

PALO VERDE NUCLEAR GENERATING STATION

HVAC

Classroom Lesson



HVAC Training	Date: 01/13/2005
LP Number: NMH10X000302	Rev Author: Paula Stapleton
Title: Diesel Air Dryers	Technical Review:
Duration : 1 Hour	
	Teaching Approval:

INITIATING DOCUMENTS:

15DP-OTR69 Training and Qualification Administration

HVAC Technician Training Requirements

Training Program Description for HVAC Maintenance

REQUIRED TOPICS

TCS 01-1135, (ENG 2353924 Replacement of old style DG air dryer with new style DG air dryer)

TCS 99 1099; Replace EDG Starting Air Dryer.

TCS 99-0900 CRDR#3-9-0089 - HVAC equipment operation without notifying the control room

TCS 02-0673, CRDR 2523596, (U-1) During troubleshooting DG-A & B air dryers. The dryers were found not working.

CONTENT REFERENCES

EDC 98-00346, APS log# 13-VTD-C-126-0006 Compair Kellogg design information

EDC 98-00346, APS log# 13-VTD-U987-0001 Ultra Air Products instruction manual

Maintenance Standard and Expectations handbook

MI# HHD00005 Clean and inspect aftercoolers and airdryer.

STM DG Volume 27/ Rev 4

VTM-C-628-00002 Compair Kellogg

Maintenance Prevent Events Strategy

Palo Verde Safety Manual

40-OP9DG02 Emergency Diesel Generator B

40-OP9DG01 Emergency Diesel Generator A

Lesson Plan Revision Data

Jan 13, 2005 Paula Stapleton Developed LP for CBT

TCSAI# 2686956 Revision includes more P.E., Standards & Expectations,

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CRDR 2523596 EDG starting air dryer found in a degraded condition due to high temperature, and CRDR 3-9-0089. Moved task ACU31- Troubleshoot the starting air dryer A/C unit to HVAC General 2.

Tasks and Topics Covered

The following tasks are covered in Diesel Air Dryers:

Task or Topic Number*	Task Statement
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Lesson: Diesel Air Dryers

ACU30	Check the operation of the starting air dryer A/C unit
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Total tasks or topics: 1

TERMINAL OBJECTIVE:

- 1.1 Given a CBT presentation, describe the purpose, operation and good maintenance practices of the Diesel Air Dryers and how the air dryers support the diesel starting air system. Mastery will be demonstrated by successfully completing the questions at the end of the CBT presentation with a score of 80% or greater.
 - 1.1.1 State the purpose of the Air Dryer A/C Unit
 - 1.1.2 Describe the operation of the Air Dryer A/C Unit
 - 1.1.3 Identify the operation of the various models of diesel starting air dryers.
 - 1.1.4 Identify good Maintenance practices when working on the starting air dryers.

Lesson Introduction: Diesel Air Dryers

The following items are things to consider in your Lesson Introduction. They are not mandatory. You should develop your own introduction and place that material in the Program Hierarchy in the Lesson Introduction Tab or appropriate Training Unit.

CLASSROOM GUIDELINES

- If applicable, remind students of class guidelines as posted in the classroom.
- Pass the attendance sheet around and have it signed in Dark ink.
- Ensure that student materials needed for the class are available for each student.
- Emphasize student participation and remind them of your philosophy on asking and answering questions, if applicable.

ATTENTION STEP

- Give a brief statement or story to get student concentration focused on the lesson subject matter.

LESSON INTRODUCTION

- Give a brief statement that introduces the specific lesson topic. Should be limited to a single statement.

MOTIVATION

- Focus student's attention on the benefits they derive from the training. At Instructor's discretion. The need for motivation in each succeeding lesson must be analyzed by the Instructor and presented as necessary.
- Instructor should include how the STAR process can be used to improve or enhance Operator Performance, if applicable.
- Read and discuss lesson terminal objective and review lesson enabling objectives, if desired.
- If applicable, briefly preview the lesson topic outline and introduce the major points to be covered. The objective review may have been sufficient.
- REINFORCE the following PVNGS management expectations as opportunities become available
 - Nuclear Safety
 - Industrial Safety Practices
 - STAR and Self-Checking
 - Procedure Compliance
 - Communication Standards
 - ALARA
 - Prevent Events

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T.Obj 1.1	Given a CBT presentation, describe the purpose, operation and good maintenance practices of the Diesel Air Dryers and how the air dryers support the diesel starting air system. Mastery will be demonstrated by successfully completing the questions at the end of the CBT presentation with a score of 80% or greater.
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1.1.1 Introduction

This lesson material covers how the air dryers support the diesel starting air system.

1.1.2 Main Idea

Prevent Events & STAR
Achieving Breakthrough Performance

It is everyone's responsibility to perform their work activities safely and prevent events. What is the first thing we do when we have a new task?

STOP!

That's right.....Every task begins with a **Pre-Job Brief**. The minimum Pre-Job Briefing will consist of the five prevent events questions....

1. What is the task I am going to perform?

TERMINAL OBJECTIVE:

Given a CBT presentation, describe the purpose, operation and good maintenance practices of the Diesel Air Dryers and how the air dryers support the diesel starting air system.

Do you understand it?

The enabling objective that are going to help you understand the terminal objectives are;

State the purpose of the Air Dryer A/C Unit

Describe the operation of the Air Dryer A/C Unit

Identify the operation of the various models of diesel starting air dryers.

Identify good Maintenance practices when working on the starting air dryers

2. What is the worst thing that could happen and how can I prevent it?

CRDR 2523596 – Documents an event that occurred when Operations found the starting air dryers in a degraded condition, with a high suction line temperature.

On 6/4/2 HVAC was called to troubleshoot the high temperature light on the "B" DG "B" air dryer. The team determined that air dryers F01B and F02A were not working. In addition F02B was working marginally and F01A was working fine. Based on the findings it was recommended that Operations blow down the air receivers to ensure that moisture wasn't accumulating in the air receivers. This was added to the area logs to do once per shift.

During the night shift on 6/4/2, the Auxiliary Operator determined that the "B" air compressor on "B" DG was continuously unloading causing the air receivers pressure to lower. Therefore, the "B" air compressor was shutdown. Operations was not aware of the status of the dryers and their procedures in effect at the time did not address two dryers out of service on the same train of EDG at the same time.

HVAC determined that the setpoint for the hot gas bypass needed to be adjusted. The routine maintenance instructions effective at the time did not include adjusting the hot gas bypass valve for seasonal changes in ambient temperatures. The work instructions were changed to include steps to make adjustments to the various styles of air dryers.

During the performance of this work, if any unexpected results are encountered, immediately notify your team leader, and operation.

3. What else could go wrong?

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CRDR 3-9-0089 – Documents an event that occurred on 6/1/99 when an HVAC technician was performing the functional testing of the "B" DG, A air dryer (DGN-F02A) following dryer replacement per WO 870591. Operations had performed their restoration steps and energized the air dryer and compressor. The HVAC technician performing the operational check of the air dryer determination that the dryer was not working correctly and turned the air dryer off without informing Operations. The technician assumed that the air dryer had not been returned to service. The technician later realized that he should have notified operations and informed the CR of his actions. Although the air dryers and non-class, the diesel generator starting system is required to support diesel generator operability. If for any reason the air dryer is not operating properly or needs to be removed from service notify the Control room immediately.

4. What safety and/or radiation protection equipment is needed?

The starting air driers are located in the Diesel building.
There are no radiological concerns. If you have questions contact the appropriate Unit Radiation Protection desk.
Required PPE; Hard hats, safety glasses with side shields, hearing protection, and a pair of work gloves.

5. Is my training and are my qualifications up-to-date?

Prerequisites to this CBT course are:
NMH05, Chiller Control Panel Troubleshooting
HVAC-0001-00 EPA Certification,
Always check your qualifications for a task prior to performing work. If you do not know how to check, or you are in doubt, ask your Leader

EO 1.1.1	State the purpose of the Air Dryer A/C Unit
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1.1.1.1 Main Idea

The diesel generator start system provides a stored compressed air supply sufficient for accomplishing diesel generator cranking cycle five times without the diesel generator air compressors available.

Two separate motor driven air compressors furnish this compressed air. The compressors maintain the air receiver tanks at a nominal pressure of 250 psig.

The air starting system is designed to reduce water vapor in the starting air supply to reduce corrosion in the air starting system, thus increasing the system reliability.

One air dryer unit is located between each compressor and the associated air receiver. These dryers are sized larger than the air compressor and run continuously to reduce the compressed air dew point at the air receivers to less than 50°F in a 70°F ambient environment or at least 10°F less than the lowest expected ambient temperature.

Although the air dryers are not safety related and the diesel generator is operable with only one starting air receiver, the reliability is significantly reduced. Therefore, to maximize the reliability of the on-site power source, the duration of a starting air system outage should be minimized.

A cross connect between the two starting air trains may be utilized for short periods of time when one compressor or dryer is out of service.

To ensure proper dehydration of starting air, the air dryer shall be running at least 2 hours before starting the associated air compressors.

EO 1.1.2	Describe the operation of the Air Dryer A/C Unit
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1.1.2.1 Main Idea

The starting air dryer consists of two complete and independent systems. One compressed air system and one refrigeration system

The compressed air portion of the system is made up of four basic interconnected components

- the main heat exchanger
- the evaporator
- the separator
- drain system and automatic trap

The process is as follows:

- Hot wet air enters the main air-to-air heat exchanger, where it is cooled by the cold outgoing air.
- The air then enters the evaporator (shell and tube heat exchanger) for the final cooling.
- As air passes through the evaporator it is scrubbed free of moisture and contaminants.
- The air then enters the cold separator, where the moisture, oil and dirt is removed. The moisture and contaminants are then allowed to flow to the automatic drain trap.
- The cold air then re-enters the main heat exchanger to be reheated by the incoming air, returning it to approximately the original volume and temperature.

The refrigeration portion of the system is made up of:

- the compressor
- the evaporator
- the condenser

An expansion valve controls refrigerant flow in the evaporator.

The hot gas bypass makes continuous machine operation from maximum load to non-load without reduction of evaporator temperature possible.

EO 1.1.3	Identify the operation of the various models of diesel starting air dryers.
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1.1.3.1 Main Idea

As a result of age related problems the starting air dryers are being replaced on as needed bases. The original manufacture, Kellogg-American has gone out of business. Replacement dryer performance parameters are identical. The main differences between the models of air dryers are:

- Refrigerant used
- Type of moisture separator
- Compressor motor horsepower
- Location of the piping connections

Lets look at three models of starting air dryers being used in the DG starting air systems:

- Kellogg- American Model 75 ($\frac{3}{4}$ HP compressor) R-12 system
- Ultra Air Model UA75AC-HP ($\frac{1}{2}$ HP compressor) R-134A system
- Comp Air- Kellogg Model K75A-HP ($\frac{1}{2}$ HP compressor) R-134A system

An overview of the basic operation of the Kellogg- American.

When the dryers are placed into service, the red (high temperature) warning light will illuminate for the first 2-3 minutes of operation. A temperature switch sensing the suction line temperature activates the warning light. Once the suction line cools the warning light will go out.

Normal operation will be indicated when:

- the amber light is on
- the refrigerant analyzer pressure is 33-40 psig (if ambient temperature is above 100°F the refrigerant acceptable suction pressure may be as high as 46 psig)
- the outlet pressure gauge should indicate no more than 5 psi pressure differential from the inlet pressure.

If an overload or malfunction occurs, the red warning light will illuminate, this could indicate the following conditions:

- failure of the refrigeration unit or components
- excessively hot inlet air temperatures
- high inlet flows
- high ambient temperatures
- loss of refrigerant charge

An overview of the basic operation of the Ultra Air Model UA75AC-HP.

When the dryers are placed into service, the red (high temperature) warning light will illuminate for the first 2-3 minutes of operation. A temperature switch sensing the suction line temperature activates the warning light. Once the suction line cools the warning light will go out.

Normal operation will be indicated when:

1. the **amber** light is on
2. the refrigerant analyzer pressure is 33-35 psig (if ambient temperature is above 100°F acceptable suction pressure can be as high as 54 psig)
3. the outlet pressure gauge should indicate no more than 5 psi pressure differential from

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the inlet pressure

4. If a malfunction occurs, the red warning light will illuminate.

An overview of the basic operation of the Comp Air- Kellogg Model K75A-HP
This model air dryer is not equipped with a warning light.
Normal operation will be indicated when:

1. the refrigerant analyzer pressure is 33-35 psig (if ambient temperature is above 100°F acceptable suction pressure can be as high as 54 psig)
2. the outlet pressure gauge should indicate no more than 5 psi pressure differential from the inlet pressure.

CRDR 2523596 – Documents an event when the starting air dryer condition degraded due to high suction line temperatures.

As a result of this it was determined that seasonal changes may require adjustments of Hot Gas Bypass valve and Expansion Valve.
This should be performed following the work instructions for the particular equipment.

Operations also changed their procedure to include instructions to blowdown the air receivers more often when a dryer is taken out of service for maintenance, troubleshooting, or a failure.

Whenever there is a problem that will take the dryer out of service Operations needs to know the status of the equipment.

EO 1.1.4	Identify good Maintenance practices when working on the starting air dryers.
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1.1.4.1 Main Idea

HVAC performs PM tasks on the starting air dryers and after coolers such as:

- Clean and inspect air dryers and after coolers
- Check the refrigerant charge

When you performed the initial Pre-job briefing you may not have included all the specifics for the task of checking the charge. However, as you progress through the work evolution you need to use the Prevent Event tools to redirect your focus from one task to the next. This may include adjustments of the Hot Gas Bypass valve and Expansion valve to compensate for seasonal changes in ambient conditions.

Since the type of refrigerant charge will vary depending on the model unit, the technician should verify the charge and all equipment is compatible prior to servicing.

Use the refrigerant gauge that is installed on the air dryer to check suction pressure. This will prevent a loss of charge due to using a manifold gauge set.

Always ensure that the unit suction pressure has stabilized prior to making adjustments.

Operations may use the red (high temperature) light as the only indication of a malfunction when it remains on after a start or comes on during normal operations. Verify ambient temperature was not the cause.

The diesel generator starting system is required to support diesel generator operability. If for any reason the air dryer is not operating properly or needs to be removed from service notify the Control room immediately.

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.