

ATTACHMENT A TO NLS-84-490

SHEARON HARRIS NUCLEAR POWER PLANT  
UNIT 1 - DOCKET 50-400

EMERGENCY DIESEL  
GENERATOR EQUIPMENT

DECEMBER 17, 1984

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The purpose of this report is to discuss the status of the Shearon Harris Nuclear Power Plant (SHNPP) emergency diesel generator equipment. This report is organized as follows:

Section A - Introduction and Discussion of SHNPP Equipment.

Section B - Discussion of Equipment Electrical Loading.

Section C - Discussion of 1984 Inspection Results and Resolution of Phase I Components.

Section D - Discussion of CP&L Plans for Placing the Equipment into Operation.

Section E - Maintenance and Surveillance.

Section F - Discussion of Owner's Group SHNPP Phase II DR/QR Report.



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## SECTION A

## INTRODUCTION AND DISCUSSION OF SHNPP EQUIPMENT

Concerns regarding the reliability of diesel generator units of the type supplied by TDI to SHNPP were first prompted by a crankshaft failure at Shoreham in August 1983. Based upon a review of industry experience with TDI diesel generators, the reliability of a number of components were questioned and deficiencies were identified. The NRC considered that the deficiencies stemmed from inadequacies in design, manufacture, and QA/QC by TDI.

In response to these problems, 13 U.S. nuclear utility owners, including CP&L, formed a TDI Diesel Generator Owner's Group to address operational and regulatory issues relative to diesel generator sets used for standby emergency power. The Owner's Group Program, which was initiated in October 1983, embodied three major efforts:

1. Resolution of 16 known generic problem areas (Phase I Program) intended by the Owner's Group to serve as an interim basis for the licensing of plants.
2. Design review of important engine components and quality revalidation of important attributes for selected engine components (Phase II Program).
3. Identification of any needed additional engine testing or inspections, based on findings stemming from the Phase I and II Programs.

Phase I of the program has been completed with submittal to the NRC by the Owner's Group of 33 reports addressing analyses and evaluations of the 16 known generic problem areas.

Phase II of the program is plant specific and results in a DR/QR (Design Review/Quality Revalidation) Report. The DR/QR Report for SHNPP was issued by Owner's Group Letter QGTP-535-0-328, dated November 15, 1984 and is provided to NRC as part of this submittal.

A maintenance matrix addressing engine future inspections is provided as part of the DR/QR Report (see Volume 4, Appendix II).

The Owner's Group Program has shown that with implementation of their recommendations, the TDI diesel generators are fully capable of reliably performing their intended safety function at full-rated output.

The SHNPP emergency diesel generators were initially ordered in August 1974. The Unit 1 equipment was delivered in 1981 and the Unit 2 equipment in late 1983; SHNPP has four diesel generators at the site, but only two are installed for Unit 1. While there are many parameters, the following tabulates the basic design of the SHNPP diesel generators:

Manufacturer: Transamerica Delaval, Inc. (TDI)  
Model: DSRV-16-4  
Number of Cylinders: 16  
Total Displacement: 76,266 cu. in.  
BHP at RPM: 9074 at 450  
BMEP: 209 psi  
Load Rating: 6500 kw net  
Seismic: Yes  
Electrical Category: Class 1E

BHP = brake horsepower  
BMEP = brake mean effective pressure  
RPM = revolutions per minute  
kw = kilowatts

## SECTION B

## DISCUSSION OF EQUIPMENT ELECTRICAL LOADING

The SHNPP equipment was procured by the plant Architect Engineer (Ebasco) utilizing Specification Ebasco 216-73Tb, "Diesel Engine - Generator Unit and Control Panel for Nuclear Power Plants". The equipment was required to satisfy the following parameters:

- ° 6900 volts, 6500 net kw, 0.8 pf, 60 Hz, and three phase.
- ° Capable of reaching full speed and be ready for loading in no more than 10 seconds, and pick up full-rated load in not more than 45 seconds after receiving a start signal.
- ° Capable of operating at 110 percent of rated load for two hours out of every 24 hours.

By CP&L letter dated July 15, 1983, Mr. M. A. McDuffie to Mr. Harold R. Denton, a revised FSAR Table 8.3.1-2 (Emergency Diesel Generator Loads and Starting Sequence) was provided to update the loadings anticipated to be applied to the diesel generators. Load blocks one through eight are automatically applied to the diesel generators starting at ten seconds after the safeguards signal is actuated. Load Block 9 contains loads that are manually activated. The following tabulates the summation of the 1E loads from the referenced letter:

<u>Engine</u>	<u>Condition</u>	<u>Blocks 1-8 Load, kw</u>	<u>Block 9 Load, kw</u>	<u>Total Load, kw</u>
1A	Safe Shutdown	4821.05	703	5524.05
	LOCA	5247.55	344.5	5592.05
1B	Safe Shutdown	4823.05	748.5	5571.55
	LOCA	5249.55	348.5	5598.05

The maximum load of 5600 kw (5598.05) indicates a substantial margin to the design rating (6500) of the diesel generators. However, it must be noted that these numbers are subject to revision particularly in light of the cancellation of SHNPP Unit 2.

## SECTION C

DISCUSSION OF 1984 INSPECTION RESULTS  
AND RESOLUTION OF PHASE I COMPONENTS

As CP&L is a participating member of the Owner's Group and in conjunction with the Unit 1 construction schedule, a decision was made to disassemble and inspect the engines prior to operation. The engines have only accumulated a small amount of factory operating time (42.2 hours for 1A and 11.2 hours for 1B). The disassembly of both engines began in June 1984 and was complete by about mid-July. Following disassembly, inspections were initiated in accordance with procedures prepared for SHNPP by the Owner's Group. Documentation of these inspections is available at the SHNPP site.

All Owner's Group Phase I recommendations for inspection have been fulfilled except for those applicable to "after operation" of the engine; this applies to the turbocharger and jacket water pump, but the pump was visually inspected and found satisfactory. The remaining recommendations will be implemented following engine reassembly and testing.

The purpose of this section is to briefly discuss the results of these inspections with respect to the 16 generic engine components. While most of this information is contained in DR/QR Report, it is provided in the attached table to simplify the review and add some inspection results not reflected in the report due to the data not being available when the report was prepared.

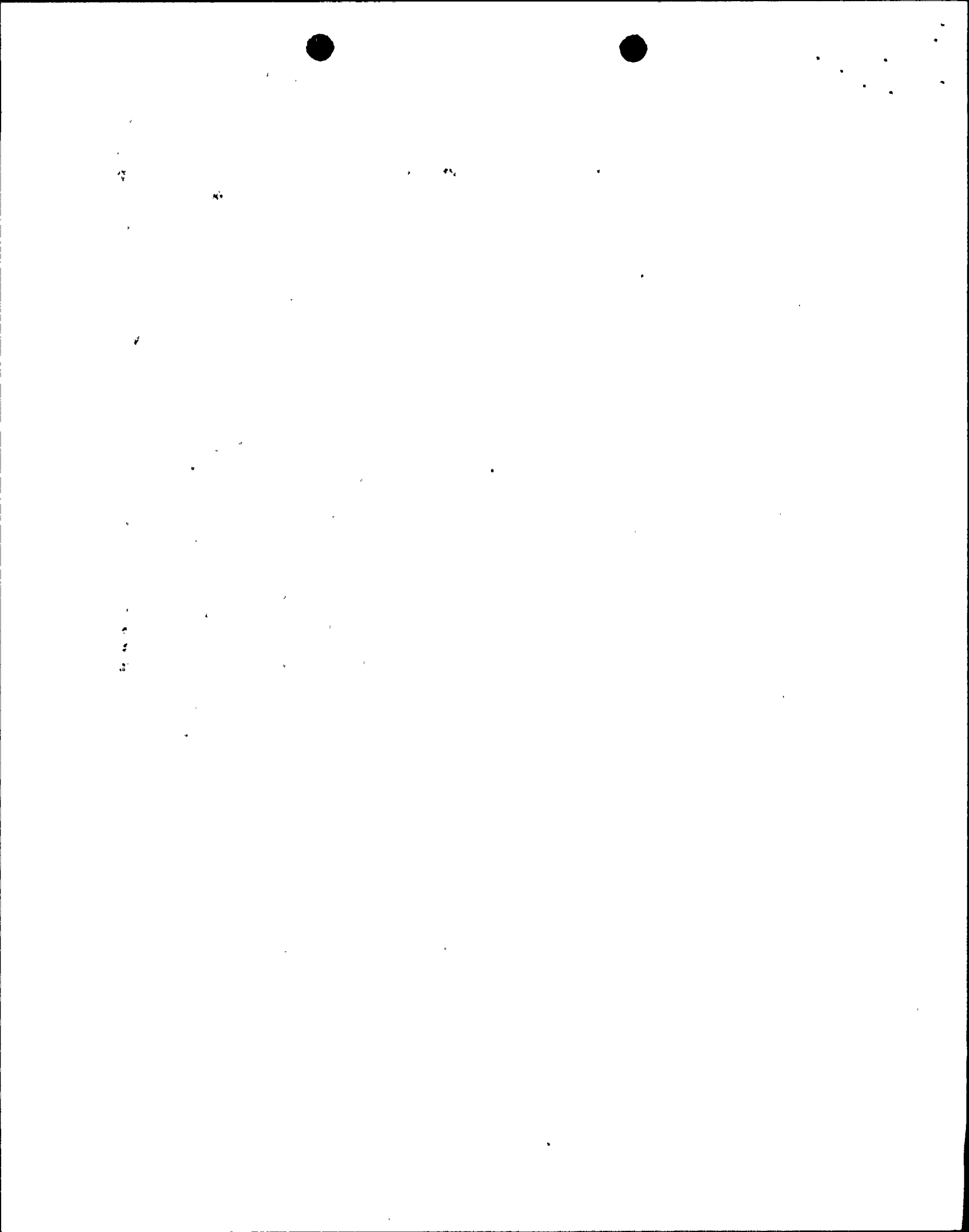
Definitions of inspections are as follows:

ECT -	Eddy Current Testing
LP -	Liquid Penetrant
MT -	Magnetic Particle
RT -	Radiography Test
UT -	Ultrasonic Test

SHEARON HARRIS NUCLEAR POWER PLANT  
 TDI DIESEL GENERATOR  
 PHASE I COMPONENT INSPECTION SUMMARY

<u>Component and Number</u>	<u>Engine IA</u>	<u>Engine IB</u>	<u>Inspections Performed and Results</u>
1. Crankshaft 02-310A	Original	Original	For both engines, visual and ECT was performed. Crankpins and No. 2 through 9 main journal oil holes were honed to a depth of 3 inches or more to achieve a smooth finish. Final ECT was satisfactory.
2. Connecting Rod Bearing Shells 02-340B	1 replaced	5 replaced	Originals have, and replacement shells will, be subjected to visual, dimensional, RT, LP, and ECT.
3. Piston Skirts 02-341A	Install AE design	Install AE design	New components have been LP and MT inspected and found satisfactory. Original AN designs are not being used.
4. Cylinder Heads 02-360A	Group III	Group III	Originals (Gr. II on A) have been replaced with equipment at site and 100% UT inspected. MT and LP performed on 25%. Only acceptable items are being installed.
5. Cylinder & Block and 6. Liners 02-315A and 02-315C	Original	Original	LP tests on surfaces (A-8, B-all) were satisfactory. Liners machined to meet latest TDI design. Samples of both engine blocks have been sent to FaAA for evaluation. Dimensional inspection of A was satisfactory.
7. Engine Base and Bearing Caps 02-305A, C, and D	Original	Original	LP and visual inspection on Nos. 4, 6, and 8 main bearing saddles. Nos. 4, 6, and 8 main bearing caps visually inspected and are satisfactory. No. 5 main bearing was visually and dimensionally inspected with satisfactory results. Solvent cleaning of cap and bearing surfaces has been completed.
8. Cylinder Heads Studs 02-315E	New Rev. G Design	New Rev. G Design	Material and hardness tests on originals. Due to machining costs, originals were replaced with new design stud. Proper torque will be used during installation.





9.	Push Rods 02-390-C & D	Install friction welded design	Install friction welded design	Original ball end rods were replaced. New rods were MT inspected and are satisfactory.
10.	Rocker Arm Capscrew 02-390F	Original	Original	Material comparator, hardness, and MT tests for 4 cylinders on each engine. Results were satisfactory. Additional MT (100%) to be done after operation.
11.	Connecting Rods 02-340A	Original	1 bushing replaced (1 bushing still being evaluated)	Material comparator, hardness, ECT, MT, and LP tests performed. Linearity and bow checked. Results were satisfactory.
12.	Wiring and Terminations 02-688B	Original	Original	Visual inspection performed. Aware of OG recommendations and work is in progress.
13.	Fuel Oil Injection Tubing 02-365C	7 tubes replaced	10 tubes replaced	ECT and visual inspections performed. Installed tubing is satis- factory.
14.	Turbocharger MP-022/023	Original	Original	Rotor float and clearance was measured and is satisfactory. Prelube modification to be installed prior to operation.
15.	Jacket Water Pump 02-425A	Original	Original	Material comparator and hardness test on "B" shaft were satisfactory. "A" to be inspected after operation.
16.	Airstart Valve Capscrew 02-359	Use 2-3/4" long screws	Use 2-3/4" long screws	Material comparator and dimensional checks were satisfactory.

## SECTION D

## DISCUSSION OF CP&amp;L PLANS FOR PLACING THE EQUIPMENT INTO OPERATION

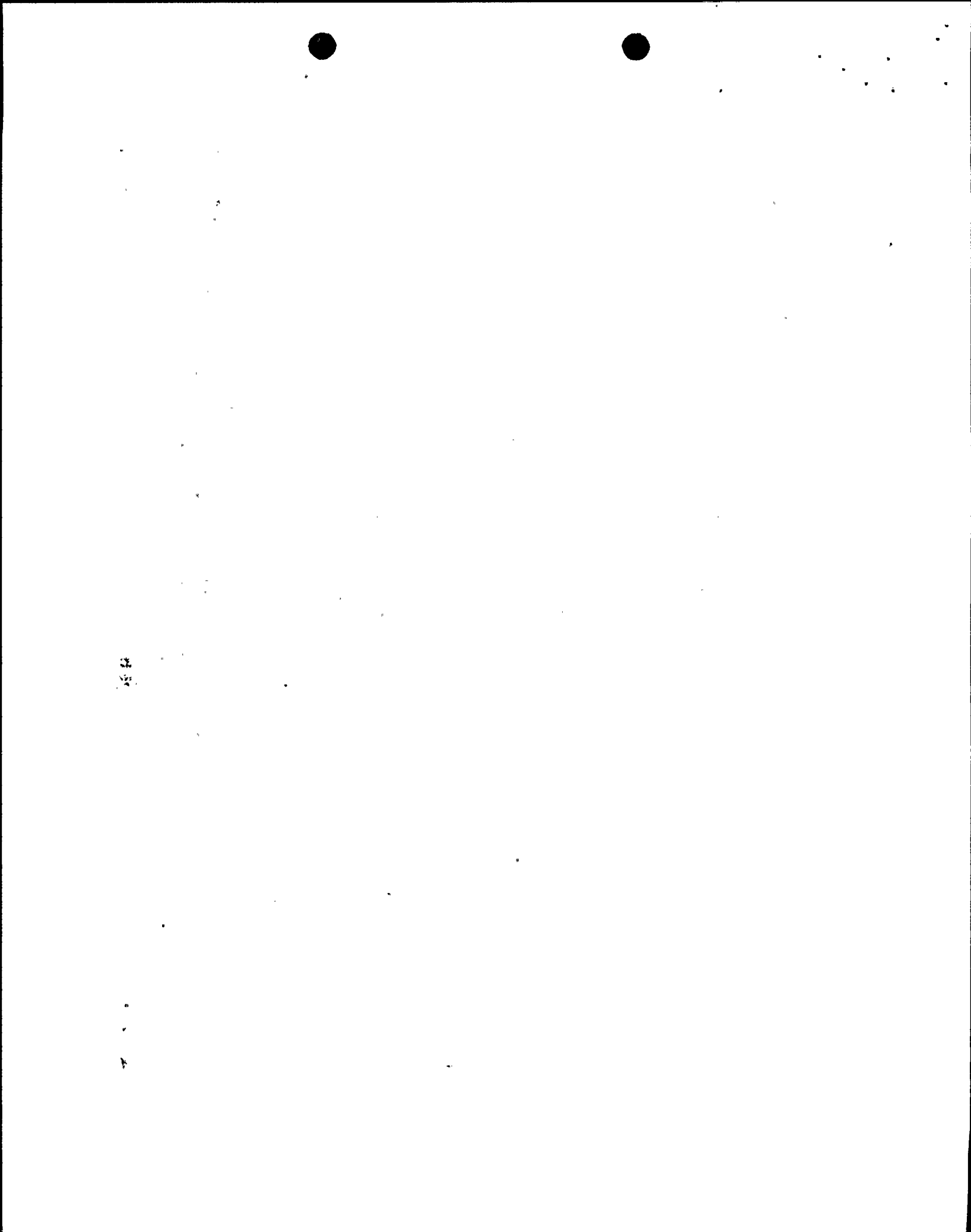
Diesel Engines 1A-SA and 1B-SB are presently being reassembled. Diesel Engine 1A-SA reassembly will be completed in January 1985 and 1B-SB reassembly will be completed in February 1985. The present construction schedule indicates that all systems necessary to operate the diesel engines will be operational by April 1985 for both diesel engines.

Initial diesel engine operation is planned for May and June 1985 for training of operators, to establish satisfactory system operation, and accumulate engine hours prior to the final Phase II DR/QR inspection to be performed by CP&L. One diesel engine will be inspected per TDI Owner's Group recommendation contained in the Phase II Report. Based on initial inspection results, the need for inspection of the second SHNPP TDI diesel will be determined. This inspection period will occur between June and October 1985. After reassembly, diesel engine generator preoperational testing will start. The estimated completion date for preoperational testing is February 1986 and the diesels will then be declared operational.

Figure 1 is a simplified schedule showing these activities.

Subsequent to the planned May 1985 engine operation, the following post-endurance inspections will be performed:

<u>Component</u>	<u>Inspection Scope</u>
1. Turbocharger	-One turbocharger, either engine
2. Crankshaft and Bearings	-Facsimile inspection of Nos. 4, 6, and 8 main journal oil holes -Inspection of caps and saddles, (Nos. 4, 5, 6, and 8) visual and LP -Dimensional and visual inspection of main bearing (No. 5) -Torsiograph Test -Thrust and deflection measurement
3. Crankcase	-Visual inspection of nut pockets for cracks
4. Cylinder Block	-LP inspection block top, both engines -Visual inspection of block/liner mating surface



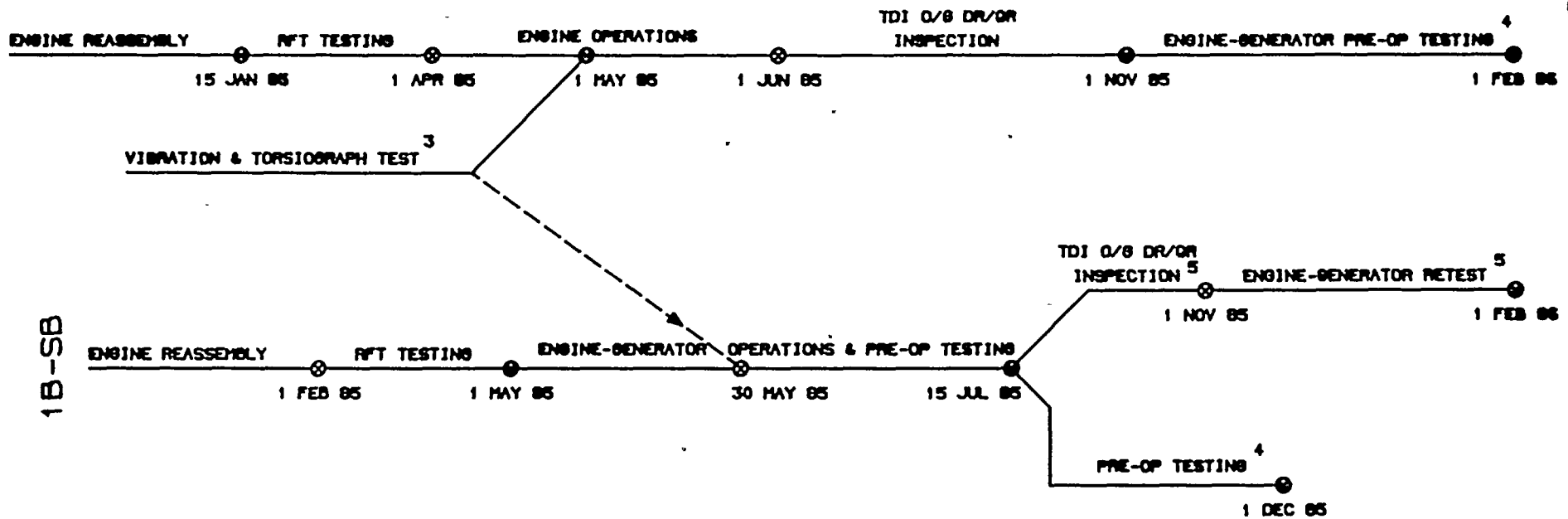
5. Cylinder Liner
  - Visually examine Liners 3 through 6 in both right and left banks, borescope remaining liners and second engine
  - Dimensional (diameter) checks of liners
6. Connecting Rods
  - LP inspection of wrist pin bushings on Pistons 3 through 6 in both right and left banks on one engine
  - MT connecting rod bolts
  - Facsimile inspections of connecting rod bolt holes
  - Inspection of rack teeth
7. Connecting Rod Bearing Shells
  - Visual and dimensional inspection
8. Pistons
  - Visual inspection of crown and skirt
  - Visual and dimensional checks of piston rings
9. Piston Pins
  - Visual inspection of pin
  - Installation of snap rings (if not accomplished)
10. Camshaft and Engine Gears (Cam, Idler, and Crankshaft)
  - Visual inspection for wear
  - Check tappets free to rotate
11. Accessory Gears (L.O. Pump, Jacket Water, Governor [2])
  - Visual inspection for wear
12. Cylinder Head Subcovers
  - Visual inspection of covers
  - LP inspection of subcover to rocker arm mating surface (100% for one engine)
13. Rocker Arm Assemblies
  - MT inspection of holddown bolts
  - Visual inspection of pushrod cups
  - Recheck material hardness of shafts
14. Air Start Valve
  - Visual inspection of valve - four valves, one engine
15. Cylinder Heads
  - Visual inspection of head and gaskets

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|-----|---|---|
| 16. | Cylinder Heads -<br>Intake/Exhaust Valves | -Valve-to-valve guide clearance<br>-Visual inspection of seating<br>surface             |
| 17. | Jacket Water Pump                         | -Perform inspection of pump per<br>OG recommendations                                   |
| 18. | Governor Shaft and<br>Drive Gear          | -LP inspection<br>-Dimensional check of shaft<br>-Visual inspection of gear for<br>wear |

# PRELIMINARY SHNPP TDI DIESEL ENGINE-GENERATOR TEST & INSPECTION SCHEDULE

DECEMBER 13, 1984

1A-SA



## NOTES

1. EMERGENCY DIESELS ARE NOT A HOT FUNCTIONAL REQUIREMENT.
2. RFT = RELEASE FOR TESTING
3. TESTING ON ONE ENGINE ONLY
4. FSAR / REG GUIDE TESTING
5. ONLY IF "1A" RESULTS INDICATE A POTENTIAL GENERIC PROBLEM.

## SECTION E

## MAINTENANCE AND SURVEILLANCE PROGRAM

As part of the TDI Diesel Generator Owners Group effort, a maintenance and surveillance matrix has been developed for the SHNPP equipment. This matrix is provided in Appendix II of the DR/QR Report (see Volume 4).

The maintenance matrix was developed utilizing TDI instruction manuals, TDI service information memos (SIMs), TDI correspondence on specific components, and Owners Group technical staff input resulting from the development of the diesel generator reliability program. The maintenance matrix provided in the DR/QR Report is based upon technical information available as of the beginning of November 1984. Accordingly, information developed, or to be developed, will be added to the program identified in the matrix.

The DR/QR Maintenance Matrix will be used in lieu of the manufacturer's manuals. CP&L commits to following the Owner's Group maintenance recommendations as a minimum, incorporating these in the overall SHNPP maintenance program subject to the following clarifications:

1. Where five-year inspections are indicated, these will be performed at the first refueling outage following the completion of the fifth year of plant commercial operation.
2. Where ten-year inspections are indicated, these will be performed at the first refueling outage following the completion of the tenth year of plant commercial operation.
3. Regardless of the accumulation of engine operating hours, the first inspection requiring disabling of the diesel generator will be performed at the first refueling outage following plant commercial operation.
4. Subsequent to licensing of SHNPP, periodic testing of the diesel generators during normal plant operation will cause the equipment to run for about 40 to 50 hours during a fuel cycle. During the 1985 testing phase on this equipment, CP&L intends to operate one diesel generator for at least 50 hours more than the other diesel generator. This unit will then be the "lead" diesel generator and will be disassembled and inspected as required by the maintenance matrix. The "follow" diesel generator inspection will be performed at the next refueling outage. The intent is to only perform major maintenance on one diesel during a particular outage. This is reasonable utilizing the "lead" engine concept.
5. The rack teeth inspection for Component 02-304A/B (Page 8 of the matrix) is to be done during the five-year inspection (i.e., move the X one column to the right).



The commitment to utilize the Owners Group Program as the basis for the SHNPP Program will require a change to SHNPP Technical Specification No. 3/4.8.1.1.2.c.1. The existing technical specification reads as follows:

"c.1. Subjecting the diesel to an inspection in accordance with procedures prepared in conjunction with its manufacturer's recommendations for this class of standby service,"

This will be revised by deleting the words "its manufacturer's" to read as follows:

".... procedures prepared in conjunction with recommendations for this....".

This change reflects that CP&L will not be solely relying upon the manufacturer's maintenance recommendations.



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## SECTION F

DISCUSSION OF OWNER'S GROUP  
SHNPP PHASE II DR/QR REPORT

The TDI Diesel Generator Owner's Group SHNPP DR/QR Report represents a comprehensive review of the equipment procured for installation at the SHNPP site. It encompasses about 167 items as identified with an "X" in either the DR or QR column of Table 2-2 (see Volume 1). On the basis of implementation of the recommendations contained within the DR/QR Report, it is concluded that the SHNPP diesel generators are fully capable of performing their intended safety function as described in the FSAR.

As discussed elsewhere in this report, the engines have been disassembled, inspected, upgraded as deemed appropriate, and are presently being reassembled. At this time, not all actions have been completed. However, CP&L commits to satisfying the intent of the recommendations contained within the DR/QR Report, as discussed within this section, or will specifically notify NRC of the justification for required action, if different from the OG recommendations.

The purpose of this section is to identify clarifications needed in the SHNPP DR/QR Report based upon CP&L's preliminary review. This does not include editorial, or labeling, corrections that could be incorporated. Further, as one item may appear in more than one place in the four volume report, the following comments are identified by component number and apply in all applicable locations:

1. Component 00-520: Identified as an instruction plate (see Volume 2, Page ii) but the QR Report is not provided. This is to be deleted.
2. Component 02-385A: Relief valves are not included at SHNPP. Refer to Component 02-386A.
3. Component 02-525B: This is not presently installed at SHNPP.
4. Component 02-315C: Hardness testing has been deleted by the Owner's Group. Material comparator testing has indicated that the liners are satisfactory. However, 50 percent of the liners will be visually inspected on Engine 1A-SA during post-endurance inspection (not at 50-hour intervals). If any one visual inspection result is unsatisfactory, then 100 percent will be inspected. At completion of start-up testing, all liners will be borescoped to ensure satisfactory conditions exist.
5. Component F-068: At SHNPP, a low-point drain already exists. Therefore, no plenum modification is required.



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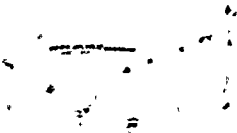
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6. Component 02-340A: CP&L will inspect a sample on one engine at the first outage. Absent any problems, it is safer to leave the components undisturbed and avoid potential mechanical errors due to disassembly and reassembly than to MT the connecting rod bolts each outage. TDI has evaluated the 1A-6-4 connecting rod bolt and determined that it is satisfactory. It is to be reinstalled.
7. Component 02-700A: The vent line drawing used for the DR is not the correct drawing. This will need revisions.
8. Component 02-700E: Information used was incorrect for SHNPP. This will need revisions.
9. Component 02-455B: The modifications are not necessary, based on engineering evaluation of the strainer installation.
10. Component 02-475B: TDI SIM 322 has been incorporated.
11. Component 02-689: Due to equipment layout/installation within the building, the liquid level transmitter design is being changed. The new design will satisfy the intent of the Owner's Group recommendations.
12. Component 02-315E: The studs will be installed using a graphite-oil lubricant and to a free length of  $15 \pm 1/8$  inches. Both of these parameters have been verbally approved by TDI.
13. Component 02-310A: A torsigraph test will be performed on one engine. The main journal oil holes have been polished and inspected with satisfactory results.
14. Component 02-650B: Cabinet ventilation and other needed modifications will be pursued. Other recommendations may not be prudent due to existing equipment layout and mounting.
15. Appendix II: The SHNPP commitment with respect to the maintenance and surveillance matrix is discussed in Section E of this report.
16. Appendix III: The criteria documents presented reflect the generic methodology of how the tasks were performed. These are provided for information only.



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