

REV. 2

DIESEL GENERATOR OPERATION - CLUSTER # 11

OUTSIDE AREA OPERATOR

QUALIFICATION SIGNOFF CRITERIA

NAME \_\_\_\_\_ SSN \_\_\_\_\_ DATE \_\_\_\_\_

I SUMMARY INFORMATION

A. General References

1. Plant Vogtle Procedures:
  - 13145, "Diesel Generator"
  - 13146, "Diesel Generator Fuel Oil Transfer System"
  - 14980, "Diesel Generator Operability Test"
  - 11960, "Outside Area Operator Qualification Checklist"
  - 60605, "Non-Licensed Operator Training Program"
2. Technical Specifications:
  - 3.8.1 Electrical Power Systems, AC sources.
3. "Emergency Diesel Generator," Vogtle Training Text Chapter 16C, VEGP
4. Piping and Instrument Diagrams:
  - 1X4DB170-1
  - 1X4DB170-2
  - 1X4DB195-5
5. System Schematics:
  - AX4AK01-27 (Lube Oil)
  - AX4AK01-26 (Jacket Water)
  - AX4AK01-29 (Starting Air)
  - AX4AK01-28 (Fuel Oil)
6. Control Logic Diagrams:
  - 1X5DN107-1 (DG Fuel Oil System)
  - 1X5DN107-2 (DG Unit Engine)
  - 1X5DN107-3 (Generator)
7. Elementary Diagrams:
  - 1X3DB4003-C through J
8. One Line Diagrams:
  - 1X3D-AA-K01A
  - 1X3D-AA-A01A
9. F.S.A.R.: 8.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8
10. F.S.A.R. Questions:
  - 430. Series Questions
11. Transamerica DeLaval Diesel Manuals:

AX4AK01-509

AX4AK01-510

AX4AK01-563

12. NUREG 1216.000 "Safety evaluation report-related to operability and reliability of emergency diesel generators manufactured by Transamerica DeLaval Inc."

13. GAP Commitments:

SOER 83.006 "Unavailability of emergency power caused by diesel and breaker unavailability."

SOER 83.001 "Diesel generator failures."

QMR 297 "Grid high voltage and undervoltage trip relays contribute to EDB output breaker lockout."

LEN 86.007 "Lack of detailed instructions and inadequate observation of precautions during maintenance and testing of Woodward governors."

#### B. Completion Requirements

1. Knowledge requirements of section II have been adequately sampled and verified adequate.

-----/-----  
Evaluator

Date

2. Practical requirements as contained in section III have been adequately verified.

-----/-----  
Evaluator

Date

Completion authorizes signoffs on CL 11 Diesel Generator Operation on checklist:

- 11960

SECTION 11. KNOWLEDGE REQUIREMENTS

PART I. EMERGENCY DIESEL GENERATOR, GENERAL OVERVIEW (NL-LP-11201-C)

TRN/EVAL

- /----- 1. State the purpose of the emergency diesel generators.
- /----- 2. Draw a simple one-line drawing of ESP bus 1AA02 (or 1BA03) indicating normal and alternate supplies.
- /----- 3. List the four cycles of a four-cycle diesel engine, and state what occurs on each.
- /----- 4. Given drawings of a basic diesel engine, identify the following internal components:
  - a. Cylinders
  - b. Pistons and pins
  - c. Crankshaft
  - d. Camshaft
  - e. Valves
- /----- 5. For the emergency diesel engine, state:
  - a. number of cylinders and arrangement
  - b. RPM
  - c. horsepower rating
  - d. number of engines per unit
- /----- 6. Given drawings of a DSRV-16 diesel engine, identify the following components:
  - a. generator
  - b. generator bearing pillow block
  - c. exciter (brushes)
  - d. flywheel
  - e. JW standpipe
  - f. turbochargers
  - g. combustion air coolers
  - h. intake air inlet
  - i. exhaust outlet
  - j. jacket water cooler
  - k. NSCW inlet/exit connections on JW cooler
  - l. crankcase vacuum fan

-----/----- 7. State the purposes of the following emergency diesel generator auxiliary systems:

- a. Fuel oil system
- b. Air start system
- c. Lube oil system
- d. Jacket water system
- e. Combustion air supply and exhaust system
- f. Crankcase ventilation system
- g. Diesel engine control system
- h. Generator control system

-----/----- 8. For the emergency diesel generator, state:

- a. voltage rating
- b. KVA rating
- c. continuous rating in kilowatts
- d. overload rating in kilowatts per time
- e. Hertz rating
- f. number of poles
- g. RPM

-----/----- 9. State the functions of the safety sequencer as related to the emergency diesel generators.

-----/----- 10. State the location from which the generator can be paralleled.

-----/----- 11. List the personal protective equipment necessary for monitoring a running diesel generator.

#### PART 11. EMERGENCY DIESEL GENERATOR FUEL OIL STORAGE, TRANSFER AND SUPPLY (NL-LP-11202-C)

-----/----- 1. State the functions of the Fuel Oil Storage and Transfer System.

-----/----- 2. Beginning at the DFO day tank, list the correct sequence which fuel will pass on its way to the combustion chambers.

- a. DFO day tank
- b. duplex strainer
- c. fuel oil pump (engine-driven)
- d. duplex fuel filter
- e. supply header

- /----- 3. State the capacities and functions, and number of the following Fuel Oil Storage and Transfer System components:
- a. diesel fuel oil storage tanks
  - b. diesel fuel oil transfer pumps
- /----- 4. State the function and describe the basic operation of the following fuel oil components:
- a. eductor
  - b. shrouded line leakage tank
  - c. pressure-regulating valve
  - d. injector pumps
  - e. injectors
  - f. engine-driven fuel oil pump
  - g. fuel oil strainers
  - h. fuel oil filters
- /----- 5. List the electrical power supplies for the fuel oil transfer pumps for each emergency diesel generator.
- /----- 6. State the start/stop permissives for the DG FOST pumps including the day tank level program, and state the location of the control switches.
- /----- 7. List the instrumentation in the fuel oil storage building from which a local reading can be taken.
- /----- 8. List two places DFO day tank level can be read in the DG building.
- /----- 9. Make a drawing of the Fuel Oil Transfer System for one Unit, including DFO storage tanks, DFO day tanks, pumps, and piping to and from the Auxiliary Boiler FOST and the other unit's tanks. Indicate the correct position for locked valves to achieve the following flowpaths:
- a. recirculation of DFO Storage System
  - b. supply train A day tank from train B DG FOST
  - c. supply train B day tank from train A DG FOST
  - d. transfer fuel oil from DG FOST to aux boiler FOST
  - e. normal alignment, DG FOST to its day tank
- /----- 10. State the following about water in the Fuel Oil

System:

- a. problems caused
- b. how to check for it
- c. how to prevent it

- /----- 11. State the actions necessary for internal and external contact with fuel oil.
- /----- 12. State two safety precautions which are observed to prevent or mitigate the consequences of a fuel oil fire during fuel oil transfer.
- /----- 13. List the safety equipment to be worn when transferring fuel oil.
- /----- 14. State how oil storage areas are to be posted during fuel oil delivery.

PART III. EMERGENCY DIESEL ENGINE AUXILIARIES: AIR START SYSTEM  
(NL-LP-11203-C)

- /----- 1. List the functions of the Air Start System.
- /----- 2. Make a drawing of one train of the air start system, including the following components as a minimum, and stating the function of each:
  - a. compressor
  - b. aftercooler
  - c. air dryer
  - d. air receiver
  - e. barring device supply
  - f. air supply to engine control panel
  - g. air start solenoid valves (admission valves)
  - h. air start distributor
  - i. air supply manifolds (on engine)
  - j. air start valves (at cylinder heads)
- /----- 3. Explain the theoretical principle behind the operation of the air dryers.
- /----- 4. List the power supplies for the:
  - a. air compressors
  - b. air dryers
  - c. air start solenoid valves



- /----- 5. State the start/stop permissives of the air compressor and aftercooler fans.
- /----- 6. List the diesel engine permissives associated with the Starting Air System, to include how depletion of the Air Start System is prevented during multiple start sequences.
- /----- 7. List the locations in the diesel building where Starting Air System pressures can be read.
- /----- 8. Describe the response of the Starting Air System on receipt of a DB start signal (emergency or normal).
- /----- 9. List the points of the Starting Air System which can be "blown down" to check for or remove moisture.
- /----- 10. State the condition indicated by a hot starting air pipe to a cylinder.

PART IV. EMERGENCY DIESEL ENGINE AUXILIARIES: LUBE OIL SYSTEM  
(NL-LP-11023-C)

- /----- 11. State the pump supplying lube oil when the emergency diesel engine is:
  - a. running
  - b. in standby
- /----- 12. State the functions of the Diesel Lube Oil System, including major engine components which are lubricated.
- /----- 13. Draw a sketch of the lube oil keep warm circuit, including as a minimum the following components:
  - a. lube oil sump tank
  - b. keep warm heater
  - c. keep warm suction isolation valve
  - d. keep warm pump
  - e. keep warm filter
  - f. keep warm strainer
- /----- 14. Draw a sketch of the engine lube oil pump circuit, including as a minimum the following components:

- a. pump suction foot valve
- b. engine L.O. pump
- c. L.O. cooler
- d. duplex oil filter
- e. lube oil strainers
- f. pressure regulators

- /----- 15. State the type and power supplies for the following lube oil components:
- a. main oil pump
  - b. keep warm circulating oil pump
  - c. lube oil keep warm heater
- /----- 16. For the lube oil cooler, state:
- a. how cooled
  - b. type of liquid on tube side
  - c. type of liquid on shell side
- /----- 17. For the lube oil sump, state:
- a. number of tanks
  - b. capacity
- /----- 18. List the start/stop permissives of the lube oil keep warm pump.
- /----- 19. State how lube oil temperature is controlled when the DG is in standby, and when running.
- /----- 20. List the diesel generator trips associated with the Lube Oil System, including the setpoints.
- /----- 21. List the various methods by which lube oil sump level can be measured.
- /----- 22. List the pressure (and delta P) instruments for the Diesel Lube Oil System which can be read in the diesel generator building. State what possible problems an abnormal (HI/LOW) reading indicates.
- /----- 23. State the reason that the turbochargers are prelubricated before a planned engine run.
- /----- 24. State how and where lube oil is added.
- /----- 25. State how the diesel engine would respond to:



- a. failure of engine-driven main oil pump
- b. inoperable lube oil keep warm pump
- c. inoperable lube oil keep warm heater

PART V. EMERGENCY DIESEL ENGINE AUXILIARIES: CRANKCASE VENTILATION SYSTEM  
(NL-LP-11203-C)

- /----- 26. State the function of the crankcase ventilation system.
- /----- 27. State the causes and effects of high crankcase pressure.
- /----- 28. Give the start/stop permissives of the crankcase fan.
- /----- 29. State the diesel generator trip associated with the crankcase ventilation system.
- /----- 30. State which type of instrument is on the engine control panel for the crankcase ventilation system, and how it is correctly read.

PART VI. EMERGENCY DIESEL ENGINE AUXILIARIES: JACKET WATER COOLING SYSTEM  
(NL-LP-11203-C)

- /----- 31. State the functions of the Jacket Water Cooling System.
- /----- 32. Make a drawing of the flow paths of the jacket cooling water, including as a minimum the following major components, and stating the function of each:
  - a. jacket water pump
  - b. jacket water cooler
  - c. thermostatic control valve
  - d. jacket water standpipe
  - e. lube oil cooler
  - f. jacket water keep warm pump
  - g. jacket water keep warm heater
- /----- 33. List the power supplies for the following:
  - a. jacket water keep warm pump
  - b. jacket water keep warm heater

- /----- 34. List the start/stop permissives for the jacket water keep warm pump and heater.
- /----- 35. List the diesel generator trips associated with the Jacket Water System.
- /----- 36. List the temperature, pressure, and level instrumentation of the Jacket Water System which can be read in the diesel generator room. State what an abnormal (HI/LOW) reading indicates.
- /----- 37. Describe how jacket water temperature is maintained during standby and during diesel engine running operations.
- /----- 38. Describe the purpose for which each of the following systems interfaces with the Emergency Diesel Generator System:  
a. demineralized water  
b. NSCW

#### SYSTEM INTERFACES

#### PART VII. EMERGENCY DIESEL ENGINE AUXILIARIES: COMBUSTION AIR SUPPLY AND EXHAUST SYSTEM (NL-LP-11203-C)

- /----- 39. State the functions of the combustion air supply and exhaust systems.
- /----- 40. State the principle of operation of a turbocharger.
- /----- 41. Make a simple drawing of the combustion air supply and exhaust system, including as a minimum:  
a. Cycloil air intake filter  
b. Air intake silencers  
c. Turbochargers (air supply blades)  
d. Combustion air coolers  
e. Combustion air supply dampers  
f. Air intake manifolds  
g. Exhaust outlet manifolds  
h. Turbochargers (exhaust blades)  
i. Exhaust muffler
- /----- 42. State the response of the combustion air supply dampers to a diesel engine trip.

- /----- 43. State the maximum cylinder temperature, and the reason for that limit.
- /----- 44. State the consequences of water in the intake manifolds, and how it can be detected.
- /----- 45. State the principles of operation of the Cycloil air intake filter, and indicate the importance of proper filter oil level.

PART VIII. EMERGENCY DIESEL ENGINE CONTROL AND PROTECTION  
(NL-LP-11204-U)

- /----- 1. State the uses of the pneumatic portion of the emergency diesel engine control and protection system.
- /----- 2. State the source of air supplied to the pneumatic engine control system.
- /----- 3. List the basic uses of the A, B, and C control circuits, and state how they are monitored.
- /----- 4. List the diesel engine and generator control panel permissives that are necessary for the following to occur:
- a. Normal manual start, from control room
  - b. Normal manual start, from engine control panel
  - c. Automatic start on Loss of Offsite Power
  - d. Automatic start on Safety Injection Signal
- /----- 5. List the protective trips available to the diesel generators after a normal start.
- /----- 6. List the protective trips available to the diesel generator after an emergency start has occurred.
- /----- 7. Describe the operation of the PULL-TO-RUN/PUSH-TO-STOP button at the engine front.
- /----- 8. For the following pushbuttons on the diesel engine control panel, state the response which will occur when each is pushed or actuated:
- a. EMERGENCY START (when glass is broken)

- b. START
- c. OPERATIONAL MODE
- d. MAINTENANCE MODE
- e. ENGINE ROLL
- f. EMERGENCY STOP (break glass, pushbutton)
- g. EMERG-STOP RESET
- h. STOP
- i. RESET FROM LOCA

-----/----- 9. For the following indicators on the diesel engine control panel, state the significance of each being lit:

- a. UNIT AVAILABLE
- b. EMERGENCY STOP
- c. DIESEL AUTO START SIGNAL
- d. SHUTDOWN SYSTEM ACTIVE
- e. SAFETY INJECTION SIGNAL
- f. IN TEST SEQUENCE
- g. 52-G CLOSED
- h. READY TO LOAD
- i. RUNNING
- j. STOPPING
- k. BYPASS TEST FAILURE
- l. STARTING

-----/----- 10. State the function of the Woodward Governor System.

-----/----- 11. Give a brief description of the uses for the three control knobs on the EGB-35 governor/actuator, and the approximate values to which they are normally set:

- a. Load limit
- b. Speed setting adjustment
- c. Speed droop

-----/----- 12. Describe how the Woodward type SG Overspeed Trip functions to shutdown the diesel engine.

-----/----- 13. Describe the response of the fuel rack shutdown cylinder and combustion air valves to a diesel trip signal.

-----/----- 14. State the permissives which allow barring of the diesel engine, and state the difference between

barring and rolling.

- /----- 15. Give a brief description of the moisture cylinder check.
- /----- 16. Discuss how trends in the parameters monitored by logging (using 11885-C) during operation can be used to determine operational problems.
- /----- 17. State a probable consequence of starting the EDG with an inadequate governor oil level, or without proper governor venting by maintenance personnel.
- /----- 18. State the method of detecting engine imbalance, and the possible consequences of sustained engine operation in an unbalanced condition.
- /----- 19. State the reason for the cylinder moisture check after the emergency diesel generator has been run, and give the time schedule for the check.

PART IX. GENERATOR CONTROL AND PROTECTION FOR THE EMERGENCY DIESEL GENERATOR (NL-LP-11.05-C)

- /----- 1. State the purpose of the generator.
- /----- 2. State the basic function of the voltage regulator.
- /----- 3. State the function of the Neutral Grounding transformer.
- /----- 4. State the function of current transformers on the generator leads.
- /----- 5. State the function of potential transformers on the generator leads.
- /----- 6. For the following controls on the generator control panel, state the response of the diesel generator to the selection of each position, and state operating conditions in which that selection would be made.
  - a. LOCAL/REMOTE Switch
  - b. SPEED RAISE/LOWER switch
  - c. AUTO/MANUAL pushbuttons for voltage



regulators

- d. EXCITER ENABLE Switch
- e. FIELD FLASH pushbutton
- f. VOLTAGE CONTROL SWITCHES, RAISE/LOWER (auto and manual switches)
- g. EXCITER SHUTDOWN pushbutton
- h. UNIT PARALLEL SWITCH

- /----- 7. State permissives that must be made to allow automatic closure of the Emergency Diesel Generator Output Breaker.
- /----- 8. State the source of excitation voltage for the generator section of the EDG.
- /----- 9. State which 480V auxiliary systems of the emergency diesel generator are affected when the non-class 1E busbar (INB01 and INB10) are not energized.
- /----- 10. Describe the purpose for which 125VDC systems interface with the emergency diesel generator system.

-----  
-----

Complete all knowledge requirements in this section and obtain a waiver.

QB

Complete parts 1 and 2 below:

- / 1. Attended training \lecture
- /----- 2. Passed Systems exam on or including this topic.

### III PRACTICAL REQUIREMENTS

TRN/EVAL		PSCC	PHASE
---/---	1. Walk down the emergency diesel generator and auxiliary systems. Point out to the evaluator the major components, loca. indicators, and system interfaces. Also make the checks performed as part of a standby mode status check in VEGP 13145-1.	P	OJT
---/---	2. Lockte the 480 VAC MCCs and 120 VAC and 125 VDC distribution panels listed in VEGP 13145-1 and found in the generator building.	P	OJT
---/---	3. Using the outside area PEO rounds sheet, locate all listed emergenc, diesel generator associated parameters.	P	OJT
---/---	4. Fill the fuel oil storage tank.	P,S	OJT
---/---	5. Transfer emergency diesel generator fuel oil to the auxiliary boiler fuel oil storage tank.	P,S	OJT
---/---	6. Prepare the emergency diesel generator for startup.	P,S	OJT
---/---	7. Manually start the diesel generator locally.	P,S	OJT
---/---	8. Emergency start the emergency diesel generator.	P,S	OJT
---/---	9. Manually stop the emergency diesel generator locally.	P,S	OJT
---/---	10. Respond to emergency diesel generator lube oil system alarms.	P,S	OJT
---/---	11. Investigate emergency diesel generator jacket water system alarms.	P,S	OJT
---/---	12. Investigate emergency diesel generator fuel oil system alarms.	P,S	OJT
---/---	13. Investigate emergency diesel generator "Disabled" alarms.	P,S	OJT
---/---	14. Investigate emergency diesel generator "Generator" alarms.	P,S	OJT

- 15. Investigate emergency diesel generator "Miscellaneous" alarms. P.S. GJT
- 16. Perform emergency diesel generator operability test. P.S. GJT
- 17. Emergency stop DG locally P.S. GJT