

PALO VERDE NUCLEAR GENERATING STATION

Mechanical Maintenance Training

Classroom Lesson



Mechanical Maintenance Training	Date: 7/23/2010 7:19:42 AM
LP Number: NMC61C001002	Rev Author: LEE BAKER
Title: Combustion Air System	Technical Review:
Duration : 2 HOURS	Teaching Approval:

INITIATING DOCUMENTS

Task Analysis of Tasks

REQUIRED TOPICS

None

CONTENT REFERENCES

PM Task # 029606, 007267

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 Combustion Air System :

Task or Topic Number*	Task Statement
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Lesson: Combustion Air System

EDG004	Perform routine maintenance on emergency diesel engine
EDG010	Troubleshoot emergency diesel engine

Total task or topics: 2

TERMINAL OBJECTIVE:

- 1 Given applicable maintenance instructions the Maintenance Mechanic will, state the function of and explain the preventive maintenance associated with the EDG Combustion Air System, demonstrated by passing a written exam with a score of 80% or better.
 - 1.1 Describe the EDG Combustion Air System and give its functions
 - 1.2 Describe the EDG Combustion Air System components giving location, function, basic construction and operation.
 - 1.3 Explain the routine preventive maintenance performed on the EDG Combustion Air System

CONTENT**METHODS AND ACTIVITIES**

<p>I. Motivation</p>	<p>Focus student attention on “What’s In It For Me”.</p>
<p>II. Pre-Job Brief</p> <p>A. Pre-job briefing on the day’s activities modeling the use of the Palo Verde Standards & Expectations, Preventing Events</p> <p>B. Focus On Five (Task Preview)</p> <p>Familiarize worker with the scope of work, task sequence, and critical steps.</p> <p>1. Critical Steps (Terminal Objectives)</p> <p>Given applicable maintenance instructions, the Maintenance Mechanic will, state the function of and explain the preventive maintenance associated with the EDG Combustion Air System, demonstrated by passing a written exam with a score of 80% or better</p> <p>2. Identify error likely situations (error traps)</p> <p>a. Discuss at least one specific error likely situation.</p> <p>3. Identify the Worst thing that can happen.</p> <p>4. Identify specific error prevention defenses to be used.</p> <p>5. Identify actions to assure proper configuration control.</p> <p>C. Break policy</p> <p>1. Two Minute Drill – After lunch at a minimum</p>	<p>PVNGS Standards & Expectation book (Focus on five) Highlight the critical steps (Terminal Objectives) on the power point presentation.</p> <p>Look at Error Precursors in S&E book</p> <p>Apply to the setting you’re in. (Lab versus Classroom)</p> <p>What defenses can we employ to prevent the “Worst thing that could happen”</p> <p>This may not be applicable in every training setting.</p> <p>At Instructor’s discretion, not to interrupt class flow.</p>

CONTENT

METHODS AND ACTIVITIES

III. Lesson Enabling Objectives

Read and/or discuss the lesson objectives

EO01 Describe the EDG Combustion Air System and give its functions

EO02 Describe the EDG Combustion Air System components giving location, function, basic construction and operation

EO03 Explain the routine preventive maintenance performed on the EDG Combustion Air System

TO: 1 Given applicable maintenance instructions the Maintenance Mechanic will, state the function of and explain the preventive maintenance associated with the EDG Combustion Air System, demonstrated by passing a written exam with a score of 80% or better.

EO: 1.1 Describe the EDG Combustion Air System and give its functions

CONTENT

METHODS AND ACTIVITIES

- I. System Description
 - A. Air Intake System
 - 1. Functions
 - a. Provides clean air under pressure to engine cylinders for engine combustion
 - b. Scavenges exhaust gases
 - c. Cools combustion chamber
 - d. Purges Air Start Piping to prevent accumulation of explosive gas mixtures and moisture
 - 2. Description
 - a. Air is taken from atmosphere through a filter and a silencer
 - b. Pressure increased by the Turbocharger
 - c. Goes to a combination heater/intercooler
 - d. Enters into inlet manifold and power cylinder
 - B. Exhaust System
 - 1. Functions
 - a. Collects exhaust gases from each cylinder and directs them to atmosphere
 - b. Provides the energy required for operating the turbocharger

CONTENT

METHODS AND ACTIVITIES

2. Description
 - a. Collects exhaust gases from each cylinder and directs them through turbine section of turbocharger to drive it
 - b. Exhaust gases from turbocharger proceed through a flexible connector and piping to silencer and then to atmosphere
 - c. Thermocouples monitor temperatures in the system

EO: 1.2 Describe the EDG Combustion Air System components giving location, function, basic construction and operation.

CONTENT**METHODS AND ACTIVITIES**

I. Component Description

A. Air Intake Filter

1. Location

- a. 115' elevation of Diesel Generator Building

2. Function

- a. Filter intake air

3. Operation & Construction

- a. Air enters under hood
- b. Approx. 20% of air passes across oil control pan and underneath air deflector skirt where it lifts oil droplets to the scrubbing chamber
- c. Balance of air passes directly to scrubbing chamber where it forms rotating air mass that is thoroughly scrubbed by oil present
- d. Air and oil mixture then move up to deflector plates
- e. Deflector plates intercept most of the oil and directs it to oil return tube
- f. Air continues through to metal mesh filter-separator where very small particles of dirt are removed and any oil still in the air is intercepted

B. Air Intake Silencer

1. Location

- a. 115' elevation of Diesel Generator Building

CONTENT	METHODS AND ACTIVITIES
2. Function a. Reduce noise and vibration levels due to air flow induced oscillations 3. Operation and Construction a. Baffles straighten air flow reducing oscillations and therefore vibration and noise	
C. Overspeed Shutdown Butterfly Valve	
1. Location a. Just before the turbocharger above aux. skid 2. Function a. Stop engine when in an over-speed condition	
<i>NOTE: Over-speeding can result if engine begins to run on its own lubricating oil (known as a "Run Away Engine"). If this is the case the engine can still operate even with the fuel racks turned "off". Hence, the need to shut-off combustion air to stop engine</i>	
3. Operation and Construction a. Tripped by over-speed governor 1) Lever locking butterfly open is released by a cable from the over-speed governor and the butterfly is closed by a spring	
D. Turbocharger	
1. Location a. Mounted on forward end of the engine 2. Function a. Increase engine efficiency	

CONTENT

METHODS AND ACTIVITIES

- 3. Operation and Construction
 - a. Exhaust gases from cylinders drive the turbine at virtually no increase in load on the engine
 - b. Fresh air is drawn in by the impeller and is forced under a slight pressure through double discharge casing of turbocharger into the two air inlet manifolds on the engine
 - c. Lubricated from engine lubricating system
 - 1) Oil inlet line from engine contains duplex full flow oil filter
 - d. Cooled by water from Jacket Water Cooling
- E. Heater/Intercooler and Controls
 - 1. Location
 - a. Between turbocharger and inlet manifolds

CONTENT**METHODS AND ACTIVITIES**

2. Function, operation, and construction
 - a. Intercooler
 - 1) Reduces amount of heat in combustion air placed there by compression at turbocharger. (increases engine efficiency)
 - 2) Spray Pond cooling water circulates through tube side of tube and shell heat exchanger to remove heat of compression
 - b. Heater
 - 1) Helps insure instant starts and smooth acceleration
 - 2) Warm Jacket Water circulates through tube side of tube and shell heat exchanger to heat intake air when air temperature into heater/intercooler is 105°F or below
 - c. Controls
 - 1) Controls position of Jacket Water to Heater cutout valve
 - 2) Opens Jacket Water to Heater cutout valve when air temperature into heater/intercooler is 105°F or below
 - 3) Heater cutout valve
 - a) Closes valve when air temperature is greater than 105°F
 - b) One located in each air intake header
- F. Exhaust Manifold
 1. Location
 - a. Mounted along the "V" of the engine
 2. Function
 - a. Collects exhaust gases from each cylinder

CONTENT

METHODS AND ACTIVITIES

- 3. Operation and Construction
 - a. A separate connection ties each cylinder to the manifold
 - b. Manifold directs exhaust gases to turbocharger
 - c. An adapter connects manifold to turbocharger

- G. Exhaust Silencer
 - 1. Location
 - a. elevation of the Diesel Generator Building
 - 2. Function
 - a. Reduce noise in the exhaust system
 - 3. Operation and Construction
 - a. Same as air intake only bigger

- H. Exhaust gases
 - 1. Vented to atm. at 193' elevation
 - 2. Away from intake to prevent the intake of already combusted gases

EO: 1.3 Explain the routine preventive maintenance performed on the EDG Combustion Air System

CONTENT

METHODS AND ACTIVITIES

- I. Preventive Maintenance
 - A. Lubricate Intercooler Heater Three-Way Temperature Control Valve Seal Rings
 - 1. Basic Procedure
 - a. Ensure equipment is in a safe work condition
 - b. Unscrew end cap and remove spool
 - c. Wash out the old grease from valve bore and spool. Inspect seals for damage, replace parts as necessary
 - d. Reinstall spool into bore of valve and reinstall end cap
 - B. Service Intake Air Filter
 - 1. Clean Trash Screen and Oil Reservoir
 - a. Clean trash screen from outside with stiff brush or rag
 - b. Drain dirty oil
 - c. Remove cleanout door
 - d. Scrape out sludge using long-handled scraper

CONTENT	METHODS AND ACTIVITIES
<ul style="list-style-type: none">2. Clean Element<ul style="list-style-type: none">a. Remove rain skirt sections as requiredb. Remove both sections of trash screen and wipe out oil panc. Remove cap screws from top cover, disengage air outlet piping, slide the filter to one side and remove the coverd. Wash element thoroughly from top down with hot water or steame. Flush out sludge deposits off scrubbing chamber and top of port cover platesf. Wipe out water in oil pan and in oil reservoirg. Replace cover, trash screens, clean out door and rain skirth. Fill oil reservoir to sight-glass	
C. Clean and Inspect the Turbocharger	<i>Performed as part of the 18-month Surveillance Test</i>
<ul style="list-style-type: none">1. Disconnect then remove the Over-speed Shutdown Valve2. Visually inspect all exposed parts for the following<ul style="list-style-type: none">a. Build up of dirt on the impeller or diffuserb. Evidence of oil carryover<ul style="list-style-type: none">1) Oil could possibly carryover from the intake oil filter (oil bath type). This would imply that the oil filter requires servicingc. Freedom of movement. (rotate rotor manually)3. Clean out any dirt found in impeller or diffuser4. Install and reconnect the Over-speed Shutdown Valve	

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.