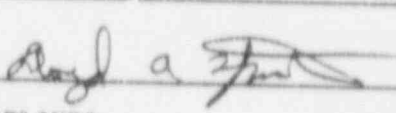


05-44-90

GEORGIA POWER  
POWER GENERATION DEPARTMENT  
VOGTLE ELECTRIC GENERATING PLANT  
TRAINING LESSON PLAN

TITLE:	EMERGENCY DIESEL GENERATOR AUXILIARIES AIR START SYSTEM	NUMBER:	LO-LP-11102-05-C
PROGRAM:	LICENSED OPERATOR	REVISION:	5
SME:	C. BREWER	DATE:	12/6/89
APPROVED:		DATE:	12/8/89

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

FOR INFORMATION ONLY

MASTER COPY

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

INTENTIONALLY LEFT BLANK

## 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 SYSTEMS"
  - 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, VEGP
4. PLANT MANUAL CHAPTER 23
5. 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

## REFERENCES:

- 1X3D-AA-K01A
- 6. VENDOR MANUALS
  - AX4AK01-509
  - AX4AK01-510
  - AX4AK01-563
- 7. F.S.A.R: 8.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8
- 8. OAP COMMITMENTS: NONE
- 9. INSTRUCTIONAL UNITC - NONE
- 10. TRANSPARENCIES
  - LO-TP-11102-001 LESSON OBJECTIVES
  - LO-TP-11102-002 STARTING AIR SYSTEM
  - LO-TP-11102-003 "A" DIESEL GENERATOR AIR START SOLENOID VALVES
  - LO-TP-11102-004 AIR START DISTRIBUTION LAYOUT

## III. LESSON OUTLINE:

NOTES

## I. INTRODUCTION

## A. Overview

1. This lesson describes the Diesel Air Start System and how it and its components work in storing air for starting conditions. The lesson includes the air compressors and storage components, as well as engine-mounted components. The Air Start System itself is presented as a component is the presentation of the entire DG course.

2. Present the Objectives

## B. The lesson is presented in the following sequence:

LO-TP-11102-001  
Write on board

1. Function
2. Component Description
3. Controls and Instrumentation
4. Operations
5. Administrative
6. Summary

## II. PRESENTATION

- A. Main purpose: Provide the means for quick starting the diesel upon receipt of a start signal, by injecting high pressure air into the cylinders

## B. Functions:

1. Starting air supply
2. Supply engine control air
  - a. Two sources, one to 'A' engine control circuits, one to 'B'
  - b. Regulated to 60 psig
  - c. Used to operate pneumatic logic used for engine protective circuits
3. Supply air for barring

LO-TP-11102-002

Objective 8b

## III. LESSON OUTLINE:

NOTES

- a. Barring device pneumatically operated
- b. Supplied via air receiver 001 only
- 4. Supply air for rolling engine
  - a. Spins engine without starting it
- 5. Governor oil booster air
  - a. Increases oil pressure in governor when starting
  - b. Causes fuel linkage and racks to move to an "on" position
  - c. Conserves air on starting, since fuel racks move sooner on start
  - d. Shuttle valve allows manifold with highest air pressure to supply governor oil booster and shutdown pushbutton located on south end of engine auxiliary skid

Governor oil pressure low initially on start otherwise

## C. Component Description:

- 1. Two independent and redundant starting air systems with each system containing:
  - a. Air compressor
  - b. Aftercooler
  - c. Air dryer
  - d. Air receiver
  - e. Piping, piping to barring device (one system only)
  - f. Air supply to engine control panel
  - g. Air start solenoid valves (2 each)
  - h. Air distributor
  - i. Air supply manifold
  - j. Air start valves (one per cylinder)
- 2. Major Components in order of flowpath:

Objective 1

## III. LESSON OUTLINE:

NOTES

## a. Compressor

- 1) Reciprocating, air cooled, 2 stages, with intercooler between low and high pressure stages
- 2) Two low pressure cylinder, one high pressure
- 3) 76 s.c.f.m. at 250 psig
- 4) Motor: 30 hp, 480V ac,
- 5) Power supplies
  - a) A Train - 1NBI
  - b) B Train - 1NBO
- 6) Designed to be capable of recharging its air receiver from minimum working pressure to 250 psig in 30 minutes
- 7) Filter on air intake
- 8) Splash-type workcase lube, using thrower gear

Objective 2  
(partial)

## b. Aftercooler

- 1) Air-to-air cooler
- 2) Electric fan blows ambient air through honeycomb to remove heat of compressor
- 3) 3/4 hp
- 4) Power supplies same MCC as compressors

MCC in respective  
DG room

## c. Air dryer

- 1) Removes moisture from compressed air
- 2) 1 dryer per air compressor set
- 3) Powered from 120/240V  
Distribution panel part of 1NBI/1NEO
  - a) A Train - 1NY11 (1NBI)
  - b) B Train - 1NYO2 (1NBO)

Objective 2  
(partial)



## III. LESSON OUTLINE:

NOTES

- 4) 1 hp motor
- 5) Air to refrigerant (R-12) heat exchange
- 6) 200 s.c.f.m. at 275 psig
- 7) Air dryers crankcase heater - must be on at least 24 hours prior to dryer start

## d. Air receiver

- 1) Vertical, cylindrical, 305 ft<sup>3</sup> capacity
- 2) Capable of providing air for a minimum of 5 consecutive engine starts without compressor assistance when the initial receiver pressure is normal
- 3) Pressure relief 275 psig  $\pm$  8 psig
- 4) Normally maintained 225 to 260 psig

## e. Air start solenoid valves (admission valves)

LO-TP-11102-003

- 1) Two, parallel valves/circuit, 4 total/engine
- 2) Pilot operated diaphragm valve
- 3) Admits air to starting air manifold for that bank
- 4) Train A DG example:
  - 9070A and 9070B (parallel) for right bank
  - 9068A and 9068B (parallel) for left bank

## 5) Power supplies

Objective 2  
(partial)

- a) 'A' circuit air start solenoid valves (9068A, 9070A)
  - (1) Powered by "A" circuit engine control power

## III. LESSON OUTLINE:

NOTES

- (2) Indicated by white light on engine control panel
- b) 'B' circuit air start solenoid valves (9068B, 9070B)
  - (1) Powered by "B" circuit engine control power
  - (2) Indicated by white light on engine control panel
- 6) Will not open (fails closed) on loss of 125V dc diesel engine control power Objective 3
  - a) Train A, Circuit A - 1AD11, 2AD11
  - b) Train A, Circuit B - 1AD12, 2AD12
  - c) Train B, Circuit A - 1BD11, 2BD11
  - d) Train B, Circuit B - 1BD12, 2BD12
- 7) Either train will admit sufficient air to start the EDG
- f. Starting air valves
  - 1) One per cylinder, mounted in engine head
  - 2) Pilot air to open from air start distributor
  - 3) Closes by spring (and firing pressure)
  - 4) Admits air to cylinder from starting air manifold
- g. Air start distributor LO-TP-11102-004
  - 1) The air distributors time the starting air to each cylinder in relation to the power stroke of each piston
  - 2) Two, one per bank
  - 3) Driven by engine crankshaft

## III. LESSON OUTLINE:

NOTES

- 4) Pilots starting air valves on each cylinder head
- 5) Lubricated by "oilspitter"
- 6) Located near flywheel

## D. Controls and Instrumentation:

1. No control room start/stop switches or meters
2. Local indicators
  - a. Pressure indicator on each receiver
  - b. Pressure indicator on engine control panel for left bank and right bank
  - c. Also, control air pressure gauge on engine control panel
3. Annunciator alarms
  - a. DG DISABLED LOW PRESS STARTING AIR  
215 psig  $\pm$  5 psig
    - Technical Specifications require at least one receiver greater than 210 psig
  - b. DG HIGH PRESS STARTING AIR
    - 265 psig
  - c. DG SWITCH NOT IN AUTO
    - 1) Aftercooler switch not in AUTO
    - 2) Compressor switch OFF
    - 3) Other functions not associated with air start system also cause this alarm
  - d. DG LOW PRESS CONTROL AIR
    - 1) Starting air system pressure less than 55 psig
4. Automatic functions
  - a. Each receiver maintained 225-250 psig by its compressor

A related alarm

Objective 4

## III. LESSON OUTLINE:

NOTES

- 1)  $\leq$  225 psig receiver pressure - compressor starts
  - 2)  $\geq$  250 psig, compressor stops
  - 3) Low lube oil level trip of air compressor
- b. Interlock
- 1) Should starting air pressure decrease to 150 psig, and DG does not start on an emergency start attempt, it will not try again.
  - 2) Manual attempt can be made
- c. Aftercooler
- 1) Starts/stops with its compressor
- d. Air dryer
- 1) Runs continuously once started
- e. Air start solenoid valves
- 1) All four (2 from circuit A, 2 from circuit B) open on DG start signal
  - 2) At 200 rpm, increasing, all four solenoid valves close

## E. Operations

1. Air receivers maintained at an operating pressure by compressors
  - a. Auto start at 225 psig
  - b. Auto stop at 250 psig
  - c. Low pressure alarm at 210 psig
  - d. Upstream check valve on receiver inlet ensures broken pipe from compressor will not effect receiver operability
2. Upon receipt of start signal
  - a. All four solenoid valves open directing starting air to each cylinder from both

Objective 5

## III. LESSON OUTLINE:

NOTES

- systems (HV9068A and B and HV9070A and B)
- b. Air distributor properly times the opening of the air valve in each cylinder at the proper time. Distributor turns in relation to engine speed
  - c. When engine has fired and is running on its power, a speed switch deenergizes and shuts the air start valves
    - 1) Speed switch set to 200 rpm
    - 2) Normally after 2 to 3 revolutions the combustion chamber pressure is too high to allow air injection to the cylinder
  - d. Emergency auto start signals may continue until air receiver pressure drops to 150 psig. Normal start attempts - are 5 seconds in duration maximum. Manual starts may continue until receiver pressure drops to 90 psig
3. Power to compressor and aftercooler fans not available (Train 1A example)
- a. Safety injection
    - 1) 480V MCC 1NBI deenergized
    - 2) Non-1E supplied from 1E bus otherwise
    - 3) Compressors should not be restarted until procedures allow
  - b. Loss of off-site power
    - 1) Power to 1NBI temporarily interrupted
    - 2) Compressors and aftercoolers restart when power returns following sequencing
  - c. Possible to restore power to non-1E 480V switchgear during SI conditions
    - 1) 1AA02 (Train A) supplies transformed 480 VAC to switchgear 1NB01, and non-1E 1NBI, which supplies compressors and several other DG accessories

## III. LESSON OUTLINE:

NOTES

- 2) 1BA03 (Train B) supplies transformed 480 VAC to switchgear 1NB10, which supplies 1NB0 (similar to Train A)
- 3) Trip/override pushbutton allows safety injection override reset (SIOR) on the breakers to 1NB01 (or 1NB10)
- 4) The pushbuttons are at switchgear 1AA02 and 1BA03

## F. Administrative

1. Tech Specification surveillance requirement
  - a. Receiver air pressure greater than or equal to 210 psig
  - b. Read on PI-9060, PI-9061, PI-9064, PI-9065 at receiver
2. Independent verification required for:
  - a. Air start receiver discharge isol valves (open)
  - b. Air start receiver drains (verify closed)

## III SUMMARY

## A. Review the Objectives

1. DESCRIBE THE FLOWPATH OF ONE TRAIN OF THE AIR START SYSTEM FROM THE COMPRESSOR TO THE AIR SUPPLY MANIFOLDS  
See LO-TP-11102-002
2. DETERMINE THE POWER SUPPLIES TO THE AIR COMPRESSORS, AIR DRYERS, AND AIR START SOLENOID VALVES

Air Compressors 480V AC Non-IE	Train A EDGs - 1NBI, 2NBI Train B EDGs - 1NB0, 2NB0
Air Dryers 120/240V AC Non-IE	Train A EDGs - 1NYI1, 2NYI1 Train B EDGs - 1NYO1, 2NYO1
Air Start Solenoid Valves	Train A EDGs - 1AD11, 1AD12,





## III. LESSON OUTLINE:

NOTES

the proper time. This function is terminated when the 200 rpm DG running switch closes the air start solenoid valves and/or the combustion pressure in the cylinder forces its air start valve closed



---

**I PURPOSE STATEMENT**

---

Following completion of this lesson, the student will possess those knowledges systematically identified for the performance of the DE AUX - AIR START SYSTEM tasks.

---

**II LIST OF OBJECTIVES**

---

1. Describe the flowpath of one train of the Air Start System, from the compressor to the air supply manifolds.  
(KSA numbers: 064000K105)
2. Determine the power supplies to the air compressors, air dryers, and air start solenoid valves.  
(KSA numbers: 064000K201)
3. Describe the failure mode for the air start solenoid valves and the impact this has on EDG operability.  
(KSA numbers: 064000A201)
4. Describe the permissives and interlocks associated with the air start system.
5. Explain how each of the following responds to an EDG start signal.
  - a. Air compressors
  - b. Air start solenoid valves
  - c. Air distributor(KSA numbers: 064GEN0007)

**FOR INFORMATION ONLY**