PALO VERDE
NUCLEAR GENERATING STATION

Mechanical Maintenance Training

Classroom Lesson

Mechanical Maintenance Training	**Date: 7/23/2010 5:59:35 AM**
LP Number: NMC61C000302	**Rev Author: LEE BAKER**
Title: Cooling Water System	**Technical Review:** Martin J. Sullivan — Digitally signed by Martin J. Sullivan DN: cn=Martin J. Sullivan, o=Mechanical Planning, ou=8561, email=Martin.Sullivan@apc.com, c=US Date: 2010.07.27 06:10:43 -07'00'
Duration : 1 HOUR	**Teaching Approval:** Steinmetz, Tim P(Z99348) — Digitally signed by Steinmetz, Tim P(Z99348) DN: cn=Steinmetz, Tim P(Z99348) Reason: I am approving this document Date: 2010.07.27 09:30:11 -07'00'

INITIATING DOCUMENTS

Task Analysis of Tasks

REQUIRED TOPICS

None

CONTENT REFERENCES

PM Task # 011769

VTM-C628-002: Diesel Generator Auxiliaries

TCSAI 2951007 EDG Cooling Water Modification.

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 Cooling Water System :

Task or Topic Number*	Task Statement
Lesson:	Cooling Water System
EDG004	Perform routine maintenance on emergency diesel engine
EDG010	Troubleshoot emergency diesel engine

Total task or topics: 2

TERMINAL OBJECTIVE:

1 Given the applicable maintenance instructions, , the Maintenance Mechanic will state the function of and performance of the preventive maintenance associated with the EDG Cooling Water System demonstrated by passing a written exam with a score of 80% or better

1.1 Describe the function of the EDG Cooling Water System

1.2 Describe the EDG Cooling Water System components

1.3 Explain the routine preventive maintenance performed on the EDG Cooling Water System

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)	PVNGS Standards & Expectation book (Focus on five) Highlight the critical steps (Terminal Objectives) on the power point presentation.
Given the applicable maintenance instructions, the Maintenance Mechanic will state the function of and performance of the preventive maintenance associated with the EDG Cooling Water System demonstrated by passing a written exam with a score of 80% or better	
2. Identify error likely situations (error traps)	Look at Error Precursors in S&E book
a. Discuss at least one specific error likely situation.	
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
A. Lesson Enabling Objectives	Read and/or discuss the lesson objectives
EO01 State the Function of the EDG Cooling Water System	
EO02 Describe the EDG Cooling Water System Components	
EO04 Explain the routine preventive maintenance performed on the EDG Cooling Water System	

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

EO: 1.1 Describe the function of the EDG Cooling Water System

CONTENT	METHODS AND ACTIVITIES
I. EDG Cooling Water System	
A. Composed of the Jacket Water System and the Spray Pond System	
1. Functions – Jacket Water System	
a. Cools the engine cylinder jackets, turbocharger and the hydraulic governor oil cooler	
b. During start-up and depending on the air ambient temperature, warm jacket water is circulated through the heater portion to the air intercoolers to heat the air	
c. During shutdown a motor driven circulating pump, circulates heated water through the engine to facilitate immediate start-up and loading	
2. Operation	
a. Takes water from standpipe and pumps it through the thermostatic valve and cooler	*Point out standpipe, engine driven pump, thermostatic valve and cooler.*
b. From cooler, water flows into engine jacket water heaters	*Point out engine jacket water headers*
c. Jacket water headers supply cooling water for turbocharger and water to heat air passing through air intercoolers	*Point out turbocharger and intercooler heaters*
1) Water only flows to the intercoolers when control valves are open	
d. Individual connections on inlet headers supply water to each cylinder	
3. Function of Spray Pond (Raw Water) System	
a. Removes heat from the lube oil cooler, jacket water cooler, combustion air at air inter-cooler, and fuel oil return from injector pumps	

EO: 1.2 Describe the EDG Cooling Water System components

CONTENT **METHODS AND ACTIVITIES**

I. Cooling Water System Components

A. Main Water Pump

1. Location – mounted on top of forward end housing
2. Function – provides pressure during engine operation
3. Construction - chain driven, centrifugal
4. Operation - runs at approximately 1750 rpm and circulates 1350 gpm at 70 ft.

B. Jacket Water Circulating Pump and Heater

1. Location - Mounted on the Auxiliary Skid
2. Function - circulate heated water through the engine when in standby to facilitate immediate loading.
3. Construction
   a. Pump - Motor driven, vertically mounted, centrifugal pump.
   b. Heater - Electric heating elements in parallel flow heat exchanger.
4. Operation
   a. Takes water from standpipe and pumps it through the heater and into the engine.
   b. Pump rotates at 1750 rpm and circulates 175 gpm at 17 psi.
   c. Low temperature control starts pump and turns on heater at 120° falling and turns them off at 130° rising.

CONTENT	METHODS AND ACTIVITIES

C. Thermostatic Valve

1. Location - mounted on the Auxiliary Skid downstream of the Main Pump.
2. Function - controls Jacket Water Cooling System water temperature.
3. Construction - three-way thermostatically controlled valve.
4. Operation - water enters at 175° all the water is directed through the cooler. At less than 170 degrees flow bypasses cooler.

D. Jacket Water Standpipe

1. Location - mounted on the auxiliary skid
2. Function – acts as a reservoir, de-aerator, expansion tank and provides NPSH to the main and circulating pumps
3. Construction - approximately 258 gal capacity standpipe which provides a sufficient water inventory to support 25 hours of EDG operation during an emergency event without any makeup water to the system.
4. Operation
   a. Auxiliary Operator (AO) is to monitor standpipe fluid level every 12 hours while the EDG is in standby condition, thirty minutes after initial loading, and every two hours during loaded operation.
   b. AO is to refill the standpipe if needed.

E. Jacket Water Cooler

1. Location - auxiliary skid
2. Function - transfer heat from jacket water cooling system to the spray pond system
3. Construction and Operation - Shell and tube, cross-flow type with a removable bundle.

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EO: 1.3 Explain the routine preventive maintenance performed on the EDG Cooling Water System

CONTENT	METHODS AND ACTIVITIES
I. Preventive Maintenance	
A. Clean and Inspect Jacket Water Cooler	
1. Same as that for Cleaning and Inspecting the Lube Oil Cooler	
2. When given the PM to clean and inspect the spray pond side of the jacket water cooler, take care not to damage the gasket sealing surfaces	
B. Clean and Inspect Jacket Water Heater	
C. Replace Jacket Water Temperature Control Valve	
1. Same as replacing Lube Oil Temperature Control Valve	
II. River Bend Station Unit 1	*This is From IN 2007-27 Evaluation of Recent OE to identify reoccurring events involving operability of the EDG's*
A. EDG was inoperative for 23 days	What Happend

CONTENT	METHODS AND ACTIVITIES
1. During EDG testing, a minor leak was identified at a compression fitting in the jacket water cooling system 2. A mechanic performed a tightness check on the fitting, but the leakage rate did not change 3. During a subsequent EDG run, the jacket water tubing separated at the same fitting, causing a significant leak 4. The most probable cause of the failure was a combination of normal engine vibration and damage caused by over-tightening during past maintenance	Why Did This Happen
B. Can this happen at PVNGS	*Discuss with class the significance of this event to our plant (ie- same configuration, or related maintenance)*
C. What can we do to mitigate this event	*What preventative measures or barriers are in place (ie HU tools, CAP, maintenance tracking)*
1. One recurrent event that continues to stand out involves the vibration-induced failure of EDG piping and tubing 2. To prevent this type of failure, it is important that EDG piping and tubing be properly routed, supported and maintained	
3. In many cases, major piping failures occurred after minor leaks were identified and not immediately or properly repaired by the licensee	*AT PVNGS how do we track minor leaks*

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.