

# PALO VERDE NUCLEAR GENERATING STATION

## Mechanical Maintenance Training

### Classroom Lesson



|  |                                   |
|--|-----------------------------------|
| <b>Mechanical Maintenance Training</b>     | <b>Date: 7/23/2010 5:29:03 AM</b> |
| <b>LP Number: NMC61C000102</b>             | <b>Rev Author: LEE BAKER</b>      |
| <b>Title: Emergency Diesel Description</b> | <b>Technical Review:</b>          |
| <b>Duration :</b>                          | <b>Teaching Approval:</b>         |

**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]

Tasks and Topics Covered

The following tasks are covered in Emergency Diesel Description:

| Task or Topic Number* | Task Statement |
|-----------------------|----------------|
|-----------------------|----------------|

Lesson: Emergency Diesel Description

|        |   |
|--------|---|
| EDG011 | Remove generator rotor on emergency diesel                                    |
| EDG001 | Dismantle EDG engine (remove cylinder head and pull piston and liner)         |
| EDG002 | Reassemble EDG engine (install liner, piston, and cylinder)                   |
| EDG003 | Locate a tripped main or connecting rod bearing temperature shutdown detector |
| EDG004 | Perform routine maintenance on emergency diesel engine                        |
| EDG005 | Rework emergency diesel turbocharger  |
| EDG006 | Inspect, Test and Rework fuel injectors                                       |
| EDG008 | Test fuel injectors   |
| EDG009 | Inspect governor on emergency diesel engine                                   |
| EDG010 | Troubleshoot emergency diesel engine  |

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**

**METHODS & ACTIVITIES**

I. Motivation

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

A. Importance of the Diesel

*Tie in the significance of performing proper maintenance on the EDG’s (ie- Nuclear Safety)*

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

*DBA = Design Basis Accident  
LOCA= Loss of Coolant Accident*

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

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

2. Identify error likely situations (error traps)

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

3. Identify the Worst thing that can happen.

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

**CONTENT**

**METHODS & ACTIVITIES**

4. Identify specific error prevention defenses to be used. What defenses can we employ to prevent the “Worst thing that could happen”

5. Identify actions to assure proper configuration control. This may not be applicable in every training setting.

C. Schedule Lay out the schedule and expectations for schedule adherence

1. Length of class

2. Break policy

a. Two Minute Drill (Expected after lunch at a minimum) At Instructor’s discretion, not to interrupt class flow.

3. Evaluation

4. Post training critique Feedback ( i.e.Class Climate)

D. Qualification Identify what they will be qualified to do upon completion of the course

**III. Lesson Introduction**

A. Lesson Terminal Objective Read and/or discuss the lesson objectives

**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**

**METHODS & ACTIVITIES**

I. Function

PPT

- 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 (eg 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



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

CONTENT

METHODS & ACTIVITIES

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

2. Maximum Load - 6050 KW

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

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.

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

## METHODS &amp; ACTIVITIES

- 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.