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F. L. Clayton, Jr.
Senior Vice President
Flintridge Building

Alabama Power
the southern electric system

October 14, 1981

Docket Nos. 50-348
50-364

Director, Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. S. A. Varga

Gentlemen:

Joseph M. Farley Nuclear Plant - Units 1 and 2
Diesel Generator Task Force Report

In accordance with Enclosure 3 to your July 31, 1981 letter granting a temporary one-time Technical Specification change, the subject report is hereby submitted as Enclosure 1. This report addresses all action items of NUREG CR-0660. The recommendations contained in this report are being implemented on an expedited basis.

A proposed change to the Farley diesel generator Technical Specifications has been developed by Alabama Power Company and will be submitted by separate letter. This change is intended to improve diesel reliability by providing for more appropriate testing to verify operability and providing sufficient opportunity for preventive and corrective maintenance.

The repair report related to the Diesel 1C failure is complete and will be submitted via separate letter in the near future.

If there are any questions, please contact us.

Yours very truly,

for F. L. Clayton, Jr.

FLCJr/OWK:de

Enclosure

cc: Mr. R. A. Thomas
Mr. G. F. Trowbridge
Mr. J. P. O'Reilly
Mr. E. A. Reeves
Mr. W. H. Bradford

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Intracompany
Correspondence

Enclosure 1

Alabama Power
NT-81-1232

Subject: J. M. Farley Nuclear Plant
Diesel Generator Reliability
Task Force Report

Date: September 25, 1981

From: R. L. George
At: Nuclear Generation

To: Mr. R. P. McDonald
Nuclear Generation

In accordance with the directions of your letter of May 5, 1981, the Diesel Generator Task Force initial recommendations were submitted on June 24, 1981. Subsequently, the Task Force has now finalized such recommendations. These recommendations covering the following areas are hereby submitted:

(1) Design Improvement - Attachment 1
(2) Operational and Maintenance - Attachment 2
(3) Baseline Information Related to FNP D/G - Attachment 3
(4) Guidelines for Determining D/G Test Failures - Attachment 4
(5) Comparison of Task Force Actions which Address NUREG/CR-0660 Recommendations

It is recommended that the proposed information/instruction be implemented in these areas promptly in order that greater reliability of the diesels be realized. This information should be implemented in the form of training lecture updates; procedures for D/G operation and maintenance; changes to utilization and classification of plant maintenance personnel; and design modifications.

In addition to the information provided above, it is recommended that the Task Force finalize its review of D/G technical specifications. Currently, a D/G may only be inoperable for eight hours without starting the other diesel generator set for that unit. FNP D/G's are required to start and attain voltage and frequency within ten seconds while D/G's at other nuclear sites are required to start within 12 to 15 seconds. The Task Force proposes to complete its indepth study and provide recommended draft D/G specifications with justification to you by October 5, 1981.

If there are any questions or comments, please advise.

R. L. George
Task Force Leader

OWK:bs

cc: Mr. H. O. Thrash
Mr. O. D. Kingsley, Jr.
Mr. W. G. Hairston, III
Mr. W. B. Shipman
Mr. D. N. Morey
Mr. O. W. Kennamer
Mr. H. Ebskorn
Mr. Roy Lyons
Mr. F. D. Kuester
Mr. J. W. Tangye - Colt Industries
R-TYPE A4.04

ATTACHMENT I - V

APPENDICES A - F

ATTACHMENT I

DESIGN IMPROVEMENT ITEMS

1. Inside the day tank, extend the excess fuel oil header return pipe below the low level alarm level to preclude loss of fuel header prime via check valve leakage.

   PCR 81-1005 and 81-2047

   This action will prevent loss of fuel header prime and preclude engine slow starts presently being experienced.

2. Change the 38TD8-1/8 fuel oil header low pressure alarm setpoint from 10 psig to 15 psig to provide a greater time margin for shifting the duplex filter.

   PCR 81-1006

   The 10 psig alarm point is too close to the minimum acceptance fuel header pressure of 8 psig.

3. Change out the lube oil filter and strainer pressure gauges with differential pressure gauges and install D/P gauges on the PC-2V rocker arm lube oil filters.

   PCR 81-1007 and 81-2048

   This change will provide continuous indication of differential pressure on all lube oil filters and strainers.

4. Change the jacket water keep warm system low temperature alarm setpoint from $90^{o}F$ to $105^{o}F$.

   PCR 81-1008 and 81-2049

   The alarm setpoints are being changed because the normal operating temperature was changed from $110^{o}F$ to $120^{o}F$ on Colt's recommendation.

5. Install constant vents on the PC-2V jacket water pumps to preclude air binding.

   PCR 81-1009 and 81-2050

   Provide means for venting pumps after jacket water system drain and fill operations.

6. Upgrade the 38TD8-1/8 turbocharger water relief valves which have a setpoint of 25 psig with ones that have a setpoint of 40 psig.

   PCR 81-1010

   Change out of the original valves is recommended because of seat leakage problems.

7. Upgrade starting air compressor discharge check valves with ones designed for higher temperatures.

   PCR 81-1012 and 81-2052

   Currently installed valves are not designed for the current system operating temperatures.

8. Rework the muffler thermal insulation and/or remove roofing materials to correct fire hazard.

   PCR 81-1011 and 81-2051

   Roofing materials adjacent to the muffler are a potential fire hazard.

9. Upgrade the starting air inlet filter elements to reduce the amount of rust and scale introduced into skid equipment.

   PCR 81-1012 and 81-2052

   The purpose of this change is to reduce the maintenance frequency on air start control valves and filters.

10. Change out the 38TD8-1/8 crankcase pressure shutdown switch with one having a range that will permit a 1.0" water shutdown setpoint.

    PCR 81-1013

    A change in the shutdown setpoint from 0.5" to 1.0" water pressure is recommended in order to provide a higher (safer) engine shutdown in the test mode.

11. Install a continuous lubrication system on the 38TD8-1/8 engines.

    PCR 81-1014

    This system will keep the lower crankshaft bearings lubricated and reduce the time it takes oil to reach the upper crankshaft bearings during engine starts.

12. Reset the low lube oil pressure alarm to 10 psig below normal operating pressure with maximum allowable strainer and filter differential pressure.*

    PCR 81-1015 and 81-2053

    These engines should not be operated near the low lube oil shutdown pressure. The low lube oil alarm point should be increased to provide advanced warning of lube oil strainer and filter problems.

13. Change the PC-2V jacket water system control orifices to provide a pump differential pressure of 47-53 psig to ensure adequate cooling water flow to the turbocharger.

* Since this parameter has been included on the diesel generator operating logs and the strainers are being equipped with differential pressure gauges, this change was not deemed necessary.

13. PCR 81-1016 and 81-2054

Currently the system is operating at a differential pressure of about 33 psid. As designed the system may not be providing adequate cooling water flow to the turbochargers.

14. Increase the mesh of the fuel oil storage tank discharge strainer elements and provide a means for blowdown external to the valve box.

PCR 81-1017

This will reduce the amount of debris transfered to the day tank.

15. Install physical protection of engine instrumentation where needed (e.g.: PC-2V high lube oil temperature detector).

PCR 81-1021 and 81-2056

This will provide protection to instruments subject to physical abuse.

16. Provide a portable lube oil storage tank with the capacity of a PC-2V sump to facilitate maintenance.

PCR 81-1018

This tank will aid in the drainage of engine oil sump.

17. Provide equipment to facilitate transfer of lube oil containers within the diesel building.

PCR 81-1018

Currently lube oil drums can only be transported by physical force with no mechanical assistance.

18. Provide positive valve position indication on the main control board for the D/G service water inlet and outlet valves.

PCR 81-961

Such valve position will provide positive indication of this vital parameter on the main control board.

19. Evaluate fuse protection in all control instrumentation and voltage control circuits considering circuit current requirements and troubleshoot blown fuse problem in potential transformer circuits (PT1-PT4).

PCR 81-1022 and 81-2055

Control circuit fuse failure have caused the engines to trip on overspeed and loss of generator voltage control.

20. Remove the diodes in the DC power supply circuit for the motor in the motor operated potentiometer.

PCR 81-1020 and 81-2057

Since the power supply is DC, the diode bridge is not required. Malfunctioning of the diode could cause a short circuit of the power supply.

21. Provide design correction recommendation for the D/G load sequencer timers and review the technical specification D/G 10 second start time requirement.

PCR 81-1019 and 81-2058

Determine if the D/G 10 second start time requirement can be lengthened and action necessary to ensure the repeatability of the load sequencer timers.

22. Provide the design and equipment specifications for an off-skid lube oil cleaning system.

PCR 81-1030 and 81-2065

Installation of a lube oil cleaning system would extend the service life of the lube oil filters and strainers.

23. Provide the specifications for a portable steam or high pressure water unit for cleaning lube oil strainer elements.

PCR 81-1030 and 81-2065

This will provide an effective method for cleaning strainer elements.

24. Provide the design for spare strainer element storage containers.

PCR 81-1030 and 81-2065

This will provide protection against element oxidation and physical damage.

25. Change out the service water low pressure alarm and pressure gauge for a low differential pressure alarm and differential pressure gauge.

PCR 81-1031 and 81-2066

This will provide positive indication of service water flow through the heat exchangers.

ATTACHMENT II

OPERATIONAL AND MAINTENANCE

TASK FORCE RECOMMENDATIONS

1. Establish a dedicated maintenance group responsible for all routine, preventive and corrective engine maintenance and for trending and evaluating operating data.

   The size of the current maintenance force precludes each member from being thoroughly trained in diesel maintenance. Currently, mechanics are drawn from the "pool" as needed and may not be familiar with the task to be performed. This could lead to unnecessary down time and may require a trained foreman to be available at all times to direct each detail of the task. A dedicated support group, thoroughly trained on the unique features of the diesel generators, would precipitate a measurable increase of component reliability.

2. Complete overdue preventive maintenance within operational restrictions.

   Due to the diesel availability requirements, not all scheduled maintenance has been performed. Diesel maintenance should be scheduled during outages to reduce the impact on two unit operations.

3. Establish and maintain an appropriate calibration program for D/G instruments.

   Diesel generator operability and protection depends on the proper functioning of its instrumentation. Currently such instruments do not appear to be within the scope of an adequate qualification program.

4. Monitor the emergency power board during D/G load tests.

   Since diesel load tests are conducted with the generator in parallel with other sources, the load will fluctuate and could exceed the diesel generator rating resulting in damage to the engine or generator.

5. Operations conduct turnover on D/G status during shift change.

   Maintenance work usually concludes near the end of shift which results in the on coming operations shift performing the diesel testing. In addition, important D/G status needs to be discussed with oncoming personnel as a result of testing and operational activities on the previous shift.

6. Implement the preventive maintenance program recommended by Colt Industries.

   The preventive maintenance program outlined in the technical manual is for an engine that operates continuously. Colt has provided a recommended program for FNP diesels (Appendices A & B). These recommendations can only be implemented in a manner that is compatible with existing operational and licensing requirements.

7. Initiate periodic engine inspections by Colt Industries during outage including review and evaluation of engines operating data.

   The Colt Representative would assist the maintenance group in their efforts during the refueling maintenance period.

8. Perform quarterly analysis of engine sump lubricating oil with the results being made available to the maintenance group.

   Lube oil analysis can provide early warning of impending failure in engine bearings.

9. Procure the necessary spare parts to support the recommended preventive maintenance program (Appendices A & B) and the long lead time spare parts required for a major engine overhaul.

   The timely completion of preventive and corrective maintenance depends on the availability of spare parts.

APPENDIX A

MAINTENANCE PROGRAM

For Model 38 TD 8 1/8 Standby Units June 17, 1980

The following inspection routine is supplemental to information in the instruction book and is recommended for engines in standby nuclear service. The unit may not accumulate significant operating hours between refueling and maintenance periods but the service and importance of availability justifies the frequencey of inspection.

Daily Inspections:

1. Standby heaters and pumps are operational; minimum lube oil temperature 130°F, water temperature 105°F.
2. Control power is available and there are no alarms.
3. Engine controls are set for operation.

Weekly or Biweekly - Operation & Checks:

1. Check fuel oil day tank supply level.
2. Check jacket water surge tank level.
3. Check lube oil engine sump level. Note: The lube sump level will be higher than the run level mark on the dipstick. The actual height is dependent upon the drain back from the oil cooler, filter and strainer which may take several days.
4. Drain airstart tank condensate.
5. Check the DC control supply and service batteries as required.
6. Unit Operation
   a. Prelube the engine 3 minutes immediately prior to starting. The unit should always be operated immediately after prelube to minimize oil collecting in the exhaust system.
   b. Start and apply load (60 percent or greater) at no faster rate than required by specification. As with your car, moderate treatment improves longevity.
   c. Operate the unit 1 to 2 hours. Temperature and pressure data should be recorded after startup and after 1 hour operation. The second line of data will reflect stabilized temperatures and should be plotted to indicate possible changes in performance.
   d. Wipe down the unit and clean the area noting any oil, fuel or water minor leaks in need of repair.
   e. Reduce load and minimize no load operation to 2-3 minutes for cool down prior to shut down. Excessive no load operation results in unburned lube oil accumulation in the exhaust system.
   f. Analyze operating data to determine if maintenance is required or if temperature or pressure data requires further investigation.

Quarterly:

1. Service all the auxiliaries, such as the starting air compressor, fan drive, (where applicable) lube oil filter and strainer as required and condition of air filters.

Quarterly Con't

2. Check the condition of the jacket water for the required treatment, obtain a sample for an analysis.
3. Check the lube oil for its condition, obtain a sample for an analysis.
4. Check the injection pump racks and engine control linkage to determine if all is free and working in good condition - lubricate as necessary.
5. Check the governor oil level and add approved oil as required.
6. Check the alternator bearing(s) oil level and add approved oil as required.
7. Check all pump seals for excessive leakage.
8. Check and observe engine during starting for air leakage in piping, booster servo and main bearing servo/oil accumulator.

Refuel: (1 YR - 18 MO.)

1. Check safety and shutdown controls for proper setting and operation.
2. Check injection nozzles for operation and opening pressure.
3. Check fuel injection timing, timing chain tension and timing gears.
4. Clean exhaust ports, inspect rings, pistons and liners for wear (visual).
5. Water test engine and inspect for internal and external leaks.
6. Inspect lube oil and water pump drives and blower gears (visual).
7. Check lower crank strain, crank lead, end float and all bearings.
8. Check cam shaft bearing, cams and roller faces and torsional dampers (visual).
9. Check conditon of engine blower lobes and clearance (visual and feeler gauge).
10. Check vertical drive coupling and bearings (visual).
11. Clean crankcase vacuum ejector assembly.
12. Check heat exchanger lube oil coolers, radiators, etc., for scale and debris.
13. Check alternator/exciter collector rings, brushes and bearing(s) (visual and feeler gauge).
14. Drain, flush and refill alternator bearing(s) with new approved oil.
15. Drain and refill governor with approved oil.
16. Check engine, foundation and generator hold down bolts for tightness.
17. Check alternator coils and poles for indication of movement (visual).
18. Where applicable, check fan drive assembly for lubrication wear or damage (visual).
19. Fuel and lube oil filter cartridges should be replaced during the refuel shutdown if they were not replaced during prior operating period.

    NOTE: Prime fuel and lube filter cannisters before initiating engine start up procedure.

We recommend that units be checked out annually by a Fairbanks Morse Field Service representative to verify inspections and operating performance.

4½ - 5 Years

1. Clean turbocharger impeller and diffuser if drop in air receiver pressure indicates. Check impeller for excessive end float.
2. Remove and inspect #13 & 14 lower main bearings. Check others with feeler gauge for clearance at parting line and between cap 1" from parting line.
3. Clean/replace air filter elements as appropriate.
4. Clean air start valves.
5. Check torsional damper bushings and pins for wear. Sample check adequate.
6. If visual inspection indicates, remove lower piston and check piston ring wear and side gap (land wear). Disassemble piston and check pin and bushing for wear. Inspect cylinder liner for signs of wear and chart measurements if appearance is questionable.

JWT:csu

APPENDIX B
MAINTENANCE PROGRAM
For Model PC2V Standby Units

April 9, 1981

The following inspection routine is supplemental to component part operation and service instructions in the instruction book and is recommended for engine and standby nuclear service. The unit may not accumulate significant operating hours between refueling and maintenance periods but the service and importance of availability justifies the frequency of inspection.

It is of primary importance that every repair and malfunction is entered onto the engine operating log. Operating log data must be used to graph critical pressures and temperatures to determine trends in operating performance. It is of equal importance that this data be available in the Maintenance Department for ready reference and analysis by maintenance and visiting service personnel.

Daily Inspections:

1. Lube oil level in turbochargers, oil sumps, outboard bearing, governor, air distributor and air compressor. Presence of water in the oil requires determination of cause and immediate correction. Note that unlike automotive engines, oil leveling and measuring procedures are performed with the engine operating at controlled temperatures.

2. Standby heaters and pumps are operational; minimum lube oil temperature 120°F, water temperature 105°F.

3. Jacket water surge tank level. Changes in the level of the surge tank or presence of oil must be investigated and the cause corrected.

4. Control power is available, there are no flags on the switch gear controls and no annunciator alarms. The engine control should be set for operation.

Weekly or Biweekly - Operation & Checks:

1. All preceding instructions plus drain air start tank condensate.

2. Check injection pump racks for free movement.

3. Check the DC control supply and service batteries as required.

4. Unit Operation
   a. During run in of replacement parts and performance checks other than emergency starts, it is desirable to start the engine at idle speed, increase the speed over a 5 to 10 minute period to 514 rpm and apply load over a 10 to 30 minute period. As with an automobile, moderate treatment improves longevity. Actual run in procedures vary depending upon part replacement and will be provided by our service representative.

   b. Start and apply load (60 to 80 percent preferred) at no faster rate than required by the specification.

   c. Operate the unit 1 to 2 hours. Temperature and pressure data should be recorded after startup and after 1 hour operation. The second line of data will reflect stabilized temperatures and should be plotted to indicate possible changes in performance.

d. Wipe down the unit and clean the area noting any oil, fuel or water minor leaks in need of repair. Unusual heat on bearing housings should be investigated. Site glasses for flow and levels should be rechecked.

e. Check generator field slip ring brushes for arcing.

f. Record lube oil usage.

g. Reduce load and operate 2 to 3 minutes for cool down prior to engine shut down.

h. Analyze operating data to determine if maintenance is required or if temperature or pressure data requires further investigation. Jacket water, lube oil, air manifold, raw water, fuel oil and exhaust temperatures and pressures should remain relatively constant for any given load. Changes in temperatures or pressures or differentials in temperatures or pressures generally means a change in operating condition of the engine and the causes should be determined.

Quarterly:

1. All preceding instructions.

2. Service all the auxiliaries, such as the starting air compressor, lube oil filter and strainer as required and check the condition of the air inlet filters.

3. Sample the jacket water for the required level of treatment.

4. Sample the lube oil for condition and contaminates. Check and add approved oil as required to the alternator bearing, governor and turbochargers.

5. Check all pump seals for excessive leakage.

6. Check and observe engine during starting for air leakage in piping, servo and controls.

7. Sample check rockers. Remove rocker box cover, check for proper lubrication, tappet clearance and confirm no water is leaking into the rocker arm compartment.

8. Thoroughly clean engine room.

Annual/Refuel: (1 Year-18 Months)

1. All preceding instructions.

2. Remove and check injection nozzles for operation and opening pressure.

3. Remove, disassemble, clean and repair all air start valves and air start distributors.

4. Drain and refill governor and turbochargers with approved oil.

5. Drain, flush and refill outboard bearing with approved oil.

6. Check tightness on all foundation, block to base, oil and water line bolts.

7. Check sample of rocker lube oil for condition and contaminate.

8. Check turbocharger inlet casing and turbo casing water passages for scale. The inside surface of these casings is the best indication for adequacy of water treatment.

9. Check and tighten exhaust manifold flanges to cylinder heads and to the turbocharger inlets.

10. Check all safety and shutdown controls for appropriate pressure and temperatures.

11. Borescope all cylinder liners.

12. Inspect the crankcase end of all cylinder liners.

13. Check main bearing cap tightness and side bolts.

14. Visually examine gear train and drives, cam shafts and bearings, push rods and rocker arms.

15. Check crankshaft alignment and bearing clearances.

16. Check connecting rod bearing clearances with feeler gauge.

17. Water test engine and inspect for internal and external leaks.

18. Check alternator coils and poles for indication of movement (visual).

19. Check alternator bearing journal condition.

20. Inspect and clean overspeed trip mechanism. Check operation according to overspeed trip test instructions.

Biannually (2-3 Years)

1. All preceding instructions.

2. Gear Train
   a. Check backlash (.2-.4 mm/.008-.016 inches).

   b. Check camshaft flexible drive locking plate capscrews for tightness.

3. Check fuel control linkage roll pins for tightness. Replace worn parts.

4. Remove one pair of exhaust valve cage assembly, inspect and repair if required. It is recommended that the valve selection be made by the serviceman and based on engine operating data.

The above recommendations are basic and may be altered dependent upon site experience. Deletions and/or additions may be made depending upon site operating history. The f[illegible]r inspection should be reviewed with the factory.

JWT:csu

4/14/81 - Add to WEEKLY OPERATIONS & CHECKS: Operate the rocker prelube pump five (5) minutes weekly if the engine is not operated weekly.

ATTACHMENT III

BASELINE INFORMATION REGARDING

FNP DIESEL GENERATORS

This attachment includes the following:

1. Recommended modified operating log with appropriate notes on using and interpreting log data (Appendices C & D).

2. Recommended additions to the diesel generator lecture notes used by the Training Group (Appendix E).

3. Guidelines for routine/preventative maintenance and routine engine monitoring (Appendix F).

It is recommended that the FNP Staff utilize this information as appropriate in training, operating, and maintaining the FNP diesel generators.

JAMES RIVER GRAPHICS 800 7-78 21170

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DIESEL GENERATOR 1-2A / 1B / [illegible] (CIRCL

TIME	CRANKCASE VACUUM (in. of H_2O)	RAW WATER PRESSURE (PSIG)	JACKET WATER PRESSURE (PSIG)	LUBE OIL PRESSURE (PSIG)	LUBE OIL FILTER ΔP (PSID)	FUEL OIL PRESS. TO FILTER	FUEL OIL PRESS. FROM FILTER	LUBE OIL TEMP. TO ENGINE (°F)	LUBE OIL STRAINER ΔP (PSID)	ENGINE TEMP — ENGINE HOURS (2900-0000) — CYLINDER TEMPERATURES (°F) 1	2	3	4	5	6	7	8	9
MAX	1.0	61	35	100	13 PSID REPLACE FILTER	10 PSID DIRTY FILTER		140	10-12 PSID CLEAN STRAINER	1000	1000	1000	1000	1000	1000	1000	1000	1000
MIN	0.5	30	26	66				120		670	650	670	680	710	650	640	640	660

DIESEL GENERATOR 1C / 2C (CIRCLE ONE)

TIME	CRANKCASE VACUUM (in of H_2O)	COOLANT PUMP DISCH. PRESS. (PSIG)	FUEL OIL INLET TO FILT (PSIG)	FUEL OIL OUTLET FROM FILTER (PSIG)	RAW WATER PRESSURE (PSIG)	SCAVENGE AIR PRESSURE (PSIG)	LUBE OIL PRESSURE (PSIG)	JACKET COOLANT TEMPERATURE (°F)	LUBE OIL TEMP. FROM ENGINE (°F)	ENGINE TEMPER — ENGINE HOURS (2400-0000) — CYLINDER TEMPERATURES (°F) 1	2	3	4	5	6	7	8	9
MAX	6.3	35	10 PSID DIRTY FILTER		53	20	60	195	225	1100	1100	1100	1100	1100	1100	1100	1100	1100
MIN	0.8	18			30	10	30	165	180	760	760	620	720	720	640	800	740	670

NOTES:

1. Diesel operating logs are established for 100% load. If diesel is operated below maximum (i.e., 100%) load, operator should note same in comments section. Operator should obtain load information from control.

2. Out-of-spec. readings are any readings above or below the max. or min. values respectively. Such readings are to be red-circled, and a brief explanation concerning these problems should be given in the comments section.

3. Any reading recorded with a check mark indicates a normal or accepted condition. In order to indicate abnormalities, the check mark should be red-circled and appropriate remarks recorded in the comments section of the log.

4. Initial readings are taken approximately 30 minutes after diesel operation has begun, and every hour of operation thereafter.

5. It is acceptable to have a maximum differential of 20 psid across the lube oil strainer without shutting down the engine. However, the strainer must be cleaned before the next run.

COMMENTS:

_____

OPERATOR

_____

SHIFT FOREMAN

APPENDIX D

DIESEL OPERATING LOG NOTES

CRANKCASE VACUUM

1. On the small diesels, crankcase vacuum is established by an ejector. The crankcase vacuum varies with load and at full load should be approximately 2" water. Failure of the crankcase ejector, excessive combustion gas leakage pass the piston compression rings or water leakage into the lube oil can cause loss of crankcase vacuum. In the event crankcase vacuum is less than 0.5" water, the engine should be shutdown, conditions permitting, and the problem investigated.

2. On the large diesels, crankcase vacuum is established by an external fan. Vacuum will be highest during no load operations and decrease as load is applied due to combustion gas leakage pass the compression rings.

SERVICE WATER PRESSURE (RAW WATER PRESSURE)

1. Although the proper system pressure may exist, it does not provide positive indication of flow in the system. For instance, with the service water outlet valve was shut, proper pressure would exist with no flow.

JACKET WATER PRESSURE & EXPANSION TANK LEVEL

1. Eight to ten psig fluctuations in jacket water pump discharge pressure is an indication of a combustion gas leak into the jacket water system resulting in pump cavitation. Such leakage may also cause fluctuations in the jacket water expansion tank level. Should either condition exist, an immediate investigation should be conducted.

LUBE OIL PRESSURE, STRAINER AND FILTER DIFFERENTIAL PRESSURE

1. Lube oil header pressure should be maintained above the minimum pressure specified on the log sheet. The header pressure will slowly decrease during engine operation due to strainer and filter loading.

2. The strainers and filters are rated for a miximum differential pressure of 20 psid and should be serviced when the differential pressure reaches that specified on the log sheet. On the large diesels, the strainers will reach the limiting differential pressure first because it sees flow from the attached engine driven pump and the oil circulating pump. On the small engines, the full flow filter will reach the limiting differential pressure first since it is up stream of the strainer and removes most of the foreign material.

FULL OIL FILTER DIFFERENTIAL PRESSURE

1. When the differential pressure across the on service element of the duplex filter reaches 10 psid, shift to the clean element. The off-service filter element should be replaced and the unit refilled and vented.

LUBE OIL TEMPERATURES

1. As indicated on the log, normal lube oil operating temperature for the small diesels is higher than that for the large diesels. In addition, on the small diesels, the gauge board temperature instrument monitors the lube oil before it enters the cooler whereas oil temperature is monitored out of the cooler on the large diesels.

SCAVENGING AIR PRESSURE

1. During no load operations, scavenging air pressure will be approximately zero. The pressure will increase as load is increased to rated load to within the range specified on the log sheet.

CYLINDER & TURBOCHARGER TEMPERATURES

1. Cylinder exhaust temperature variations between cylinders should not exceed 250^{0}F (small engines) or150^{0}F (large engines). Any significant variation, over a periof of time, in the exhaust temperature of any one cylinder indicates an instrument or engine operational malfunction and a detailed inspection should be performed to determine and correct the malfunction.

DIESEL LUBE OIL SUMP LEVEL

1. Oil may be added to the sumps in a running or shutdown condition in accordance with FNP-O-SOP-38.0. Before start, the level should be checked to ensure that the level is between the shutdown "add" and "full" marks on the dipstick. After about 30 minutes of load operations, to allow temperatures to stablize, sump level should be adjusted to within the running "full" and "add" marks on the dipstick.

GENERATOR BEARING TEMPERATURE AND OIL LEVEL

1. The generator bearing on the large diesels is a water cooled pillow block type. Oil from the bearing sump is circulated by oil rings within the pillow block. Operation of these rings can be observed by removing the inspection covers on top of the bearing. The generator bearing on the small diesels is an oil lubricated spherical roller bearing. The oil level indicated on the oil gauge is the standstill level and does not indicate the running oil level. Because of the operating characteristics of the bearing, oil should be added only when the engine is stopped. The proper bearing oil levels and temperature limits are listed on the diesel logs.

APPENDIX E

DIESEL GENERATORS ADDITIONS TO LECTURE NUMBER TR 1225

LUBE OIL SYSTEM

1. The 4075 KW diesel generators are equipped with a bypass lube oil filter. The oil circulating pump (keep warm system) runs continuously to provide flow through the filter.

   The full flow lube oil strainer consists of two single 40 micron element units connected in parallel. Because of the filter and strainer arrangement, the strainer removes most of the foreign particles.

2. The 4075 KW diesel generator pre-lube pump lubricates only the rocker arm system. The keep warm system oil circulating pump provides continuous lubrication to all other bearings and must be used to refill the lube oil filter and strainer after element changeout or cleaning.

STARTING AIR SYSTEM

1. Each compressor is equipped with an air dryer with intergal air cooler equipped with an automatic blow down valve that operates periodically to remove condensation. The air coolers are cooled by service water.

2. On the small diesels, each of the two air start solenoid valve supplies one air start distributor and six cylinders.

3. On both type diesels, starting air operates the governor booster servomotor which supplies oil under pressure to the governor during the start sequence. This results in the governor moving the engine linkage into the fuel-on position. The engine will then fire at once instead of after the time lag normally required for the rotary gear pump within the governor to build up oil pressure to move the linkage.

GOVERNING SYSTEM

1. On the small diesels, energizing the shutdown solenoid valve removes oil pressure from the governor power servo causing the engine linkage to move to the minimum fuel position.

2. On both type engines, the overspeed shutdown is caused by a mechanical overspeed governor built into the engine and is <u>independent</u> of the Woodward governor.

   Operation of the overspeed device "trips" the fuel racks to the minimum fuel position. The mechanical overspeed device must be manually reset by operation of the reset level on the engine.

   In addition, the mechanical overspeed device closes a contact to energize the Engine Overspeed Relay.

3. On both type engines, the Woodward governor is, in effect, two governors in one; an electric and mechanical governor, each independently capable of positioning the engine control linkage. During normal operations, the electric governor controls fuel to the engine. The Woodward governor is adjusted so that, if the electric control signal is lost, the electric section moves the fuel linkage to maximum fuel. When engine speed reaches the level for which the mechanical governor is set (always slightly higher than the setting of the electric governor) the mechanical assumes and maintains control of engine speed.

   However, if the electric control signal is lost during the engine starting sequence, the control linkage will remain in the maximum fuel position until the speed setting of the mechanical governor is reached. Because of the high rate of change in engine speed during start and of the mechanical governor speed setting, the engine may trip on overspeed.

AIR INTAKE SYSTEM

1. A filter housing, located on the diesel building roof, consisting of 16 dry type filter elements filters the combustion air prior to its entrance into the turbochargers.

   The filter elements should be replaced when the differential pressure across them exceeds 2.5 inches of water during engine operations at full load.

APPENDIX F

GUIDELINES FOR ROUTINE D/G OPERATION AND MAINTENANCE

I. Work/action that can be accomplished while engine is operable.

Shift and change fuel filter elements
Shift and change rocker arm lube oil filter elements (large diesels)
Sound and add oil to lube oil sump
Add oil to generator bearing (large diesels)
Add water to jacket water expansion tank
Changeout jacket water keep warm pump
Changeout lube oil circulating pump (small diesels)
Add oil to governor
Blowdown starting air strainers
Repair/service air compressors and dryers
Instrument calibration
  Scavenging air pressure
  Fuel oil pressure
  Coolant pressure gauges
  Starting air receiver pressure gauges and alarms
  Jacket water expansion tank low level alarm
  Service water pressure gauge and alarm

II. Filter/Strainer Service Guidelines

1. Lube Oil Filter

Obtain replacement elements & cover "O" ring
Place engine out-of-service
Stop oil circulating pump (large diesels)
Drain filter vessel
Vent and remove cover
  Do not lay cover on the "O" ring sealing surface
Remove and discard elements
Inspect interior of vessel for cleanliness
Install new elements
Check condition of element bypass valves
Install new cover "O" ring
Align cover lugs before cover contacts "O" ring
  Do not rotate cover to obtain alignment after it has contacted "O" ring.
Torque cover nuts to 70-80 lb. ft.
Close drains
Fill and vent vessel, check for cover leaks
  NOTE: On the large diesels use oil circulating pump to fill system. For the small diesels, the pre-lube pump must be used to fill system.

2. Lube Oil Strainer

Obtain clean strainer screens & new cover "O" ring(s)
Place engine out-of-service
Stop oil circulating pump (large diesels)
Drain strainer vessel(s)
Vent and remove cover(s)
  Do not lay cover(s) on the "O" ring sealing surface

2. (Continued)

Remove and disassemble strainer screens
Inspect interior of vessel for cleanliness
Inspect strainer screen gaskets and, if satisfactory, reassemble strainer basket using clean strainer screens.
Inspect strainer basket assembly "O" ring and, if satisfactory, install basket assembly.
Do not tip or rotate the basket assembly after "O" ring contacts seating surface
Replace pressure plate and torque nuts to 50-60 lb. ft. (small diesels)
Install new cover "O" ring
Align cover lugs before cover contacts "O" ring
Do not rotate cover to obtain alignment after it has contacted "O" ring
Torque cover nuts to 70-80 lb. ft.
Close drains
Fill and vent vessel, check for leaks
NOTE: On the large diesels, use oil circulating pump to fill system. For the small diesels, the pre-lube pump must be used to fill system.

3. Duplex Filters (Fuel & Rocker Arm Lube Oil)

Obtain replacement element
Ensure that filter is off-service
Vent and remove filter housing
Discard dirty element
Inspect interior of housing for cleanliness
Install new filter element
Inspect cover "O" ring and, if satisfactory, reassemble housing
Fill and vent housing slowly by positioning filter shift level toward mid position.
NOTES: (1) If the engine is stopped, the fuel hand pump should be operated during fill and vent operation on fuel filters.
(2) On the large diesels, the rocker arm pre-lube pump should be operated during fill and vent operations on lube oil filter if the engine is stopped.
Check for leaks
Position shift level so that the clean filter is off-service

4. Oil Circulating Pump (Keep Warm) Strainers

Small Diesels

Stop oil circulating pump
Close inlet and outlet valves
Remove and clean strainer
Reinstall
Open inlet and outlet valves
Start oil circulating pump
Check for leaks

Large Diesels

Place engine out-of-service
Stop oil circulating pump
Close inlet valve
Remove and clean strainer
Reinstall
Open inlet valve
Start oil circulating pump
Check for leaks
Place engine in service -

5. Starting Air Inlet Strainers

Place filter cloth over discharge
Open & close the blowdown valve
Check condition of filter cloth
NOTE: If excessive amounts of debris are collected in the filter cloth, the frequency of strainer blowdown should be increased.

6. Fuel Oil Transfer Pump Strainers

Place filter cloth over discharge
Align the pump for recirculation
Start the transfer pump
Open and close the blowdown valve
Align the pump and valves for normal operation
Check condition of filter cloth
NOTE: If excessive amounts of debris are collected in the filter cloth, the frequency of strainer blowdown should be increased.

7. Air Start Control Valve Air Inlet Filter (Large Diesels)

Place engine out-of-service
Disassemble and clean filter element
Reassemble
Check for leaks during next engine start

III. Monitoring of Engine Parameters

1. During Start

Observe lube oil, jacket water and fuel oil pressure increase to normal operating valves.
Check crankcase vacuum
Inspect engine for fuel, water, air and exhaust leaks
Feel air start jumper pipes
Check lube oil sump level approximately 10 minutes after start

2. Running

Ensure engine parameters are within the limits specified on the log sheet.
Inspect engine for fuel, water, air and exhaust leaks

3. Upon Shutdown

Check that the lube oil and jacket water keep warm systems are operating.
Inspect engine for fuel, water and air leaks.

IV. Valve, Piping and Component Identification

1. A valve and piping color code system is not recommended.

2. The piping and components on one of each type engine have been identified by hand labeling with a felt tip marker. It is recommended that the nonmenclature on these engines be used as a guide for applying permanent identification to all engines.

V. Gauge Red Lines, Sight Glass and Dipsticks

1. Dipsticks are adequate marked.

2. The generator pedestal bearing sight glass needs to have standstill level marked. It is recommended that a red line be added and labeled "maximum".

3. The jacket water expansion tank sight glass 1/4 mark should be labeled as "minimum". Also, adequate illumination should be provided for the sight glass.

4. The following gauges should be red lined at the indicated pressure with the work "minimum" on the red line:

   Fuel oil pressure (15 PSIG, small diesels and
   7 PSIG, large diesels)
   Lube oil pressure (30 PSIG, small diesels and
   66 PSIG, large diesels)
   Jacket water pressure (18 PSIG, small diesels and
   26 PSIG, large diesels)

5. The generator phase current meters on the Local Control Panel should be red lined with the work "maximum" on the red line at the value corresponding to the continuous full load rating.

VI. Acceptable Pretest Actions on the Diesel Generators

1. No additional acceptable pretest actions were identified. However, it is recommended that the cylinder indicator valves be operated one at a time on a daily basis to check for water and oil accumulation in the cylinders during shutdown.

VII. Diesel Full Load Run Time Required for Stablization of Parameters

1. Colt Industries recommended taking the first set of log readings after 30 minutes at full load. This recommendation has been incorporated in the draft log sheet notes.

ATTACHMENT IV

METHOD TO DETERMINE

VALID/INVALID

TESTS

FOR DIESEL GENERATORS

General D.G. Assumptions/Comments

I. Assumption for differtiating between RG 1.108 and LER reporting.

A. LER Reporting

1. Section 6.9 reporting is unaffected by RG 1.108
2. Reports only required for applicable modes
3. In general this reporting deals with the Tech. Spec. definition of operability (perform its intended function)
4. For the Section 6.9 reporting notation concerning whether this report is a valid failure relating to RG 1.108 is included in the LER
5. The LER with the 7th failure will contain a special report of all failures

B. RG 1.108

1. All starts are logged and included for these tests during all modes
2. In general this reporting deals with a narrow definition of the "defined D/G unit" and is not intended to determine Tech. Spec. operability.
3. Trouble shooting test to determine cause of failure and to establish baseline data for repaired engine are not considered valid or invalid failures as long as the engine remains inoperable
4. Verification tests to prove operability are valid tests.

II. RG 1.108 definition of DG unit in general is that defined by IEEE 387-1977 plus other support equipment specifically identified in RG 1.108.

III. Logging shall be required for all starts with notations made relating to valid/invalid tests and success/failure of the tests

Sequence For Determining Diesel Failures and Tests

Utilizing Chart 1, the following notes (1) through (8) provide guidance for decisions concerning diesel pass/fail.

(1) Troubleshooting Guide Lines

a) Tests performed in the process of troubleshooting are invalid tests.

b) Troubleshooting tests are performed to determine the cause of a failure.

c) Prior to any and all troubleshooting tests the Diesel Generator must be declared inoperable.

d) Troubleshooting tests include those performed following maintenance to insure that the full extent of the cause of the failure is determined and obtain baseline data of the repair.

e) A determination of whether or not a test is performed for troubleshooting must be made prior to attempting to start diesel-generator.

f) Invalid failures experienced during troubleshooting should be logged in and included in the report of the failure (valid or invalid) that made the troubleshooting necessary.

(2) Intentional Termination of DG Tests Due to Non D/G Csuses

a) Successful D/G starts that are intentionally terminated are not valid tests or valid failures if based on conditions not associated with the DG.

EXAMPLE: D/G test terminated, without loading or before completing one hour load run, because of other control room operations or events that required the operator's undivided attention.

b) Should be logged as an invalid test with time of failure referred to test start with sufficient detail to reconstruct failure data.

(3) Abnormality Resulting DG Failure/Damage

a) S/D DG when abnormal condition or alarm is received

b) Operations and Maintenance personnel should evaluate the cause of the abnormal condition and/or the alarm to determine if an "actual" condition existed which would have resulted in DG damage or failure within the timeframe of the test which is applicable to RG 1.108 C.2.c.

c) Guidelines for the evaluation include:

i) loss of fuel/lube significant enough which would cause test to fail or DG damage

ii) Major cooling H_2O leaks would precipitate DG damage

iii) Decisions concerning whether these conditions would have caused failure or damage should not be made without proper evaluate/troubleshooting/consultation.

iv) Examples of probable conditions which probably could cause damage/failure:

- readings outside current reading bands
- excessive vibration
- dark heavy smoke except whether S/U
- persistant unusual noise
- unusual ordors, perticular the burning of electrical insulation

(4) Operating Error

Operating errors are those errors attributable to the failure of personnel to follow approved plant procedures established for starting and operating the "defined" diesel generator unit.

EXAMPLE: a) Improper generator paralleling operations that result in D/G failure.

b) Improper valve line ups that result in D/G failures.

c) Procedural error

d) Inadvertent test initiation

Notes: Action of E.O. in operating function is included in this definition.

(5) Spurious Trips

Failures due to "spurious" trips which are not operable in the emergency mode are not valid failures.

a) Spurious trips refer to false or illegitimate signals such as a shorted contact which resulted in an automatic trip.

b) This does not apply to trips which <u>are</u> operable in the emergency mode i.e., low lube oil pressure and engine overspeed on the diesel engine.

c) Operator initiated trips may be considered invalid failures dependent upon investigation and determination by Item 6.

The following trips are not operable in the emergency mode:

a) Lube oil temp. high

b) Jacket coolant temp. high

c) Jacket coolant press. low

d) Crankcase press. high

e) Non-essential generator protection

Note: Spurious only applies to trips to faulty equipment or signals. Trips which are valid should be considered failures and valid tests.

(6) Non Emergency Equipment Malfunction

Failures due to a malfunction of equipment that is not operative in the emergency mode are not valid failures. Equipment not operative in the emergency mode are as follows:

a) Synchronizing circuits

b) Surveillance start timer

c) Pre-lube pump

d) Non-shutdown alarm devices

-Low lube oil press. alarm (OPLA)

-Low fuel oil press.

-Low Service Water press.

-Low lube oil temp.

-High lube oil temp.

-High jacket coolant alarm (CTHA)

-Low jacket coolant alarm

-Low jacket coolant press.

-Start failure alarm

-Control circuit failure

-Jacket coolant level low

-Air reservoir press. low

-Day tank level low

-Day tank level high

-Low rocker lube press.

-High rocker lube level

-Borring device safety switch

-High generator bearing temp.

e) Non essential generator protection devices

(7) Definition of DG Unit

a) DG unit is defined by IEEE 387-1977, Figure 1 (attached) (enclosed by heaviest dash line)

b) The DG unit also includes the following:

A. Diesel bkr.

B. Diesel electrical controls

C. Day Tank

C. The DG unit specifically excludes the following:

A. Sequencer

B. Fuel oil transfer system

C. Surveillance start timer

D. Off-skid serv. water sys.

E. 4 KV bus

F. Diesel rm. HVAC sys.

G. MCC

H. Battery sys.

I. Synchronizing ckts.

J. Air compressor

(8) Common Mode/Multiple Failures

Where a diesel generator has experienced multiple test failures which can be attributed to a common cause which was not clearly apparent or corrected during prior troubleshooting and repair efforts, the multiple failures may be consolidated and reported as a single failure.

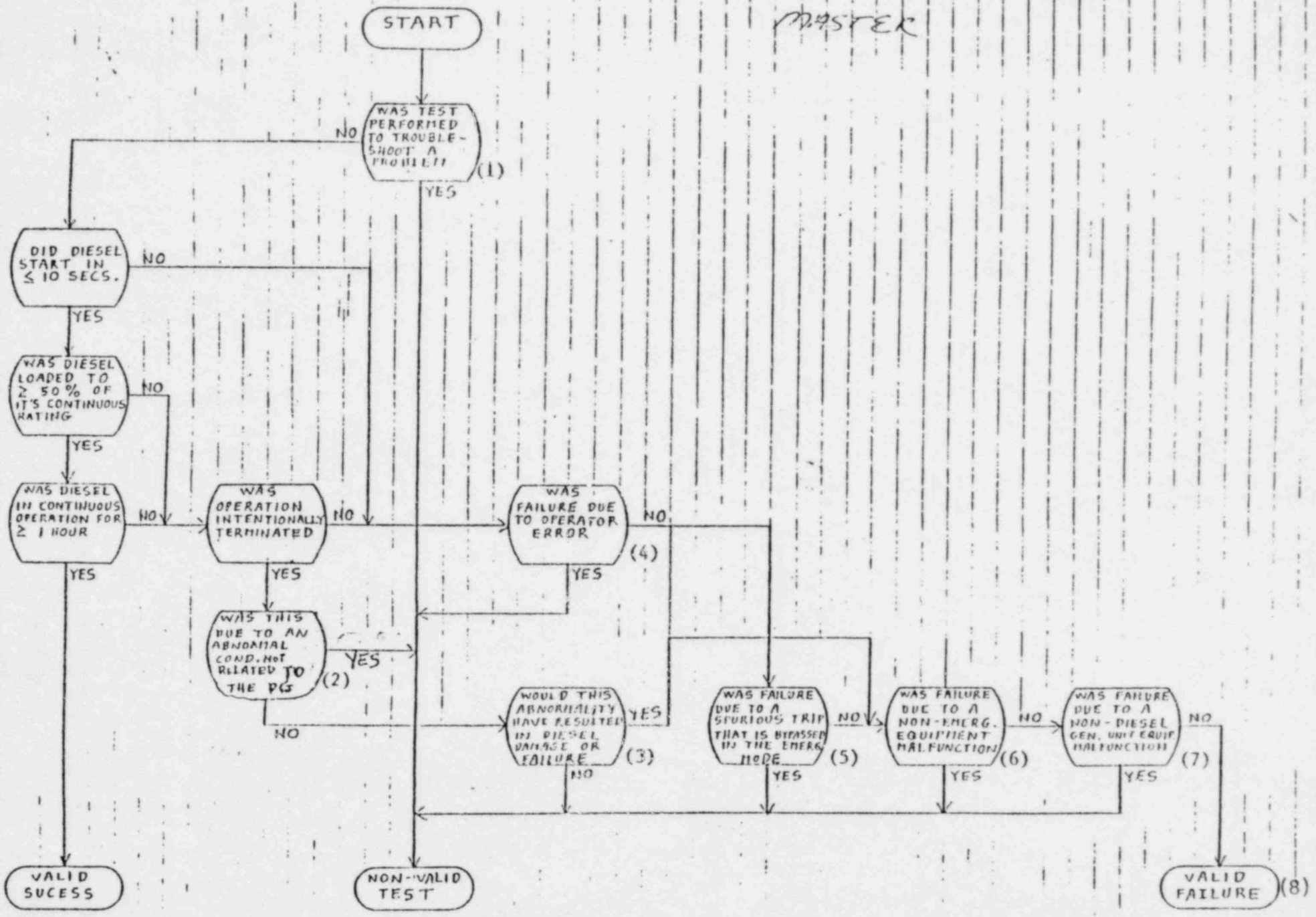
CHART 1 - Method of Determing Valid/Invalid Tests For Diesel Generators

Southern Company Services, Inc.

PREPARED BY RBL DATE 6-2-81

JOB EARLEY #1 & 2 SUBJECT DIESEL GEN. TEST CRITERIA REVIEWED BY _____ DATE _____ SHEET

POSTER



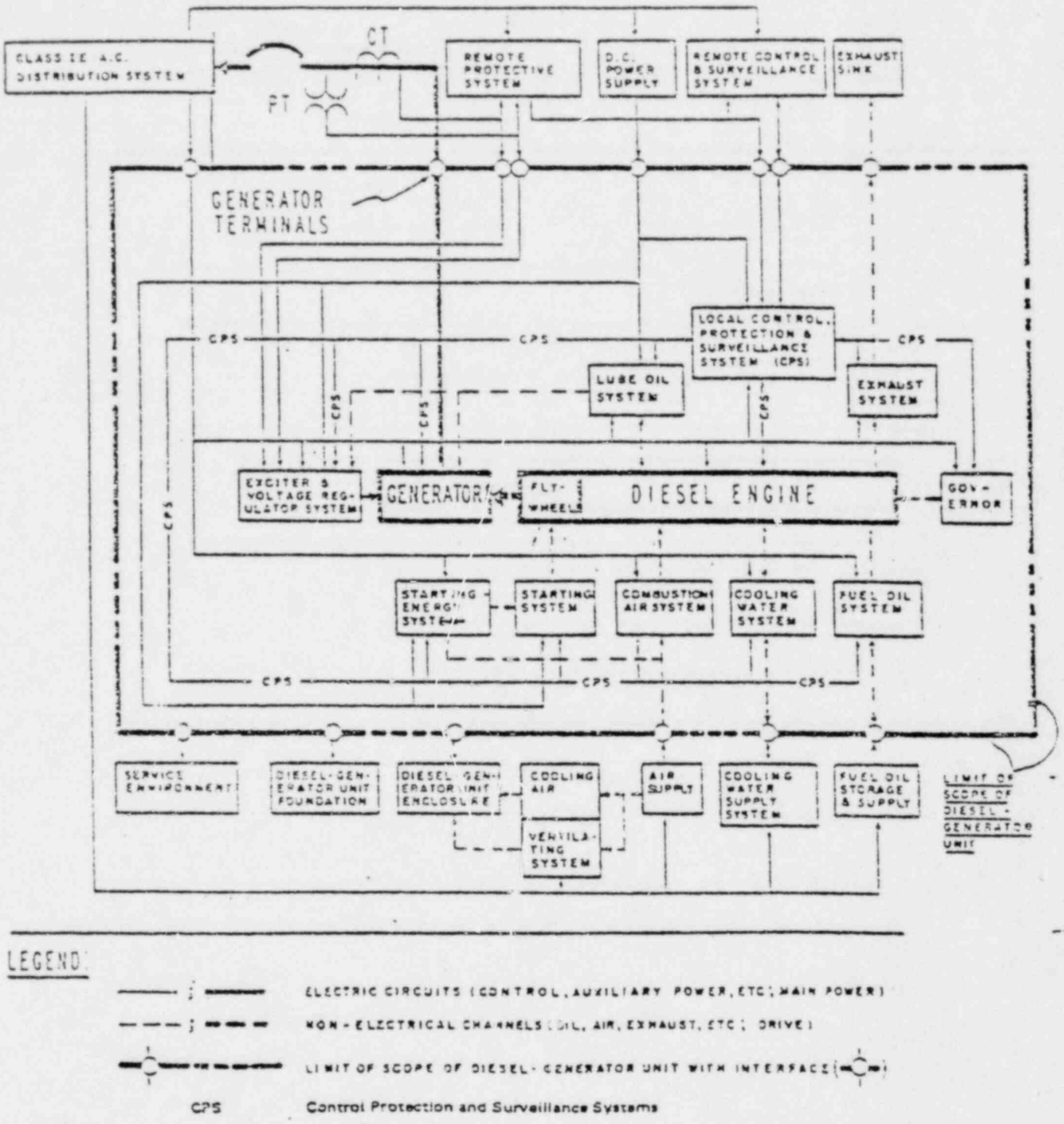


Fig. 1
Scope Diagram

[Abbreviations herein are in accordance with ANSI Y1.1-1972, "Abbreviations for Use on Drawings and in Text." Graphic Symbols and designations are in accordance with IEEE Std 315-1975 (ANSI Y32.2-1975), "Graphic Symbols for Electrical and Electronics Diagrams" (CSA Z99-1975).]

ATTACHMENT V

Comparison of Task Force Actions Which
Address NUREG/CR-0660 Recommendations

REFERENCE: Alabama Power Company letter dated September 24, 1980 from F. L. Clayton, Jr. to Mr. R. L. Tedesco, Nuclear Regulatory Commission, Assistant Director for Licensing; Subject: Joseph M. Farley Nuclear Plant - Unit 2 Request for Additional Information

A detailed review of the corrective actions listed in NUREG/CR-0660 section "TASK V - RECOMMENDATIONS" was conducted by members of the Diesel Generator Task Force. These members also participated in drafting the referenced letter answering Power Systems Branch Questions 040.1 through 040.14 on diesel generators. Listed below are steps taken to address corrective action recommendations of NUREG/CR-0660. Paragraph titles and numbers correspond to those in section "TASK V - RECOMMENDATIONS".

A. Most Significant Corrective Action

1. Air Driers in Compressed Air Starting Systems

COMMENT: Air driers are installed in all diesel air start systems as outlined in the referenced letter. In addition, Attachment I, Item 9, provides for upgrading the engine air start inlet filters.

2. Air Quality in Diesel Generator Room

COMMENT: The referenced letter provides the details on how dust, dirt, and grit is being prevented from entering the diesel generator electrical equipment.

3. Turbocharger Heavy Duty Gear Drive

COMMENT: Not applicable to J. M. Farley Nuclear Plant diesel engines.

4. Personnel Training

COMMENT: The training program for operations and maintenance department personnel was discussed in the referenced letter. In addition, Attachment II, Item 1 and Appendices D and E of the Task Force Report are related to training.

B. Significant Corrective Action

1. Pre-Lube - All Engine Starts Except True Emergency

COMMENT: As discussed in the referenced letter pre-lube is being performed in accordance with manufacturer's recommendations.

2. Pre-Lube - All Engine Starts Including Actual or Simulated Emergency Starts

COMMENT: As discussed in the referenced letter, the two Colt Industries opposed piston engines are not equipped with such a system. However, a preliminary design which is addressed by Attachment I, Item 11 of the Task Force Report has been submitted to the NRC as required by Section 2.C.(19)(c) of Farley Unit 2 Operating License NPF-8.

3. Testing, Test Loading and Preventive Maintenance

COMMENT: As discussed in the referenced letter, testing (including frequency and duration) and test loading are performed in accordance with the applicable NRC Guidelines (R. G. 1.108). In addition, system operating procedures require that the diesel generators be loaded at their continuous rating for one hour for each successful start. A diesel that has been declared inoperable for any reason must successfully complete this one hour test (NUREG CR-0660 check off test run) before being declared operable.

Preventive Maintenance is addressed in Attachment II, Items 1, 2, 3, 6, 7, 8, and 9 of the Task Force Report.

4. "Root Cause" and Corrective Action

COMMENT: As discussed in the reference letter, the obvious cause of a failure is repaired and appropriate information disseminated among plant personnel for subsequent failure evaluations. The resolution of repeated problems include an investigation to determine contributing causes not necessarily obvious on initial review.

C. Additional Corrective Action

1. DG Room Ventilation and Combustion Air Inlet

COMMENT: As discussed in the referenced letter, the combustion air system is independent of the DG room ventilation system. Combustion and ventilation air inlets and outlets are separated sufficiently to preclude recirculation within or between the systems. In addition, combustion air is provided with fine mesh filters.

2. Fuel Storage and Handling

COMMENT: As discussed in the referenced letter, the design of the fuel oil storage system meets these provisions. In addition, Attachment I, Item 14, provides for better filtration of the fuel oil at the discharge of the transfer pumps and Item 1 provides a design change to preclude loss of engine fuel header prime.

3. High Temperature Insulation for Overload

COMMENT: The 4075 KW generators have Class F insulation with an ambient temperature rating of 50°C and stator and rotor temperature rise rating of 70°C. The 2850 KW generators have Class F insulation with an ambient temperature ratings of 50°C and stator and rotor temperature rise rating of 80°C.

4. Engine Cooling Water Temperature Control

COMMENT: All FNP diesel engines have a thermostatically controlled "3-way" valve which controls water flow through the heat exchanger.

5. Concrete Floors - Painting

COMMENT: All floors in the DG building are painted as outlined in the referenced letter.

6. Instruments and Control or Monitoring Elements - Mounting and Support

COMMENT: Mounting and support of instrumentation is discussed in the referenced letter with floor mounting of instruments/monitors where functionally practical. Attachment I, Item 15 and Attachment II, Item 3, of the Task Force Report discusses physical protection and calibration, respectively.

7. Comments on Specifically Applicable Documents

   COMMENT: The specifically identified problem areas described in Appendix H have been acted upon as a result of the Task Force effort unless such problem areas had already been addressed by previous action.

8. Evaluation and Implementation of Recommendations

   COMMENT: The recommendations contained in this report (NUREG/CR-0660) have been carefully reviewed and found that the majority of such recommendations have been previously implemented, contained in the original design, or identified by the Task Force for future implementation.