficiencies noted.
Crankcase Relief Valve and Vacuum Fan (02-385A)	Additional maintenance recommended.	Disassembled and inspected crankcase vent fans and measured insulation resistance. Cleaned flame arrestor portion of relief valve.
	CYLINDER BLOCK, LINERS AND WATER MANIFOLD	
Cylinder Block (02-315A)	Verify cylinder liner bore and mating block dimensions. Additional Quality inspections recommended. Additional maintenance inspections recommended.	See Phase I
Cylinder Block Liners and Water Manifold - Cylinder Liners (02-315C)	Additional maintenance recommendations. Additional Quality inspections recommended.	See Phase I
Jacket Water Manifold Piping (Large Bore Scope Only) (02-315D)	Perform a non-destructive examination of subject piping component to ensure the integrity of pipe welds. Inspect inaccessible piping to ensure adequate seismic restraint.	Performed NDE of large bore jacket water piping welds. No indications noted. Further seismic restraint inspection not warranted.[1]
Cylinder Block Liners and Water Manifold: Studs (02-315E)	Modify head stud installation procedure to lower the stresses in the cylinder block stud boss area. Additional Quality inspections recommended.	See Phase I
Cylinder Block Liner and Water Manifold - Cylinder Head Nuts (02-315F)	Additional Quality Revalidation inspections recommended.	Performed a visual examination for forging laps and identification markings on cylinder head nuts. No problems noted. Verified torque on reassembly.
Cylinder Block - Liners and Water Manifold: Seals and Gaskets (02-315G)	Verify installation of proper cylinder liner seals (TDI P/N JF-019-000) in diesel generators.	The cylinder liner 7R that was removed was reinstalled using TDI part number JF-019-000.
Cylinder Block Covers: Gaskets and Bolts (02-385B)	Verify that the proper torque is applied and the specified material is installed. Additional Quality inspections recommended.	Visually inspected cylinder block cover gaskets for signs of elastometric compound breakdown and cracking. No problem noted. Verified torque on reassembly.
	AIRSTART AND BARRING DEVICE	
Starting Air Distributor: Distributor Assembly (00-442A)	Additional Quality Revalidation inspections recommended. Additional maintenance recommendations.	Visually inspected the poppet valves spool ends and timing. No problems noted.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Starting Air Distributor - Tubing, Fittings and Gaskets (00-442B)	All Air Distributor Tubing is addressed under component numbers 02-441A&C.	See component numbers 02-441A&C.
Air Start Valves (02-359)	Implementation of SIMs 329 and 360. Additional maintenance recommendations. Additional Quality inspections recommended.	All twenty air start valves were inspected. Eight valve faces had cracks per penetrant test results. #9L failed to close. Two valves failed blue check and were replaced. All other valves were polished, reinspected and found satisfactory for continued service. See Phase I for capscrews.
Starting Air Manifold: Piping, Tubing and Fittings (Large Bore Scope Only) (02-441A-LB)	Addition/modification of supports. Refer to DR/QR report 02-441A-LB for details.	None required.[1]
Starting Air Manifold - Piping, Tubing and Fittings (Small Bore Scope Only) (02-441A-SB)	Modify supports. Refer to DR/QR report 02-441C for details.	None required.[1]
Starting Air Manifold: Valves, Strainers, Filters (02-441B)	Additional maintenance requirements.	Changed filter elements. Cleaned, inspected and refurbished block valves.
Starting Air Manifold Support (Large Bore Scope Only) (02-441C-LB)	None	None required.
Starting Air Manifold - Supports (Small Bore Scope Only) (02-441C-SB)	Addition of two-directional supports to the tubing running from the distributor to the horizontal tubing runs on top of the engine. Addition of a two-directional lateral support to each 1/2-inch tube entering and exiting the air filter.	None required.[1]
Barring Device - Pneumatic Regulator Valve/ Shutoff Valve (02-525B)	None	None required.
Barring Device - Pneumatic: Mounting Bracket/Supports (02-525D)	None	None required.
Starting Air Tank (02-835E)	Additional maintenance recommendations.	Inspected tanks. Cleaned flow traps and calibrated pressure switches. Tanks were State recertified.
Air Start Tank Relief Valves (02-835G)	None	None required.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Skid Base - Starting Air Equipment (02-835A,F&H)	Additional maintenance recommendations.	Replaced leaking inlet check valve. Air compressor crankcase oil sampled, drained, flushed and refilled. Verified pressure relief valve spring and changed setpoint per FCN S1109-M. Inspected and cleaned compressors. Replaced belts. No problems noted. Inspected and serviced moisture traps in starting air system. All drain traps were cleaned and are in satisfactory condition.
	CONNECTING RODS	
Connecting Rods: Connecting Rods and Bushings (02-340A)	Additional inspections recommended.	See Phase I
Connecting Rod: Bearing Shells (02-340B)	Additional maintenance requirements. Additional Quality Revalidation inspections recommended.	See Phase I
	PISTONS	
Piston (02-341A)	Additional inspections of the stud boss attachment area recommended. Additional Quality inspections recommended.	See Phase I
Pistons: Rings (02-341B)	Additional maintenance and Quality Revalidation inspection recommendations.	Disassembled pistons and inspected rings. Two oil rings on 8R piston were damaged during maintenance and were replaced.
Piston: Piston Pin (02-341C)	Replacement of spiral ring retainers with Waldes SNAP ring retainers (P/N GE-003-067). Additional Quality inspections recommended. Additional maintenance recommendations.	All piston pin dimensions were checked and found satisfactory. Pin to bushing clearance was calculated; 14 pin clearances were undersized but acceptable as is. Chrome finish and end plugs inspected. Two end plugs were rerolled. Installed Waldes SNAP ring retainers.
	CAMSHAFT AND VALVE TRAIN	
Tappets and Guides: Intake and Exhaust Tappet Assembly (02-345A)	Additional maintenance recommendations. Additional Quality inspection recommended.	Tappet roller to tappet roller pin clearance was checked. Tappet rollers were visually inspected. Freedom of rotation was checked and found satisfactory.
Tappets and Guides: Fuel Tappet Assembly (02-345B)	Additional maintenance recommendations. Additional Quality inspections recommended.	Work performed similar to 02-345A.
Tappets and Guides: Fuel Pump Base Assembly (02-345C)	None	None required.
Camshaft: Camshaft Assembly (02-350A)	Additional maintenance and Quality Revalidation inspection recommendations.	Visually inspected for premature wear.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Camshaft: Camshaft Bearings (02-350B)	None	Completed cam and thrust bearing inspection satisfactorily.
Camshaft-Supports, Bolting and Gears; Idler Gear Assembly - Crank to Pump Gear; Idler Gear (02-350C, 02-355A&B)	Additional maintenance recommendations. Additional Quality inspections recommended.	Cam gear nut torqued. Performed visual inspection with satisfactory results.
Subcover (02-362A)	Additional inspections and Quality Revalidation inspections recommended.	Four subcovers (assembly web area) were visually inspected. Performed NDE on all subcovers on the machined surfaces of the rocker shaft assembly bolt bosses. Replaced subcovers 10R, 3L, 8R due to linear indications.
Rocker Shaft Assemblies: Intake/Intermediate & Exhaust (02-390A&B)	Additional Quality Revalidation inspections recommended.	Performed dimensional check of rocker arm shafts and bushings and inspected bushings. Performed inspections of rocker shaft assemblies. Rocker arm exhaust pushrod cup in subcover 2R was chipped. Replaced associated rocker arm with in kind qualified spare. Performed material comparator test of intake and exhaust rocker arm shaft for 8R.
Main and connector pushrods (02-390C&D)	Additional Quality Revalidation inspections recommended.	See Phase I
Rocker Arm and Pushrods: Bushings (02-390E)	Additional maintenance requirements.	See 02-390A&B
Rocker Arms and Pushrods: Lifters (02-390F)	Additional Quality Revalidation inspections recommended.	All lifters were inspected and verified to be in the correct position. Reinstalled and adjusted lifters.
Rocker Arms and Pushrods - Miscellaneous Bolts and Drive Studs (02-390G)	Additional maintenance recommendations. Additional Quality inspections recommended.	See Phase I.
IDLER GEAR ASSEMBLY AND FRONT GEAR CASE		
Front Gearcase Bolting (02-335B)	Additional inspections of bolts. Addition of positive locking features (bent tab or lockwire). Additional Quality inspections recommended.	Verified proper installation and torque of internal gearcase bolting.
FLYWHEEL		
Flywheel (02-330A)	None	None required.
Flywheel Bolting (02-330B)	Recommended that the assembly procedures include an effort to keep the flange faces of the flywheel, crankshaft and generator shaft free of antisieze compound. TDI bolt torque requirements should be documented.	Flywheel bolting torque was verified.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
	ENGINE INSTRUMENTATION AND WIRING	
Pyrometer Conduit Assembly: Thermocouples (02-630D)	Additional maintenance recommendations.	Verified thermocouples indicated ambient temperature when engine was cold.
Engine and Auxiliary Module Wiring Material and Fittings: Pyrometer Conduit Assembly - Conduit, Fittings and Supports (02-688A, 02-630A, B, C)	Upgrade conduit supports. Addition of supports for Category I rigid and flexible conduits.	Conduit supports were reviewed as part of a site walkdown/ inspection and were found adequate with respect to seismic considerations. Walkdown covered both diesel generators no. 1 and no. 2.
Engine and Auxiliary Module Wiring Material: Wiring and Terminations (02-688B)	Implementation of TDI SIM No. 361 on Engine No. 1 should be confirmed.	See Phase I.
Engine and Auxiliary Module Wiring Material - Boxes and Terminals (02-688C)	None	None required.
On Engine Alarm Sensors (02-690)	None	None required.
Off Engine Alarm Sensors (02-691A)	None	None required.
	OVERSPEED TRIP AND GOVERNOR	
Overspeed Trip: Governor (02-410A)	Additional maintenance requirements and Quality Revalidation inspections recommendations.	Trip setpoint was verified. Set screws were marked with torque-seal.
Overspeed Trip: Governor and Accessory Drive Assembly (02-410B)	Evaluation of crankshaft torsional response and its effect on the governor and accessory drive assembly is required. Additional Quality Revalidation inspections recommended.	Inspected and performed NDE on overspeed trip governor and accessory drive with satisfactory results. Inspection included: o Confirmation that the material of the accessory drive gear was AISI 4340. o Visual inspection of assembled accessory drive gear for wear. o Measurement of accessory drive gear shaft-to-bearing clearance. o Visual and LP inspection of the governor shaft. o Dimensional check of the governor shaft in the bearing area. o Superficial hardness tests on outer gear tooth flat (top land) of overspeed governor drive gear.
Overspeed Trip: Couplings (Flexible and Spider) (02-410C)	Additional Quality inspections recommended. Additional maintenance recommendations.	New spider and coupling were installed. This meets the requirements of SIM 363.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Vent Valve: Overspeed Trip (02-410D)	Valve "O" ring should be changed every 5 years.	Cleaned, inspected and replaced "O" rings.
Governor Drive: Governor and Tachometer Drive Gear and Shaft (02-411A)	Additional Quality inspections recommended.	Inspected and performed NDE on governor drive gear and shaft. Also inspected for key to keyway clearance. Examination results were satisfactory.
Governor Drive: Couplings, Pins and Keys (02-411B)	Additional maintenance recommendations. Additional Quality inspections recommended.	Verified set screws and lock pins are locked in place. Verified coupling grid color code. Also see 02-411A. Redoweled mounting bracket and plate to restore governor drive assembly clearance and alignment per TDI drawing.
Governor Linkage (02-413A)	Additional maintenance recommendations. Additional Quality inspections recommended.	Greased rod end fittings. Inspected linkage assembly. Installed positive locking hardware.
Fuel Pump Linkage: Automatic Shutdown Cylinder (02-413B)	Additional maintenance recommendations.	Checked automatic shutdown cylinder for extension and return. Checked tailrod vent for leakage. Checks were satisfactory.
Governor Assembly: Woodward Governor (02-415A)	Additional maintenance recommendations. Additional quality inspections recommended.	Operating procedure reviewed to verify compliance with manufacturers recommendations and required testing. Replaced governor assembly. Changed governor oil. Verified control knob settings. Governor linkage oscillation no longer observed after governor assembly was replaced.
Governor Assembly Booster Servomotor (02-415B)	Additional Quality inspections recommended.	Verified correct installation of governor servomotor following replacement with a qualified spare.
	ENGINE SHUTDOWN AND EQUIPMENT	
Engine Shutdown Equipment - Tubing/Fittings & Supports (Small Bore Scope Only) (02-695A)	Addition of two and three direction supports. Reinforcement or redesignment of interface bulkhead between engine and off engine tubing to increase vertical load capacity. Refer to DR/QR report 02-695A for details.	None required.[1]
Engine Shutdown Equipment - Valves, Regulators, Orifices (02-695B)	Additional maintenance requirements.	Pressure regulator will be replaced when parts are available from TDI.
Engine Shutdown Trip Switches (02-695C)	Additional maintenance requirements.	Verified switch setpoints.
	JACKET WATER	
Jacket Water Manifold - Manifold Assembly with Hardware, Coupling and Gaskets (Large Bore Scope Only) (02-316A&B)	Perform a non-destructive examination of subject piping component to ensure the integrity of pipe welds. Inspect inaccessible piping to ensure adequate seismic restraint.	See 02-315D.

1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.

Component	Owners Group Recommended Action	Summary of Work Performed
Water Discharge Manifold: Jacket Water Discharge Manifold, Couplings and Seals (Large Bore Scope Only) (02-317A&B)	Additional maintenance requirement.	Inspection performed routinely.
Water Discharge Manifold: Supports (Large Bore Scope Only) (02-317C)	None	None required.
Jacket Water Pump (02-425A)	Modify torque values for nuts on impeller and shaft. At the drive gear end of the pump shaft, a second hole should be drilled in the threaded end, 90 deg from the existing one to minimize nut rotation required to insert the locking cotter pin. Additional Quality inspections recommended.	See Phase I.
Jacket Water Fittings - Pipe and Fittings (Small Bore Scope Only) (02-435A)	Additional maintenance requirement.	Inspection performed routinely.
Turbo Water Piping - Pipe and Fittings (02-437A-SB) (Small Bore Scope Only)	Replacement of 1/4-inch diameter U-bolts with 3/8-inch diameter U-bolts on turbo water inlet supports for Engine 2, generator end. Addition of two-direction supports on the 1/4-inch tubing from the jacket water outlet headers to the combustion air coolers on both engines.	Modification not required.[1] Inspection performed routinely.
Turbo Water Piping - Pipe & Fittings (Large Bore Scope Only) (02-437A-LB)	Addition of a rigid anchor on the 2 1/2-inch diameter header at the location of the intersection with the two 1 1/2-inch diameter branches.	Modification not required.[1] Inspection performed routinely.
Thermostatic Valves (02-515)	Replacement of the power elements at 3 to 5 year intervals. Additional inspections recommended.	Replaced jacket water thermostatic valve. Verified exhaust ports are centerline horizontal on both valves. Replaced thermopower elements on lube oil valve. Visually inspected for leaks.
Jacket Water Standpipe Pipe, Fittings, Gaskets (02-700A)	None.	None required.
Jacket Water Standpipe and Miscellaneous Bolting Material (02-700F)	Additional inspections recommended.	Visually inspected.
Auxiliary Sub Base, Oil and Water Jacket Water Valves (02-717B)	Monthly inspections for leakage at packing.	Visually inspected.

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Component	Owners Group Recommended Action	Summary of Work Performed
Auxiliary Sub Base & Oil & Water Piping - Jacket Water: Pipe, Couplings, Fittings, Orifices Y-Strainers (Small Bore Scope Only) (02-717C)	Monthly visual inspections for leaks.	Visual inspection routinely performed.
Auxiliary Sub Base and Oil and Water Piping - Jacket Water: Gaskets and Bolting (02-717D)	None	None required.
Auxiliary Sub Base and Oil and Water Piping - Jacket Water: Supports (Small Bore Scope Only) (02-717E)	Addition/modification of supports, U-bolts and locking devices. Refer to DR/QR report 02-717E for details.	None required.[1]
Miscellaneous Equipment - Heater, Jacket Water Standpipe (02-810A)	Additional maintenance recommendations	Jacket water heater was replaced. New heater was meggered and controller calibrated.
Jacket Water Heat Exchanger (02-810B)	None	None required.
Jacket Water Standby Heater Pump (02-810C)	None	Jacket water keep-warm pump was inspected.
	CYLINDER HEADS AND VALVES	
Cylinder Heads (02-360A)	Additional maintenance recommendations. Additional Quality inspections recommended.	See Phase I
Cylinder Head Valves: Intake and Exhaust Valves (02-360B)	Additional inspections and Quality Revalidation inspections recommended.	Inspected intake and exhaust valves and valve to guide clearance. NDE performed on valves with all found satisfactory. Visually inspected subcover for valve guide blowby. Valve inspections: - Visual inspection to verify adequate valve seating (all) - Visual inspection of valve for scuffing, pitting and erosion (all) - Liquid penetrant test on blended radius of stem head for cracking (all) - Valve and valve ring material determination (metal comparator) (16 valves) 4 exhaust valves showed pitting and scuffing on tip. 8 exhaust valves did not show continuous metal seating surface. 1 intake valve had a tip cracked and was replaced. 12 valves only required minor reconditioning and were reused.
Cylinder Head and Valves: Bolting and Gaskets (02-360C)	Replacement of affected seals with those called out in SIM 315. Additional Quality inspections recommended.	All seals meet SIM 315. Visually inspected for signs of distress.

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Component	Owners Group Recommended Action	Summary of Work Performed
Cylinder Head and Valves: Spring (02-360D)	Visually inspect and document the color code of the valve springs.	Inspected for broken or cracked valve springs and verified color code.
	FUEL OIL INJECTION	
Fuel Oil Drip Tank Assembly (00-621A)	None	Repacked fuel oil drip tank pump discharge valve.
Fuel Oil Day Tank (00-621C)	None	None required.
Fuel Injection Pump (02-365A)	Additional maintenance recommendations.	Calibration/operational testing performed on all pumps by offsite contractor. Visually checked pressure bleed screws for erosion. 3R fuel oil injection pump failed calibration test and was replaced with a qualified spare.
Fuel Injection Nozzle Assembly (02-365B)	Additional maintenance recommendations.	Inspected and cleaned tips. Checked nozzle pop pressure. Checked spray pattern. Checked assembly for leakage. Replaced nozzle spray tip on 7L. Disassembled, cleaned and retested on 9L and 6R.
Fuel Injection Equipment Tube Assembly (02-365C)	Additional maintenance recommendations. Additional Quality inspections recommended.	See Phase I
Fuel Injection Equipment Supports (Small Bore Scope Only) (02-365D)	Perform a visual inspection of the support elastomer to check for signs of deterioration or degradation.	Visual inspection was performed and all support elastomers replaced due to deterioration and degradation.
Fuel Pump Control Shaft, Linkage Assembly and Bearings (02-371A&B)	Additional maintenance recommendations. Additional quality inspections recommended.	Inspected fuel pump linkage and bearings for freedom of movement. Greased swivel link on fuel pump assemblies. Routinely inspect and lubricate oil cups.
Engine Driven Fuel Oil Booster Pump (02-445)	Additional quality inspections recommended.	Visually inspected pump gears for pitting and galling and found the gears satisfactory.
Fuel Oil Header - Piping and Tubing (Small Bore Scope Only) (02-450B)	Replacement of fabricated cross on the fuel oil supply crossover header on the governor end of Engine 1 with appropriate wrought fittings (socket welding or butt welding tee and reducers).	Inspected fuel oil valves, piping and components. Modification not required.[1] Engine fuel oil pump discharge valve inlet fitting had a seepage leak and was repaired.
Fuel Oil Headers - Fuel Oil Tubing Supports (Small Bore Scope Only) (02-450D)	Modify supports and U-bolts. Install suitable locking devices on nuts. Refer to DR/QR report 02-450D for details.	None required.[1]
Fuel Oil Filters and Strainers: Filters (02-455A)	Additional maintenance recommendations.	Replaced filters. Verified bowl bolt torquing. Vented on refill.
Fuel Oil Filters and Strainers: Strainers (02-455B)	Additional maintenance recommendations.	Cleaned and inspected. Verified bowl bolt torquing. Vented and refilled.

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Component	Owners Group Recommended Action	Summary of Work Performed
Fuel Oil Filters and Strainers: Mounting Hardware (02-455C)	None	None required.
Auxiliary Sub Base and Oil and Water Piping Fuel Oil: Piping and Fittings (Small Bore Scope Only) (02-717J)	Addition/modification of supports, U-bolts and locking devices. Refer to DR/QR report 02-717J for details.	None required.[1]
Auxiliary Sub Base and Oil and Water Piping: Fuel Oil Valves (02-717K)	Additional maintenance requirements. Additional Quality inspections recommended.	Inspected installation position of fuel oil relief valves.
Auxiliary Sub Base and Oil and Water Piping - Fuel Oil: Gaskets and Bolting (02-717L)	The auxiliary piping should be walked down daily to verify the leak tightness of the fuel oil piping flanges.	Inspection routinely performed.
	GENERATOR	
Generator: Generator (SO-101)	Additional maintenance recommended.	Checked operation of brushes and slip rings. Cleaned and inspected all accessible parts of the generator. Meggered rotor and stator. Verified operation of space heaters. Measured vibration and checked against base line data.
Generator: Generator Controls (SO-102)	None	None required.
Generator - Shaft and Bearing (SO-103)	Additional maintenance recommended.	Checked ring oilers for proper operation and verified oil level. Drained, flushed and refilled bearing housing. Measured bearing housing insulation resistance. Disassembled and inspected bearing and checked clearances.
	CONTROL PANEL ASSEMBLY	
Control Panel Assembly - Cabinet/System (02-500A)	Additional maintenance recommendations.	Inspected and replaced control panel air filter bowl in accordance with 10 CFR 21 notification dated January 22, 1985. Inspected interior of cabinet for cleanliness and cleaned as required. Visually checked wiring for insulation degradation. Visually checked instrument tubing for leaks. Functionally checked cabinet heater and calibration of thermostat. Tested pneumatic S/D board logic. Pressure regulator will be replaced when parts are available from TDI.
Control Panel Assembly - Circuit Breakers and Contact Blocks (02-500C)	Additional maintenance recommendations.	Checked all terminals and cleaned and tightened as required. Visually checked wiring insulation for degradation. Trip checked circuit breakers.
Control Panel Assembly - Accumulator (02-500F)	None	None required.

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Component	Owners Group Recommended Action	Summary of Work Performed
Control Panel Assembly - Valves (02-500G)	Additional maintenance requirements.	System cleanliness maintained by filters and driers. Inspection not warranted.
Control Panel Assembly - Pressure Switches (02-500H)	None	None required.
Control Panel Assembly - Control Relays (02-500J)	Additional maintenance recommendations.	Serviced and tested relays in panels and checked associated alarms. Inspected, cleaned and adjusted as needed.
Control Panel Assembly - Solenoid Valves (02-500K)	None	None required.
Control Panel Components - Piping, Tubing, Fittings (02-500M)	None	None required.
Control Panel Assembly - Terminal Boards/Switches, Wiring (02-500N)	Additional maintenance recommendations.	Cleaned terminal boards and switch contacts. Visually checked wire insulation and terminals for tightness and degradation. Inspected for arcing and overheating.
	ENGINE AND AUXILIARY SUB BASE AND FOUNDATION BOLTS	
Foundation Bolts (02-550)	To ensure continued reliability, the foundation bolts for both engines should be torqued to 600 ft/lbs at the next refueling outage. Additional maintenance recommended.	Torqued generator foundation bolts to 600 ft/lbs. Visually inspected foundation for breaks in the bond between the sole plates and grout.
Auxiliary Sub Base and Oil and Water Piping: Auxiliary Sub Base (02-717A)	None	None required.

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1 Refer to SCE to NRC letter dated September 3, 1985, Enclosure III.