05-50-90

GEORGIA POWER
POWER GENERATION DEPARTMENT
VOGTLE ELECTRIC GENERATING PLANT

TRAINING LESSON PLAN

TITLE:	EMERGENCY DIESEL GENERATOR AUXILIARIES JACKET WATER COOLING SYSTEM	NUMBER:	LO-LP-11105-08-C
PROGRAM:	LICENSED OPERATOR	REVISION:	8
SME:	C. BREWER	DATE:	12/6/89
APPROVED:	Lloyd A. [illegible]	DATE:	12/8/89

INSTRUCTOR GUIDELINES:

I. LESSON FORMAT

A. Lecture with Visual Aids

II. MATERIALS

A. Lesson Plan

B. Transparencies and Overhead Projector

C. Dry Erase Board and Markers

III. LVALUATION

A. Oral or written exam in conjunction with other lesson plans

IV. REMARKS

A. Performance-based instructional units (IUs) are attached to the lesson plan as student handouts. After the lecture on Emergency Diesel Generator Auxiliaries Jacket Water Cooling System, the student should be given adequate self-study time for the IUs. The instructor should direct self-study activities and be available to answer questions that may arise concerning the IU material. After self-study, the student will perform, simulate, observe, or discuss (as identified on the cluster signoff criteria list) the task covered in the instructional unit in the presence of an evaluator.

I PURPOSE STATEMENT

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

II LIST OF OBJECTIVES

1. Describe the general flowpath through the Jacket Water Cooling System during standby and engine running operations.
(KSA numbers: 064000K102)

2. Determine the power supplies for the jacket water keepwarm pump and heater.

3. Describe the permissives associated with the jacket water keepwarm pump and heater.

4. Identify the diesel generator trips associated with the Jacket Water System.
(KSA numbers: 064000K402)

5. With the diesel engine running and loaded, predict the most probable results of the following conditions:
a. Thermostatic control valve stuck in the bypass position
b. Thermostatic control valve stuck open
c. Loss of NSCW to jacket water cooler
d. Failure of engine driven jacket water pump
(KSA numbers: 064000A201)

6. Explain the term "Interdependency of Safeguards Systems Components."

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 Annunciator Response Procedures
   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. 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. FSAR: 8.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8

8. OAP Commitments:

SER 84.042 "System interdependency oversights results in loss of redundant safeguards functions"

9. Instructional Units:

LO-IU-11105-C-001 Respond to Jacket Water System Alarms

10. Transparencies:

LO-TP-11105-001 Lesson Objectives
LO-TP-11105-002 Jacket Water System

III. LESSON OUTLINE: | NOTES

I. INTRODUCTION

A. Overview

1. This lesson describes the relationship of the Jacket Water Cooling Systems, both the main, engine-driven system, and the keep-warm system, and how they perform their functions of controlling engine temperature.

2. Present the Objectives — LO-TP-11105-001

B. This lesson will be presented in the following sequence: — Write on board

1. General Overview

a. Functions
b. Flowpaths

2. Component Description

3. Controls

4. Instrumentation and Alarms

5. Operations

6. System Interfaces

7. Summary

II. LESSON PRESENTATION

A. General Overview

1. The Jacket Water Cooling System provides enough engine cooling to allow continuous engine operation at maximum load

2. Provides engine warming when shut down, to promote starting

3. Flowpaths — Objective 1

a. Jacket Water Standpipe — LO-TP-11105-002

1) Provides NPSH for JW pump

2) Absorbs pump pressure variations

III. LESSON OUTLINE: NOTES

3) Absorbs volumetric changes due to temperature variation

b. JW fill and makeup

1) From demineralized water system

c. Engine driven JW pump

1) Located at engine front

2) Driven from engine gearset

3) Single-stage, centrifugal

d. Thermostatic bypass control valve

1) Located just above JW cooler

2) Modulates to maintain JW temp. by bypassing cooler, or passing flow through it

3) Receives 1800 gpm from JW pump

a) Flow through the heat exchanger shell side is limited to 750 gpm by the thermostatic bypass control valve

b) The remainder of the flow passes around the heat exchanger

e. Jacket Water Cooler

1) JW shell side

2) NSCW tube side

3) JW flow through cooler depends on thermostatic control valve

4) NSCW continuous (normally)

f. Lube oil cooler tube side to remove heat from lube oil

g. Engine Components

1) 2 main headers

a) Supply between engine "Vee"

III. LESSON OUTLINE: NOTES

b) Distribute water to jackets around cylinders

c) Removes internal engine heat

d) Exits engine at exhaust jackets in heads

2) 1 supply to governor cooler to remove heat from governor oil

3) 2 turbochargers

4) Air coolers (turbocharger intercoolers)

h. Return from engine to standpipe

i. Jacket water keep-warm heater

1) Thermostatically controlled by standpipe temp.

2) Maintains JW temp. when engine is not running

j. Jacket water keep-warm pump

1) Runs when engine is off

2) Circulates heated water through engine components when engine is off

B. Component Description

1. Jacket Water Pump

a. Single stage, centrifugal, engine driven pump

b. Circulates jacket water through the DG coolant loop during DG operation

c. Capacity - 1800 gpm

2. Jacket Water Cooler

a. Shell & tube heat exchanger

b. Cooled by NSCW

III. LESSON OUTLINE: NOTES

c. Located on right hand side of DE (if facing flywheel)

3. Thermostatic control valve

a. Three way valve controlling the temperature of the cooling water system. (Internal Temp. Sensing device)

1) HX bypassed below 152°F

2) HX full flow above 170°F

4. Turbocharger After Coolers

a. Cools combustion air after it has passed thru the turbocharger (increases density for better engine performance)

b. Air-to-water finned tube HX: two per engine

5. Lube Oil Cooler

a. Shell and tube HX cools engine lube oil during operation

b. Approx. 1/2 water flow thru tubes (900 gpm)

6. Jacket Water Standpipe

a. Surge tank providing NPSH for jacket water pump

1) Provides makeup water

2) Absorbs pump pressure variations

3) Absorbs volumetric changes due to temperature variations

b. Vertical, cylindrical tank

1) Vented to atmosphere

2) Makeup supplied from demin water

c. Operating Statistics (FSAR-Q430.25)

1) Normal operating level - 12" from top - allowance for thermal expansion

2) Low level alarm - 37" from top -

III. LESSON OUTLINE: NOTES

ensures no air pockets formed by returning jacket water

3) Expected system leakage less than 10 gallons per day. (FSAR-Q430.27)

d. Instrumentation includes gauge glass and remote level indication and alarms

7. Jacket Water Keep Warm Components

a. Consists of 3 HP, centrifugal pump and a 75 KW immersion heater

1) Pump power - (1NBI, 1NBO) Objective 2

2) Heater power - (1NBI, 1NBO)

3) Heater installed in standpipe

b. Pump runs continuously when diesel shutdown and heaters operate to maintain water temperature approx. 150°F

c. Pump auto stops when engine starts

d. Pump must be running for heater to energize

C. Controls

1. JW Keep Warm Pump Objective 3

a. START-AUTO-STOP switch on 1NBI/1NBO

b. Auto stop on engine start and run

c. Auto start when engine is not running

2. JW Keep Warm Heater

a. AUTO/OFF switch on 1NBI/1NBO

b. Heater energizes if in AUTO, and

1) JW keep warm pump running, and

2) Thermostat detects low temperature

3. Heater Thermostat

a. Senses standpipe temperature

III. LESSON OUTLINE:

NOTES

b. Set for 150°F

4. Diesel Generator Trips (Engine Protection)

a. Jacket Water High Temperature — Objective 4

1) 2/3 coincidence, 200°F

2) Water returning from engine

3) Emergency trip providing protection in all modes, (emerg. and normal starts)

4) Pneumatic Engine Protection Controls

5) HI JW temp sensor malfunction if 1/3 sensors made up

b. Low Press Jacket Water Trip

1) 6 psi, 1/1 sensor

2) Bypassed on emergency start, but will alarm only

3) If trip occurs after normal start, it remains in effect 90 seconds. Possible to <u>normal</u> restart after red "stopping" light goes out. <u>Emergency</u> restart would restart engine immediately

D. Instrumentation and Alarms

1. Panel at engine skidfront

a. JW pressure, KW pump in or out

1) Possible to measure disch pressure or suction pressure

2) 15 to 25 psig expected — From rounds sheet 11882-1

b. JW pressure, engine pump in or out

1) Possible to measure suction or discharge pressure

2. Other Associated Engine Instruments

a. JW temperature indicators at JW and LO coolers

III. LESSON OUTLINE: NOTES

b. NSCW temp IN/OUT of JW cooler

c. NSCW flow-indicating transmitters

1) NSCW IN, NSCW OUT

2) 0 - 100% range

3. Indications on Engine Control Panel PDG 2/4

a. Tailset water pressure gauge

b. "DORIC TRENDICATOR" thermocouple readout
JW IN (to engine), TC21
JW OUT (from engine), TC22

4. Annunciator Alarms (both PDG 2/PDG 4 and QEAB)

a. Low temp jacket water - IN - 140°F

b. Low temp jacket water - OUT - 140°F

c. Hi temp jacket water - IN - 175°F

d. Hi temp jacket water - OUT - 190°F

e. Trip - Hi temp jacket water - 200°F

f. Low press jacket water - 8psi

g. Trip - low press jacket water - 6psi

h. Low level jacket water: 4" below C/L of JW ret. hdr.

i. Hi jacket water temp sensor malf. - N/A

j. Switch not in AUTO - KW pump or htr. switch off

Other non-jacket water system switches also input alarm

E. System Operation

1. Standby conditions

a. Keep warm system operates continuously to maintain the unit at optimum temperature to ensure quick starting and fast loading

b. System automatically deenergizes when diesel starts

III. LESSON OUTLINE: | NOTES

2. Operating Conditions

   a. Jacket water temperature regulated by 3-way thermostatic control valve, TCV-19097

      1) Maintained SS at approximately 146.6°F (1800 gpm) 150 psig

      2) NSCW outlet temp. 133°F at 150 psig - (1200-1500 gpm)

   b. Active components include:

      1) Jacket water pump

         a) Failure indicated by low pressure alarm

         b) Failure requires engine shutdown

      2) Keep warm circulating water pump

         a) Failure indicated by - jacket water low temperature alarm = 140°F

         b) Large mass of DE retains heat

      3) 3-Way Thermostatic Valve (TCV-19096, 19097)

         a) Below 152°F, JW flow fully bypasses cooler

         b) Above 170°F, up to 750 gpm JW flow passes through cooler

These valves have manual stops to limit flow to ≤ 750 gpm (flow limiters) through shell side of HX

3. DE cooling water system components are sized to allow sufficient cooling at 100% rated load with warmest expected air temperature (FSAR-Q430.2 3)

4. Possible Casualties: Detection and Results

   a. Thermostatic control valve stuck in bypass position

Objective 5

      1) High temperature "JW-OUT" alarm

      2) High temperature "JW-IN" alarm

      3) TRIP high temperature JW

III. LESSON OUTLINE:

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4) Loss of DG - Engine could not be restarted until emergency trip has been reset

b. Thermostatic control valve stuck in the open (full flow through cooler) position

1) Low temperature"JW-IN" alarm

2) Low temperature"JW-OUT" alarm

3) No degradation; already running

c. Loss of NSCW to JW cooler

-Commitment-
SER 84.042
(in part)

1) EDG is inoperable

2) Engine could start and run approx. 3 minutes in this condition by one HI JW temp. trip

3) Hi JW in & out alarms are probable first indications

d. Failure of engine driven jacket-water pump

1) Engine trips on low jacket water pressure (6psig)

a) trip active 90 seconds after normal start

b) Low pressure [illegible] psig

2) If DG was emergency started, trips on 2/3 jacket water high temperature, 200°F

3) High temp JW-IN alarm

4) High temp JW-OUT alarm

5) Possible low level jacket water alarm - depending on failure mode of pump (leak)

5. "Loss of Interdependency of Safeguards Systems Components"

Objective 6
Start SER 84.042

III. LESSON OUTLINE:

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a. Failure to recognize interdependency of safeguards systems components can result in the loss of redundant safeguards trains

b. At Vogtle, being alert for alarms and tagged components should prevent many problems in this area, example:

1) "NSCW Train A (or B) DG Clr Lo Flow" on 1A1

2) "SEQ A (or B) safety equip. failed to start" (ALB-36 or 37 on QEAB) indicates some equipment did not sequence after a load shed

End SER 84.042

F. System Interfaces

1. Supporting JW System

a. Demineralized water system

1) Makeup standpipe level, for JW system losses

b. NSCW

1) Removing heat via JW cooler

2) NSCW tube side

3) JW (engine coolant) shell side

III. SUMMARY

A. Review Lesson Objectives

1. DESCRIBE THE GENERAL FLOWPATH THROUGH THE EDG JACKET WATER COOLING SYSTEM DURING STANDBY AND ENGINE RUNNING OPERATIONS

See Section II.A.3

2. DETERMINE THE POWER SUPPLIES FOR THE JACKET WATER KEEP WARM PUMP AND HEATER

1NBI/1NBO

3. DESCRIBE THE PERMISSIVES ASSOCIATED WITH THE JACKET WATER KEEP WARM PUMP AND HEATER

See Section II.C.1 and 2

III. LESSON OUTLINE:

NOTES

4. IDENTIFY THE DIESEL GENERATOR TRIPS ASSOCIATED WITH THE JACKET WATER SYSTEM

   2/3 High Temperature (200°F) - any time

   1/1 Low Pressure (6 psig) - bypassed on emergency start

5. WITH THE DIESEL ENGINE RUNNING AND LOADED, PREDICT THE MOST PROBABLE RESULTS OF THE FOLLOWING CONDITIONS:

   a. THERMOSTATIC CONTROL VALVE STUCK IN THE BYPASS POSITION

   b. THERMOSTATIC CONTROL VALVE STUCK OPEN

   c. LOSS OF NSCW TO JACKET WATER COOLER

   d. FAILURE OF ENGINE DRIVEN JACKET WATER PUMP

   See Section II.E.4

6. EXPLAIN THE TERM "INTERDEPENDENCY OF SAFEGUARDS SYSTEMS COMPONENTS"

   See Section II.E.5