# Mechanical Maintenance Training

## Classroom Lesson

<table>
<thead>
<tr>
<th>Mechanical Maintenance Training</th>
<th>Date: 7/23/2010 5:29:03 AM</th>
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<tbody>
<tr>
<td>LP Number: NMC61C000102</td>
<td>Rev Author: LEE BAKER</td>
</tr>
<tr>
<td>Title: Emergency Diesel Description</td>
<td>Technical Review: Martin J. Sullivan</td>
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<tr>
<td>Duration:</td>
<td>Teaching Approval: Steinmetz, Tim P(Z99348)</td>
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Digitally signed by Steinmetz, Tim P(Z99348)
CN: cn=Steinmetz, Tim P(Z99348)
Reason: I am approving this document
Date: 2010-07-27 09:31:37 -0700
INITIATING DOCUMENTS
Task Analysis of Tasks

REQUIRED TOPICS
None

CONTENT REFERENCES

VTM-C628-001: Diesel Generator Tech Manual

VTM-C628-002: Diesel Generator Auxiliaries

LESSON PLAN REVISION DATA

Jul 23, 2010  Lee Baker

Revised Lesson Plan to:
Incorporate Human Performance and Prevent Events strategies [TCSAI 3478459]
Add systems training tie-in of the Class Electrical systems [TCSAI 3260637]
Include OE from IN 07-27 [TCSAI 3319710]
The following tasks are covered in Emergency Diesel Description:

<table>
<thead>
<tr>
<th>Task or Topic Number*</th>
<th>Task Statement</th>
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<tbody>
<tr>
<td>EDG011</td>
<td>Remove generator rotor on emergency diesel</td>
</tr>
<tr>
<td>EDG001</td>
<td>Dismantle EDG engine (remove cylinder head and pull piston and liner)</td>
</tr>
<tr>
<td>EDG002</td>
<td>Reassemble EDG engine (install liner, piston, and cylinder)</td>
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<tr>
<td>EDG003</td>
<td>Locate a tripped main or connecting rod bearing temperature shutdown detector</td>
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<tr>
<td>EDG004</td>
<td>Perform routine maintenance on emergency diesel engine</td>
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<tr>
<td>EDG005</td>
<td>Rework emergency diesel turbocharger</td>
</tr>
<tr>
<td>EDG006</td>
<td>Inspect, Test and Rework fuel injectors</td>
</tr>
<tr>
<td>EDG008</td>
<td>Test fuel injectors</td>
</tr>
<tr>
<td>EDG009</td>
<td>Inspect governor on emergency diesel engine</td>
</tr>
<tr>
<td>EDG010</td>
<td>Troubleshoot emergency diesel engine</td>
</tr>
</tbody>
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Total task or topics: 10
TERMINAL OBJECTIVE:

1. Given applicable maintenance instructions the Maintenance Mechanic will, describe the general safety practices for performing preventive and corrective maintenance on the Emergency Diesel Generator, demonstrated by passing a written exam with a score of 80% or better.

1.1 Explain the function of the EDG’s

1.2 Describe the basic EDG System design and construction

1.3 State the general safety practices associated with performing maintenance on the EDG
CONTENT

I. Motivation

A. Importance of the Diesel
   1. Safe Reactor Shutdown
      a. EDG’s provide an independent source of on-site AC power to the two trains of Engineered Safety Features equipment in the event of a loss of preferred power
   2. Mitigate consequences of a DBA
   3. ESF loads are automatically connected to the EDG’s in sufficient time to provide for safe reactor shutdown and to mitigate consequences of a DBA such as LOCA

II. Pre-Job Brief

A. Pre-job briefing on the day’s activities modeling the use of the Palo Verde Standards & Expectations, Preventing Events

B. Focus On Five (Task Preview)
   Familiarize worker with the scope of work, task sequence, and critical steps.
   1. Critical Steps (Terminal Objectives)
      Given applicable maintenance instructions the Maintenance Mechanic will describe the general safety practices for performing preventive and corrective maintenance on the Emergency Diesel Generator, demonstrated by passing a written exam with a score of 80% or better
   2. Identify error likely situations (error traps)
   3. Identify the Worst thing that can happen.

METHODS & ACTIVITIES

Focus student attention on “What’s In It For Me”.

Tie in the significance of performing proper maintenance on the EDG’s (i.e. Nuclear Safety)

DBA = Design Basis Accident
LOCA = Loss of Coolant Accident

PVNGS Standards & Expectation book (Focus on five) Highlight the critical steps (Terminal Objectives) on the power point presentation.

Discuss at least one specific error likely situation. (Look at Error Precursors in S&E book)

Apply to the setting you’re in. (Lab versus Classroom)
CONTENT

4. Identify specific error prevention defenses to be used.

5. Identify actions to assure proper configuration control.

C. Schedule

1. Length of class

2. Break policy
   a. Two Minute Drill (Expected after lunch at a minimum)

3. Evaluation

4. Post training critique

D. Qualification

III. Lesson Introduction

A. Lesson Terminal Objective

B. Lesson Enabling Objectives

   EO01 Explain the Function of the EDG's

   EO02 Describe the basic EDG System design and construction

   EO03 State the general safety practices associated with performing maintenance on the EDG
| TO: 1 | Given applicable maintenance instructions the Maintenance Mechanic will, describe the general safety practices for performing preventive and corrective maintenance on the Emergency Diesel Generator, demonstrated by passing a written exam with a score of 80% or better. |
EO: 1.1  Explain the function of the EDG's

CONTENT

I. Function

A. Two diesel generators provide standby power for the 4.16kV AC class IE buses

1. The diesel generator are connected to the bus only during emergency plant conditions (e.g., loss of power) or during system testing.

2. Each diesel generator is exclusively connected to a safety features bus and there is no automatic capability for cross connecting.

3. During normal operation, the diesel is maintained in a standby condition with an automatic start feature if a loss of power (LOP) signal, auxiliary feedwater actuation signal (AFAS) safety injection actuation signal (SIAS) or containment spray actuation signal (CSAS) is received.

   a. Upon receipt of a loss of power (LOP) signal, the diesel will automatically start, come up to speed and voltage, close to bus and sequence loads.

   b. Upon receipt of an AFAS, SIAS, or CSAS, the generator will start, but will not automatically align itself to the class IE bus, unless there is also a loss of power.

4. The generator automatically operates on its own without manual control from operator. The operator can manually control the generator and will do so when it is removed from the bus and placed in standby condition.

METHODS & ACTIVITIES

PPT
EO: 1.2 Describe the basic EDG System design and construction

CONTENT

I. Purpose

A. In conjunction with the Class 1E Standby Generation System, provides a reliable source of ac power for safe plant shutdown in the event of a loss of preferred off-site power.

B. Two trains: A & B

II. Operating Design:

A. Each diesel generator is designed to attain full-load speed and begin to accept load within 10 seconds following a cold start.

B. A governor maintains diesel generator speed below the 110% of full load speed trip set point when operating under any load.

C. Diesel engine is designed to operate during and after a safe shutdown earthquake.

D. Load Rating

1. Normal - 5,500KW

Each diesel generator has a continuous rating of 5500 kW which is greater than the sum of the required ESF loads (single train) caused by a LOCA and a loss of preferred power supply.

2. Maximum Load - 6050 KW

   a. 110% of rated capacity (2 hours at this load is maximum in any 24 hour period).

III. Construction

A. Type of Diesel Engine
1. KSV - 20 T
   a. K = arbitrary letter from sequence by company
   b. S = Standby
   c. V = Vee shape
   d. 20 = Number of cylinders
   e. T = Turbocharged

B. Pistons
   1. Bore = 13.5"
   2. Stroke = 16.5"

C. Rated Speed = 600 RPM

D. Stroke = 4- stroke cycle

E. Engine Design
   1. V shape - 22.5 degrees off vertical
   2. 10 cylinders each side
   3. 10 bearings to crankshaft - Uses articulated connecting rod attached to the main connecting rod Articulated on the left.
   4. Water cooled
   5. Pressure Lubrication System
   6. Fuel Injection
   7. Air Start
EO: 1.3 State the general safety practices associated with performing maintenance on the EDG

CONTENT

I. Do not remove the access doors on the diesel engine for at least 15 minutes after it has been shut down.

A. Hot oil mist in crank case could ignite spontaneously when air is introduced. Use Peer Check to verify enough time has passed prior to opening the crankcase.

B. Ensure clearances that are hung for performance of work are correct, and that all piping and cavities are depressurized.

C. Most components are heavy, use care when lifting or moving them

D. Some components may be HOT. Use proper care and wear gloves when working around hot equipment

E. Tailboard all work

F. Use caution around Jacket Water Cooling system coolant due to Nitrate additives

1. Nitrates are oxidizers and may cause skin and eye irritation. Wear gloves and safety glasses to protect yourself

G. Emergency and first aid procedures

1. Eyes - Wash with water for 15 minutes. Call a physician.

2. Skin - Wash with copious amounts of water

3. Ingestion - Do not induce vomiting. Call a physician.
SUMMARY OF MAIN PRINCIPLES

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.

Objectives Review

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

Questions and Answers

Oral questioning

Ask questions that implement the objectives. Discuss students answers as needed to ensure the objectives are being met.

Problem Areas

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

Concluding Statement

If not done in the previous step, review the motivational points that apply this lesson to students needs. If applicable, end with a statement leading to the next lesson. You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.