05-45-90

GEORGIA POWER
POWER GENERATION DEPARTMENT
VOGTLE ELECTRIC GENERATING PLANT

TRAINING LESSON PLAN

TITLE:	EMERGENCY DIESEL GENERATORS INTRODUCTION AND OVERVIEW	NUMBER:	LO-LP-11001-06-C
PROGRAM:	LICENSED OPERATOR	REVISION:	6
SME:	C. BREWER	DATE:	12/6/89
APPROVED:	Lloyd A. Hyatt	DATE:	12/11/89

INSTRUCTOR GUIDELINES:

I. FORMAT

A. Lecture with visual aids

II. MATERIALS

A. Overhead projector

B. Transparencies

C. White board with markers

III. EVALUATION

A. Written or oral exam in conjunction with other lesson plans

IV. REMARKS

Licensed Operator Objectives for this lesson plan can be found in the Licensed Operator System Master Plan Section 2.3 (Qualification Signoff Criteria)

Rev 5 Cluster 11 DIESEL GENERATOR

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REFERENCES:

1. Plant Vogtle Procedures:
   13145 "Diesel Generator"
   13146 "Diesel Generator Fuel Oil Transfer System"
   14980 "Diesel Generator Operability Test"
   13427 "4160 VAC 1E Electrical Distribution System"
   17035, 17038, Annunciator Response Procedures

2. Technical Specifications:
   3.8.1 Electrical Power Systems, AC sources

3. "Standby (Emergency) Diesel Generator," Vogtle Training Text Chapter 16C

4. Plant Manual Chapter 23

5. VEGP Design Manual: System 1821 "Standby Power System"
   System 2403 "Diesel Generator Systems"

6. P&IDs, Logics, and other Drawings
   Piping and Instrument Diagrams
   1X4DB170-1
   1X4DB170-2

   Vendor Drawings
   AX4AK01-27 (Lube Oil)
   AX4AK01-26 (Jacket Water)
   AX4AK01-29 (Starting Air)
   AX4AK01-28 (Fuel Oil)

   Control Logic Diagrams:
   1X5DN107-1 (DG Fuel Oil System)
   1X5DN107-2 (DG Unit Engine)
   1X5DN107-3 (Generator)

   Elementary Diagrams
   1X3D-BH-G03C
   1X3D-BH-G03D
   1X3D-BH-G03E
   1X3D-BH-G03F
   1X3D-BH-G03G
   1X3D-BH-G03H
   1X3D-BH-G03I
   1X3D-BH-G03J

   One Line Diagrams
   1X3D-AA-A01A
   1X3D-AA-K01A

7. Vendor Manuals
   AX4AK01-509
   AX4AK01-510

REFERENCES:

AX4AK01-563

8. FSAR: 8.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8
Question 430.1 and VEGP Responses (Commitment for Lesson)

9. OAP Commitments:
SOER 83.001 "Diesel generator failures"
SOER 83.042 "System interdependency oversights results in loss of redundant safeguards functions"
NUREG 1216.000 "Safety evaluation report-related to operability and reliability of emergency diesel generators manufactured by Transamerica DeLaval Inc." (Not an OAP action item, but a training commitment)
VEGP Training Procedure 60602-C "Reactor Operator Training Program" (Overall Commitment for Lesson)

10. Instructional Units: None

11. Transparencies:

LO-TP-11001-001	Lesson Plan Objectives
LO-TP-11001-002	Main One Line (Simplified)
LO-TP-11001-003	4-Strokecycle Diagram
LO-TP-11001-004	Building Layout
LO-TP-11001-005	Outline of Skid Base
LO-TP-11001-006	Electrical Layout
LO-TP-11001-007	Engine Cross-section
LO-TP-11001-008	EDG - Sideview
LO-TP-11001-009	EDG - Topview
LO-TP-11001-010	DG System - Simplified

III. LESSON OUTLINE:

NOTES

I. INTRODUCTION

A. Overview

1. This lesson describes the relationship of the Emergency Diesel Generators (EDG's) with the plant's offsite and onsite electrical systems, and explains the purpose of the EDG's and the purposes of the EDG's auxiliary systems, and introduces several major components of the auxiliary systems

2. Present Objectives

LO-TP-11001-001

B. The lesson will be presented in the following sequence:

Write on board

1. General Overview
2. Four-stroke Diesel Engines
3. General System Description
4. Diesel Generator Building Layout
5. Engine Operation
6. System Interfaces
7. Technical Specifications
8. History of Problems with Diesel Engines

II. LESSON PRESENTATION

A. General Overview

FSAR Q.430.1 Commitment

1. The emergency diesel generators provide <u>standby onsite power</u> required by the <u>class 1E</u> AC power systems in the event of a loss of preferred power sources, for powering the essential loads necessary to safely shut down the reactor under any operating and accident conditions

a. The EDG provides standby power to the 4160V Class IE busses during all loss of offsite essential power conditions

b. The EDG is <u>not</u> designed to perform any main generator power generator functions

III. LESSON OUTLINE:

NOTES

2. 4160 V Class 1E busses

   a. Class 1E system divided into two redundant trains/unit each train capable of safely shutting down the unit

      1) ESF busses (1AA02, 1BA03 for unit 1 are class 1E busses)

      2) BOP (balance-of-plant) 4160 V busses are non-class 1E

   b. Two Reserve Auxiliary Transformers (RAT's)

      1) Receive 230 KV from system busses

      2) Supply 13.8 KV and 4.16 KV

      3) The 4.16 KV from the RAT supply the 4.16 KV class 1E busses

   c. Each class 1E bus is provided:

      1) Normal offsite preferred power source (breaker from its normal RAT closed)

      2) Alternate offsite power source (breaker from opposite trains RAT is not in the compartment - only one breaker between the 2 RAT sources)

      3) Standby Power Source Diesel generator

   d. Normal Plant Operation: Both class 1E 4160 V busses energized from the offsite preferred power sources, and each class 1E standby diesel generator is not running but available for automatic start

   e. Loss-of-Offsite Power: With one or both offsite power sources not available, the loads on the de-energized system(s) are shed from the busses and re-energized from the class 1E standby diesel generators by a sequencer

   f. Accident conditions: On a safety injection actuation signal, both EDG's for that unit automatically start and are made available to supply the respective 4160 V class 1E busses should offsite power subsequently occur

III. LESSON OUTLINE:

NOTES

3. Explanation of electrical flowpaths between the 230 KV busses and the 4160 V class 1E switchgear:

Objective 1
LO-TP-11001-002

a. To Train "A"

1) 230 KV busses, the source of offsite power, via closed PCB's and disconnects switch

2) Switcher 11M1A (closed)

3) Reserve Aux. Transformer 1NXRA transforming 230 KV AC to 4160 VAC

4) 4160 V Swgr 1AA02, normal supply breaker closed

5) Alternate supply to 4160 V swgr 1AA02 (from RAT 1NXRB): no breaker in compartment

b. To Train "B"

1) 230 KV busses, the source of offsite power, via closed PCB's and disconnect switch

2) Switches 11M1B (closed)

3) Reserve Aux. Transformer 1NXRB transforming 230 KV AC to 4160 VAC

4) 4160 V swgr 1BA03, normal supply breaker closed

5) Alternate supply to 4160 V Swgr 1BA03 (from RAT 1NXRA): no breaker in compartment

B. 4-Stroke Diesel Engines:

1. Advantages over gasoline engines:

a. Diesel does not need electric spark ignition, relies instead on heat of compression (approx. 1000^{o}F)

b. Fuel oil burns at approx. 450^{o}F, so is less of a fire hazard from gasoline

c. Fuel oil can be stored longer

III. LESSON OUTLINE: NOTES

d. Air/Fuel ratio varies to suit the load, so more economy is possible

2. Principles of Diesel Operation

a. Operates on a 4-stroke principle LO-TP-11001-003

b. Air Intake Stroke

1) Intake valve open

2) Piston moves down, drawning air into cylinder

3) Intake valve shuts near the bottom of the stroke

c. Compression Stroke

1) Cylinder sealed and air is compressed

2) Air temperature increases under compression

3) Fuel injected at top of stroke and ignites from high temperature

d. Power Stroke

1) Heat of combustion expands gasses forcing the piston downward

2) Exhaust valve opens just before bottom of power stroke

e. Exhaust Stroke

1) Piston moves upward expelling gasses from cylinder through exhaust valve

2) Air intake valve opens just prior to end of exhaust stroke to aid in purging exhaust gasses and cooling the inner cylinder walls

3) Gas removal and air injection aided by turbocharger

C. General System Description Objective 2

1. Diesel Engine

III. LESSON OUTLINE: NOTES

a. Number of cylinder and arrangement: V-16

b. RPM of synchronous speed: 450

c. Horsepower rating: 9694 brake horsepower

d. Two engines per unit (one for each Train, "A and B")

e. Bore and Stroke: 17 inches x 21 inches

f. Turbocharged (dual), aftercooled, 4-stroke, 4 valves per head

g. Rotation: clockwise, when viewed from the flywheel

h. One for each 4.16 KV ESF bus

i. Housed in separate enclosures for train separation

j. One diesel and associated ESF train meet requirements for all analyzed accidents

2. Generator

a. 4.16 KV, 8750 KVA, 7000 KW continuous, 3 phase, 60 Hz

b. 16 poles, 450 RPM

c. 0.8 PF

d. 7700 KW overload rating for 2 hours in a 24 hour operating period

3. Function of EDG Auxiliaries and Systems:

a. Fuel Oil System:

1) Provides onsite storage and delivery of fuel oil for approximately 7 days operation of the safety related loads as required under accident conditions, assuming a loss of all offsite power sources

2) DG consumes about 8 gpm at full load. This equates to about 80,500 gallons in a seven day period. Carrying only the ESF loads, the bus is loaded to

III. LESSON OUTLINE:

NOTES

only about half rated load, so the TS minimum tank volumes are sufficient for seven days of operation

b. Air Start System

1) Provides a means of starting the engine quickly after receipt of a start signal by injecting high pressure air into the cylinders

c. Lube Oil System

1) Provide oil for lubricating, and cooling of engine bearings and other components during engine operation

2) Provide oil for prelubrication, and warming of engine bearings and other components when the engine is in standby

d. Jacket Water Cooling System:

1) Provides enough engine cooling to allow continuous operation at maximum load

2) Provides engine warming when the engine is shut down to promote starting
NOTE: The Jacket Water Cooling System is dependent on NSCW for heat removal. Loss of NSCW will result in loss of the diesel. The engine can run for only about 3 minutes fully loaded without NSCW

SER 84.042 (in part) commitment

e. Combustion air supply and exhaust

1) Provides filtered, compressed air for combustion and a means for removal of exhaust products

f. Crankcase Ventilation System

1) Removes fumes and vapors from the crankcase, and provides partial vacuum

g. Diesel Engine Control System:

III. LESSON OUTLINE:

NOTES

1) Provides means for starting, loading, running, and stopping the diesel engine, and allow for local operations for maintenance purposes

h. Generator and Breaker Control

1) Provides means for controlling the electrical output of the generator, and protection for the generator

D. Diesel Generator Building Layout

LO-TP-11001-004

1. Unit 1 DG structures located to east side of Auxiliary Building and Containment

a. Building contains

1) Two diesel generators

2) Two fuel oil day tanks

3) Four starting air receiver/compressor units

4) Air intake vents and filters, silencers, and controls

b. Each DG and its associated equipment located in separate rooms within the DG building

2. Building Construction

a. Seismic Category 1 - Reinforced concrete structure

b. Interior and exterior walls constitute fire barrier with 3 hour resistance rating

3. Component Locations

a. Fuel Oil Storage Tanks

1) East of DG building approximately 20 feet

2) Also includes the fuel oil transfer pumps and associated valves

b. Diesel Generator Auxiliary Equipment Skid

LO-TP-11001-005

III. LESSON OUTLINE:

NOTES

1) Jacket Water Standpipe

2) Two Lube Oil Sumps

3) Jacket Water Heat Exchanger

4) Lube Oil Heat Exchanger

5) Jacket Water Keep Warm Pumps

6) Lube Oil Keep Warm Pump

7) Lube Oil Filters and Strainers

c. Air start system components

1) NW side each room

2) 2 each of:

a) Compressor

b) Receiver

c) Dryer

d. Electrical Layout

1) Motor Control Centers — LO-TP-11001-006

a) 1ABF/1BBF (Northeast Corner) — Safety-related

b) 1NBO/1NBI (West)

c) 1NBG/1NBQ (West)

2) Diesel Generator Control Panel (PDG1) — PDG3 `B' train

3) Diesel Engine Control Panel (PDG2) — PDG4 `B' train

4) Neutral Ground Transformer 25kVA - 4160/240-120VAC

4. Identify location of the following components: — Objective 3

a. Generator — LO-TP-11001-007

b. Exciter — LO-TP-11001-008

c. Jacket water standpipe — LO-TP-11001-009

d. Turgochargers

e. Combustion air coolers

f. Intake air inlet (silencers)

g. Exhaust outlet

h. Jacket water cooler

i. NSCW connections on JW cooler

j. Crankcase vacuum fan

E. Engine Operation

1. Emergency generator receives rotational energy from diesel engine

2. Air supplied to intake manifold using turbo-charger compressor — One per bank to reduce engine size

a. Turbocharger driven by exhaust gasses

b. Increases engine horsepower output by promoting more efficient burning of injected fuel

3. Fuel injected in cylinders using positive displacement injection pumps

a. Amount of fuel to cylinders changed by controlling "effective stroke" of pump

b. Pumps connected to governor by linkage mechanism

c. One injector per cylinder

4. Gear driven lube oil pump supplies oil to all surfaces requiring cooling and lubrication — Note: There are NO DC lube oil or fuel pumps

a. Electric driven keep warm pump circulates oil to engine components when shutdown to allow quick starts

b. Cooling water system also utilizes prewarming system for same reason

5. Standby Power

a. Engine rated to support steady state loads

III. LESSON OUTLINE:

NOTES

on safeguards bus, but can not support starting of all ESF loads simultaneously

b. Overloading prevented by stripping bus, then sequentially loading selected loads only the bus in prescribed fashion

F. System Interfaces

1. NSCW

a. Cools engine by removing heat from jacket water at jacket water cooler

FSARQ430.1
Commitment - interrelationships of major systems
LO-TP-11001-010

2. Demineralized Water

a. Provides makeup to jacket water cooling system

3. Diesel Generator Building HVAC

a. Provides ventilation for DG building

b. Non-essential ventilation

1) Ventilates DG room when engine is not running, pulling fresh air in from "downstairs" louvers, discharging to "upstairs"

2) Electric heaters, and air recirculation in cold weather

c. Essential ventilation

1) Two 50% capacity fans

2) Off when DG is off

3) When running, discharge air from "upstairs" to "downstairs"

4) At least 2 ESF supply fans and associated dampers per DG train required by Tech Specs

T.S. 3/4.7.13

4. Fire Protection Water System

a. Provides fire protection for the diesel generator facilities

5. Diesel Generator Building

III. LESSON OUTLINE:

NOTES

a. Protects DG against missiles, tornado

b. Separation wall between DG's as safeguards against fire, flooding, heat

6. Diesel Fuel Oil Storage Tank Pump House

a. Provides protection for the fuel oil transfer pumps

7. Auxiliary Building and Misc. Drain Systems (nonradioactive)

a. Provides drains from DG building to turbine building drain system

8. Standby Power System

a. Diesel generator supplies power to this system

b. Standby power system in turn powers the auxiliary loads for the DG and fuel oil systems

c. "Standby Power System" and "Diesel Generators" mean nearly the same. The two diesel generators and associated controls supply power to the standby power system for one unit

9. Purpose of 4160VAC Interface

a. Diesel generators supply 4160VAC to the "Standby Power System"

b. The "Standby Power System" delivers power to the class 1E 4.16KV system upon loss of offsite preferred power

10. Purpose of 480VAC (MCC 1NB1, 1NB0)

Note: Loss of either of these buses causes EDG to be inoperable (See SOP-13146)

a. Provides power to fuel oil transfer pumps

b. Provides power to air compressors and aftercooler fans

c. Jacket water circ pump and heater

d. Lube oil circ pump and heater

e. Generator space heater

III. LESSON OUTLINE:

NOTES

G. Technical Specifications

Note: Use actual T.S. when reviewing Objective 4

1. Minimum offsite and onsite AC electrical power sources required by Tech Spec 3.8.1.1 LCO, for operations in Modes 1, 2, 3, or 4

   a. Two physically independent circuits between the offsite transmission network and the onsite Class 1E Distribution System, and

   b. Two separate and independent listed diesel generators, each with

      1) A day tank containing a minimum volume

      2) A separate Fuel Oil Storage System containing a minimum volume of 68,000 gallons of fuel (76% instrument span) (LI 9024, LI 9025) and

      3) A separate fuel transfer pump

Note: Instrument scaled in %, not gallons

End Commitment FSAR Q 430.1

2. Surveillance Requirement 4.8.1.1.1a

   a. Each of the above required independent circuits between the offsite transmission network and the onsite Class 1E Distribution System shall be:

      Determined OPERABLE at least once per 7 days by verifying correct breaker alignments, and indicated power availability

3. Four situations involving offsite power sources and the diesel generators which require performing Surveillance Requirement 4.8.1.1.1.a within one hour for Modes 1 thru 4

   a. One of the two offsite electrical power sources inoperable

   b. Either diesel generator inoperable

   c. One offsite electrical power source and one of the two diesel generators inoperable

III. LESSON OUTLINE:

NOTES

d. Two of the required diesel generators inoperable

4. If one EDG is inoperable Modes 1 - 4

a. All required systems, subsystems, trains, components and devices that depend on remaining OPERABLE diesel generator as a source of emergency power are also OPERABLE, and

b. When in Mode 1, 2, 3 the steam-driven auxiliary feedwater pump is OPERABLE

5. Minimum AC electrical power sources required by Tech Spec 3.8.1.2 (for Modes 5 and 6)

a. One circuit between the offsite transmission network and the onsite Class 1E distribution system, and

b. One diesel generator, with:

1) A day tank containing a minimum volume of 650 gallons (55% of motor span) (LI-9018, LI-9019) of fuel

2) A fuel storage system containing a minimum volume of 68,000 gallons of fuel (76% of instrument span) (LI-9024, LI-9025) and

3) A fuel transfer pump

c. Immediate actions required should the minimum limiting conditions for operation (LCO's) not being met for Tech Spec 3.8.1.2

1) IMMEDIATELY suspend all operation involving:

Core Alterations
Positive Reactivity Changes
Movement of Irradiated Fuel
Crane Operations with Load over the Fuel Storage Pool

2) Provide relief capability for the RCS

At least one of the Cold Overpressurization Protection systems operable

III. LESSON OUTLINE: NOTES

3) In addition, IMMEDIATELY initiate corrective action to restore the required sources to OPERABLE as soon as possible if:

In Mode 5, with reactor coolant loops not filled, or

In Mode 6, with water level less than 23 feet above the reactor vessel flange

6. Design Bases of EDGs

Commitment: FSAR Q 430.1 Objective 5

a. Bases in Tech Spec 3/4.8 "Electrical Power System"

1) Modes 1 - 4

a) Ensure sufficient power available for safety-related equipment required for:

(1) Safe shutdown

(2) Mitigation and control of accidents

b) Satisfy requirements of General Design Criteria 17 of Appendix A to 10CFR50

2) Modes 5 - 6

a) Ensures that during shutdown and refueling:

(1) Can be maintained in shutdown or refueling for extended time periods

(2) Sufficient instrumentation and control capability for monitoring and maintaining status

b. Additional ACTION requirements with one EDG inoperable

1) Actions

a) Verify all required systems, sub-

III. LESSON OUTLINE:

NOTES

systems, trains, components, and devices depending on operable diesel as emergency power source are operable

b) Verify TDAFW pump operable

2) Bases is to provide assurance that a loss-of-offsite power does not result in complete loss of safety functions

3) Verified by administratively checking to see if components are out-of-service, NOT by performing surveillance

H. History of Problems with Diesel Engines

More detail in later lesson plans Start NUREG 1216

1. Crankshafts

a. Some engines have KW load limited due to stress and fatigue cracks

b. VEGP load still 7000 KW continuous and 7700 KW for 2 out of 24 hours

c. Do not run at critical speed, which adds stress

1) Normal 450 rpm

2) Critical 180 - 250 rpm

d. Do not run with engine imbalance - one or more cylinders carrying different load

1) Causes more crankshaft stress

2) Monitor cylinder temperatures hourly

2. Cylinder Heads

a. Leaking of water into combustion chamber can cause "hydraulic lock", causing damage and prohibiting start

b. "Barring" and air roll tests performed to look for moisture in cylinders

c. Engine not operable while this is being done - other AC sources must be available to avoid Tech Spec conflicts

III. LESSON OUTLINE:

NOTES

3. Fuel Oil Injection Tubing

   a. High pressures in fuel oil injection tubing (pump to nozzle)

   b. Hazardous to operating personnel nearby, if one breaks

4. Turbocharger

   a. Manufacturer specifies 1200°F maximum engine exhaust temperature to a turbocharger

   b. Prelubrication adds to turbocharger bearing lifetime

5. TDI Engine Cylinder Blocks

   a. Some have exhibited cracks, such as between studs

   b. Primarily a maintenance function to look for

6. How to avoid problems with engine internal components:

   a. Operate EDG in accordance with procedures

   b. Observe load limits

   c. Avoid rapidly loading the EDG whenever possible

End NUREG 1216

   d. Stay away from critical speeds

7. Industry Significant Operating Experience Report

Start SOER 83.001

   a. Industry Events

      1) Plant Hatch EDG engine bearing damage due to inadequate prelubrication

      2) Dresden 3 EDG start failure due to worn cylinder and dirt in the Air Start System

   b. Review of Reported Failure Data

III. LESSON OUTLINE:

NOTES

1) 40% failed/degraded mechanical components

a) Moisture/corrosion in the Air Start System

b) Pre-lubrication

c) Lube Oil Quality

2) 42% failed/degraded electrical/I&C components

a) Contacts

b) Relays

c) Cabinets - seals

3) 18% Personnel

60% operators, 40% technicians/ maintenance

a) Testing conditions

- Frequency
- Loading
- Duration

b) Off-Normal operating characteristics

c) Changing Parameters

c. VEGP Remedies

1) Operating procedures

2) Air Drying System incorporated in design

3) Frequent Inspection of Mechanical and Electrical components

4) Frequent sampling and analysis of Lube Oil

5) Knowledgeable personnel present during testing

d. Significance - Operability of EDG units is important for safe plant shutdown following a loss of off-site power

End SOER 83.001

III. LESSON OUTLINE: NOTES

III SUMMARY

A. Review Objectives

1. EXPLAIN THE ELECTRICAL FLOWPATHS BETWEEN THE 230 KV BUSES AND THE 4160 CLASS 1E SWITCHGEAR 1AA02 AND 1BA03, INCLUDING ALL INTERTIES TO THE CLASS 1E SWITCHGEAR

See LO-TP-11001-002

2. FOR THE EMERGENCY DIESEL GENERATOR AND ENGINE, STATE:

a. NUMBER OF CYLINDERS AND ARRANGEMENT - V16

b. RPM AT SYNCHRONOUS SPEED - 450 RPM

c. THE CONTINUOUS DUTY AND MAXIMUM INTERMITTENT KW LOADING - 7000 KW CONTINUOUS AND 7700 KW FOR 2 HOURS IN 24 HOURS

3. GIVEN DRAWINGS OF A DSRV-16 DIESEL ENGINE, IDENTIFY THE FOLLOWING COMPONENTS:

a. GENERATOR

b. EXCITER

c. JACKET WATER STANDPIPE

d. TURBOCHARGERS

e. COMBUSTION AIR COOLERS

f. INTAKE AIR INLET

g. EXHAUST OUTLET

h. JACKET WATER COOLER

i. NSCW CONNECTIONS ON JACKET WATER COOLER

j. CRANKCASE VACUUM FAN

See LO-TP-11001-008, LO-TP-11001-009, and LO-TP-11001-010

4. DETERMINE THE TECHNICAL SPECIFICATION LCOs AND APPLICABILITY FOR EACH EDG RELATED TECHNICAL SPECIFICATION

III. LESSON OUTLINE:

NOTES

See Section II.G.1 through II.G.5

5. (SRO only) FOR EACH EDG RELATED TECHNICAL SPECIFICATION, DETERMINE THE ACTION STATEMENTS REQUIRING ACTION WITHIN ≤ ONE HOUR AND THE BASES FOR THE TECHNICAL SPECIFICATION

See Section II.G.6

B. Tour EDG Building

I PURPOSE STATEMENT

Following completion of this lesson, the student will possess those knowledges systematically identified for the performance of the EMERGENCY DG-INTR AND OVERVIEW LAYOUT tasks.

II LIST OF OBJECTIVES

1. Explain the electrical flow paths between the 230 KV busses and the 4160V class 1E switchgear 1AA02 or 1BA03, including all interties to the class 1E switchgear.
(KSA numbers: 064000K101)

2. For the emergency diesel engine, state:
a. Number of cylinders and arrangement.
b. RPM at synchronous speed.
c. The continuous duty and maximum intermittent KW loading.
(KSA numbers: 064000K404)

3. Given drawings of a DSRV-16 diesel engine, identify the following components:
a. Generator
b. Exciter (brushes)
c. JW standpipe
d. Turbochargers
e. Combustion air coolers
f. Intake air inlet
g. Exhaust outlet
h. Jacket water cooler
i. NSCW connections on JW cooler
j. Crankcase vacuum fan

4. Determine the Technical Specification LCOs and applicability for each EDG related Technical Specification.
(KSA numbers: 064GEN0005)

5. (SRO only) For each EDG related Technical Specification, determine the Action Statements requiring action within < one hour and the bases for the Technical Specification.
(KSA numbers: 065GEN0006)

FOR INFORMATION ONLY