

PALO VERDE NUCLEAR GENERATING STATION

Mechanical Maintenance Training

Classroom Lesson



Mechanical Maintenance Training	Date: 7/28/2010 9:10:22 AM
LP Number: NMC61C001102	Rev Author: LEE BAKER
Title: Turning Gear	Technical Review:
Duration : 1 HOUR	Teaching Approval:

INITIATING DOCUMENTS

Task Analysis of Tasks

REQUIRED TOPICS

None

CONTENT REFERENCES

PM Task # 007265, 028166

VTM-C628-001: Diesel Generator Tech Manual

VTM-C628-002: Diesel Generator Auxiliaries

LESSON PLAN REVISION DATA

Jul 28, 2010 Lee Baker

Revised Lesson Plan to:

Incorporate Human Performance and Prevent Events strategies [TCSAI 3478459]

Provide training on inspecting and performing maintenance on EDG turning gear interlock valves, to prevent future misalignments of the valve that could cause future fast start failures when performing surveillance testing. [TCSAI 3476973]

Tasks and Topics Covered

The following tasks are covered in Turning Gear :

Task or Topic Number*	Task Statement
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Lesson: Turning Gear

EDG004	Perform routine maintenance on emergency diesel engine
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Total task or topics: 1

TERMINAL OBJECTIVE:

- 1 Given applicable maintenance instructions the Maintenance Mechanic will, state the function of and explain how to operate and maintain the EDG Turning Gear, demonstrated by passing a written exam with a score of 80% or better.
 - 1.1 Describe the EDG Turning Gear and components giving function, basic operation and construction
 - 1.2 Explain basic process to engage and disengage the Turning Gear.
 - 1.3 Explain the routine preventive maintenance performed on the EDG Turning Gear

CONTENT**METHODS AND ACTIVITIES**

I. Motivation	Focus student attention on “What’s In It For Me”
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, state the function of and explain how to operate and maintain the EDG Turning Gear, 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) a. 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)
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. Break policy	
1. Two Minute Drill – After lunch at a minimum	At Instructor’s discretion, not to interrupt class flow.

CONTENT

METHODS AND ACTIVITIES

III. Lesson Enabling Objectives

Read and/or discuss the lesson objectives

EO01 Describe the EDG Turning Gear and components giving function, basic operation and construction

EO02 Explain basic process to engage and disengage the Turning Gear

EO03 Explain the routine preventive maintenance performed on the EDG Turning Gear

TO: 1 Given applicable maintenance instructions the Maintenance Mechanic will, state the function of and explain how to operate and maintain the EDG Turning Gear, demonstrated by passing a written exam with a score of 80% or better.

EO: 1.1 Describe the EDG Turning Gear and components giving function, basic operation and construction

CONTENT

METHODS AND ACTIVITIES

- I. Turning Gear and Component Description
 - A. Turning Gear
 1. Function
 - a. Rotate engine when performing maintenance
 - b. Acts as a flywheel lock when at rest
 2. Location
 - a. Mounted on a rail at engine flywheel
 3. Operation and Construction
 - a. Consists of an air driven reversible 6.5 H.P., 62 rpm motor
 - b. Air is supplied from EDG Air Start System or Service Air
 - c. Turning Gear must be engaged with the flywheel to operate
 - d. Motor drives a shaft through a coupling
 - e. Horizontal worm gear on shaft drives a vertical gear mounted on shaft between two bearings
 - f. A gear on same shaft contacts the flywheel ring gear to turn the engine
 - g. Motor is controlled by a manually operated three-way valve

CONTENT

METHODS AND ACTIVITIES

4. Operation of Safety interlock
 - a. A safety interlock is provided to prevent engine from cranking when turning gear is engaged
 - 1) Turning Gear Interlock Valves are used to prevent an EDG start while the engine turning gear is engaged
 - a) As the turning gear is being racked in, physical movement (an adjusting screw) of the turning gear opens the interlock valve (plunger moves from valve body) allowing control air to vent from the control air system
 - b) hence disabling the cranking air valve and preventing a start of the EDG
 - 2) When an EDG is in Operable status, the turning gear is disengaged and the turning gear interlock valves are depressed, permitting control air to the cranking air valves for an engine start

EO: 1.2 Explain basic process to engage and disengage the Turning Gear.

CONTENT

METHODS AND ACTIVITIES

I. Engage and Disengage Turning Gear

A. Engage Turning Gear

Include discussion on Tagging and Permit requirements

CAUTION: WHEN PERFORMING MAINTENANCE USING THE TURNING GEAR, CLOSE SHUT-OFF VALVE AND VENT THE PIPING AT RELIEF VALVE. HANG A SIGN ON THE SHUT-OFF VALVE TO INSURE NO ONE WILL OPERATE THE TURNING GEAR WHEN SOMEONE MIGHT BE INJURED. PRIOR TO ROLLING THE ENGINE USING THE TURNING GEAR IT IS VITAL TO WALK DOWN THE ENGINE TO ENSURE NOBODY IS IN DANGER OF BEING HURT

1. Loosen two bolts
2. Using a 1 1/2" hex head socket on adjusting screw turn clockwise until gear is engaged with flywheel ring gear
 - a. Adjusting block is set to give .007" to .011" of backlash between drive gear and flywheel ring gear
3. Once Turning Gear is in position tighten the two bolts to 150 ft-lbs

NOTE: Cylinder head indicator cocks must be open when the gear is in use. This eliminates compression in the cylinders, making it possible to rotate the crankshaft smoothly

4. Install hose to air exhaust and route outside to reduce air motor noise

B. Disengage Turning Gear

1. Loosen the two hold down fasteners

CONTENT	METHODS AND ACTIVITIES
2. Using a 1 1/2" hex head socket on adjusting screw (jacking screw) back the turning gear out until the interlock valve plungers are fully depressed.	<i>(turn counterclockwise)</i>
a. Fully depressed is equal to 3/16" plunger depression with no visible indication of the drilled passage in the plunger	<i>Make sure this inspection point is emphasized Critical step in Work Mech?</i>
3. Tighten two bolts to 150 ft-lbs	
C. OE 31395 Emergency Diesel Slow Start	This involves the PVNGS Turning Gear Interlock Valves
1. On May 13th, 2010, the PVNGS Unit 3 'B' Emergency Diesel Generator experienced a slow start time (> 10 seconds, 17.2 seconds to rated voltage and frequency) during its monthly Surveillance Test. This resulted in the 3B EDG being declared INOPERABLE per Technical Specification Surveillance Requirement 3.8.1.7 at 04:04 AM on 5/13/2010	<i>What Happend</i>
2. Troubleshooting activities identified the turning gear interlock valve to be incorrectly positioned, not allowing enough control air to properly engage the starting air system cranking valve, slowing the start time	<i>What was the cause</i>
a. Contributing causes of this event are the lack of detail in work orders, lack of identification of known inconsistencies in the work orders and insufficient detail on design drawings	
3. Similar types of interlock valve failures have happened at PVNGS.	<i>Can this happen at PVNGS CRDR 280113(1998) Improperly adjusted nut on interlock valve mounting bracket</i>

CONTENT

4. Actions were put in place to fix both I & C maintenance work orders and Mechanical Maintenance work orders which did not specify the appropriate distance setting of the turning gear interlock plunger valve (1/8" vs. 3/16")

METHODS AND ACTIVITIES

What can we do to mitigate. What preventative measures and barriers are in place (discuss items like training, questioning attitude when reviewing work orders.)

EO: 1.3 Explain the routine preventive maintenance performed on the EDG Turning Gear

CONTENT

METHODS AND ACTIVITIES

I. Preventive Maintenance

A. Inspect Turning Gear Motor

1. Drain Condensate from turning gear motor assembly gear case by opening the petcock located on lower front of gearcase. Leave open until moisture no longer drains out
2. Remove turning gear motor assembly breather cap and inspect for clogging. Clean as necessary

B. Change Oil in the Turning Gear

1. Remove drain plug from air motor case and air motor gear case. Drain oil into container for disposal
2. Reinstall drain plugs. Fill air motor case with shell rotella T-40 and gear case with spirax 85/140. Fill both until level is just above level cocks on the sides of the cases. Replace fill plugs and close level cocks
3. Apply a light coat of grease to the exposed bull gear teeth if it is needed
4. Lubricate pillow block bearings and worm gear bearings

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

CONTENT

- I. Course Summary
 - A. Post Training (Job) Critique

METHODS & ACTIVITIES

Standards & Expectations
Book Why, When, & How
(page 74)