

# PALO VERDE NUCLEAR GENERATING STATION

## HVAC

### Classroom Lesson



<b>HVAC Training</b>	<b>Date:</b>
<b>LP Number: NMH30L050303</b>	<b>Rev Author: Ron Newell</b>
<b>Title: Chiller High Voltage Motor Terminations</b>	<b>Technical Review:</b>
<b>Duration : 17 Hours</b>	
	<b>Teaching Approval:</b>

**INITIATING DOCUMENTS:**

15DP-OTR69 Training and Qualification Administration

Training Program Description for HVAC Maintenance

ACAD 02-001 The Objectives and Criteria for Accreditation of Training in the Nuclear Power Industry

**REQUIRED TOPICS**

NONE

**CONTENT REFERENCES**

EPA Section 608 Clean Air Act and 40 CFR, Part 82, Protection of Stratospheric Ozone; Refrigerant Recycling

Palo Verde Expectations and Standards

13-EN-306 Installation Specification for Cable Splicing and Termination

VTD- C150-00032 INSTRUCTIONS FOR 19EP/E /FA HIGH VOLTAGE MOTOR TERMINAL ASSEMBLY [.PUB.# 99TA550107].

OE14889 - Failure of Motor Terminal Assembly Results in Complete Loss of Mechanical Chiller Refrigerant (TCS# 03-0083)

VTD-C150-0031 - MOTOR TERMINAL REPAIRS ON 19FA CARRIER CENTRIFUGAL CHILLERS.

Electrical Safe Work Practices 01DP-OIS13

EDC 2002-00418 Torque requirements for the chiller motor terminals

**Lesson Plan Revision Data**

Dec 17, 2008 Ron Newell Revised lesson based on feedback. .

Tasks and Topics Covered

The following tasks are covered in Chiller High Voltage Motor Terminations:

Task or Topic Number*	Task Statement
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Lesson: [Chiller High Voltage Motor Terminations](#)

CHL18	<a href="#">Replace chiller motor terminal assembly</a>
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Total tasks or topics: 1

**TERMINAL OBJECTIVE:**

- 1.1 Given the applicable work instructions, reference documents, tools and equipment the trainee will, inspect, repair, install and rework the chiller motor high voltage terminal connections. Mastery will be demonstrated by successfully installing a ceramic motor terminal assembly.
  - 1.1.1 Discuss the process of inspecting and re-torquing the chiller motor terminals along with the tag out expectations on the permit which will allow personnel to safely perform this task.
  - 1.1.2 Install a high voltage chiller motor terminal assembly.
  - 1.1.3 Discuss the repair process for the compressor motor leads.

## Lesson Introduction: Chiller High Voltage Motor Terminations

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

[\[Introduction\]](#)

<b>T.Obj 1.1</b>	<b>Given the applicable work instructions, reference documents, tools and equipment the trainee will, inspect, repair, install and rework the chiller motor high voltage terminal connections. Mastery will be demonstrated by successfully installing a ceramic motor terminal assembly.</b>
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### 1.1.1 Introduction

In this lesson the trainee will learn how to inspect, repair, install and rework the chiller motor high voltage terminal connections.

This work is most often performed during an outage so time pressures could create error likely situations.

### 1.1.2 Main Idea

#### Prevent Events & STAR Achieving Breakthrough Performance

**What is the task I am going to perform?**

**TERMINAL OBJECTIVE:**

Given the applicable work instructions, reference documents, tools and equipment the trainee will, inspect, repair, install and rework the chiller motor high voltage terminal connections. Mastery will be demonstrated by successfully installing a motor terminal assembly.

**Do you understand it?**

The enabling objective will help you understand the terminal objectives.

If you master each of the enabling objectives as they are covered, you will master the terminal objective.

**What is the worst thing that could happen and how can I prevent it? AND What else could go wrong?** We will be using lessons learned through out the lesson to help focus our attention to the hazard assessment and for each task.

**What safety and/or radiation protection equipment is needed?**

Ensure the chiller is tagged out appropriately for the scope of work.

Safety and radiation issues are incorporated into the lesson.

**Is my training and are my qualifications up-to-date?**

Previous experience and qualification is required in the High Voltage Terminations Work Assignment.

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	<b>Discuss the process of inspecting and re-torquing the chiller motor terminals along with the tag out expectations on the permit which will allow personnel to safely perform this task.</b>
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### 1.1.1.1 Introduction

In this objective the trainee will discuss inspecting and retorquing the various chiller motor terminals.

### 1.1.1.2 Main Idea

#### 1) Terminal inspection

- a) Assess and address workplace hazards.
- b) Verify the permit is in place and is adequate for the work scope. Expectation is to install at the starter a grounding spider. This is how the HVAC technician verifies de-energized condition. We are expected to walk down our tags and approve permit boundaries before starting work.
- c) Before pumping down the machine perform a leak test of the machine.
- d) Be sure to record the leaks found during the inspection with enough detail to ensure they will be repaired once the machine is pumped down. This is particularly important if the rework will be turned over to the next shift.

#### 2) Three terminal styles:

- a) There are three styles of high voltage terminal assemblies used on our 19FA chillers.
- b) We will refer to them as the old style, the new style and the ceramic style.
- c) The ceramic style is the only one available when a terminal replacement is required.

#### 3) Torquing the terminal

- a) Starting and stopping the chiller causes the power cables to the flex, this in turn causes the pressure seal connection to loosen.
- b) The packing nut and brass nut on the plastic terminals (old and new style) are torqued each time the terminal is serviced. Whether a leak has been identified or not.

**Emphasize: Re-torquing is only required on the plastic insulators.**

- i) Experience has shown that by performing this on a scheduled frequency leakage in this area has been eliminated.



- c) Re-torquing is not required on the ceramic terminals. If leakage occurs after initial torque is performed then the parts are defective and should be replaced.

**Emphasize: The ceramic style insulator can not be re-torqued to stop a leak or re-torqued to prevent leaks. If leakage occurs soft parts can be replaced and then re-torqued.**

- d) Different Torque values apply depending on the style of the plastic terminal assembly:

Terminal board flange bolting:

old style 10 -12 ft. lbs

new style 12 - 15 ft. lbs

Packing nut:

old style 10 ft. lbs maximum

new style 12 - 15 ft. lbs.

Brass jam nut:

old and new styles 1ft. lb maximum

The flange bolting is usually only re-torqued if it is leaking or being replaced.

- 4) A noticeable difference between the two plastic style terminal plate connections is that the old style has Loctite or epoxy on the insulator thread connection and the new style uses an O ring.

### 1.1.1.3 Demonstration

Prior to performing the demonstration have the trainees perform the hazard assessment and determine what PPE is required for the task.

During the lab portion of this training the trainee is required to wear appropriate PPE; safety glasses and gloves available when working on the chiller. When performing the Evaluation field conditions are simulated; safety glasses and gloves available when working on the chiller and hard hats on.

Using the Lab Practical Evaluation, Carrier Instruction sheet and the work instructions, show the trainee how to inspect and retorquer the chiller motor terminal.

An optional exercise is to have one of trainee's perform the inspection and retorquer as you explain the process. Based on the experience of the trainee, have one trainee read the instruction and the other perform the task. Self check/Peer check.

<b>EO 1.1.2</b>	<b>Install a high voltage chiller motor terminal assembly.</b>
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### 1.1.2.1 Introduction

In this objective the trainee will perform the procedure for installing the motor terminal assembly on 19FA Carrier Centrifugal Chillers.

### 1.1.2.2 Methods and Activities

Refer to the applicable vendor documents.

### 1.1.2.3 Main Idea

Although there are currently three styles of high voltage terminal assemblies used on our 19FA chillers, the ceramic style is the only one available for replacements.

Before using the replacement kit, check the VTD to ensure you have the correct kit needed for your application. And to make sure all parts required are included in the kit.

Be sure to carefully read and understand the installation instructions before starting the installation.

#### 1) Installation Instructions for the ceramic terminals.

To ensure a leak tight seal, the motor end terminal board mating surfaces must be clean and smoothly coated with epoxy paint which has had sufficient time to cure dry.

- a) Lightly lubricate quad ring (Parker Super Lube) or approved vendor lube. Install in terminal board groove. Slide assembly over motor lead.
- b) Install terminal board to motor shell with bolts and washers and evenly tighten bolts to approximately 5 ft lbs.
- c) Then torque bolts to 12-15 ft-lbs in a sequence As shown in the VTD or vendor supplied instructions. Users of M&TE, ensure M&TE calibrations are current as specified on the calibration label, we are responsible to ensure calibration is current. We are responsible to ensure M&TE is within its restricted usage criteria.
  - i) Take note that new bolts are included to accommodate the "thickness of the new aluminum terminal board compared to the old plastic type terminal board. (the new bolts are shorter)
- d) Install o-ring on ceramic insulator.
- e) Lubricate ceramic insulator o-ring and mating surface with o-ring lubricant.
- f) Slide terminal stud into ceramic insulator.

- g) With the terminal stud in the ceramic insulator, slide ceramic insulator over the motor lead and thread insulator into motor housing, Torque insulator to 25 Ft lbs.
- h) Lubricate terminal stud o-ring and slide over the threaded portion of the copper stud, then install copper sleeve.

Important: The copper sleeve, which contacts the o-ring packaged with the ceramic terminal, has been machined to fit that terminal assembly inside diameter. Do not mix terminals insulators and sleeves, use only the sleeves, use only the sleeve provided with each individual terminal.

- i) Slide the copper washer over the stud and next to the copper sleeve. If replacing the old plastic terminal and not the terminal stud, two or more washers will be necessary because of the difference in length between the old insulator and the new ceramic insulator.
- j) Install the brass jam nut and tighten against the washers to maximum of 3 Ft lbs while holding copper stud. This will seat the copper washer against the insulator and draw the internal shoulder onto the stud against the internal edge of the insulator.

**Note: The copper sleeve will not crush the o-ring.**

**If leakage occurs after the terminal is assembled, then the parts are defective and should be replaced. Do not over tighten to eliminate leaks.**

### 1.1.2.4 Demonstration

Prior to performing the demonstration have the trainees perform the hazard assessment and determine what PPE is required for the task. Using the Lab Practical Evaluation and the work instructions, show the trainee how to perform the installation.

An optional exercise is to have one of trainee's perform the installation as you explain the process. Based on the experience of the trainee, have one trainee read the instruction and the other perform the task. Self check/Peer check.

### 1.1.2.5 Practice

Have trainee assemble the terminal

<b>EO 1.1.3</b>	<b>Discuss the repair process for the compressor motor leads.</b>
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### 1.1.3.1 Introduction

In this objective the trainee will discuss the procedure for repairing the motor leads on 19FA Carrier Centrifugal Chillers.

### 1.1.3.2 Main Idea

- 1) Compressor motor lead repair on 19FA Carrier Centrifugal Chillers.
  - a) Disassemble terminal.
  - b) Slip new terminal over leads and thread terminals into plate (not tightly - they will be removed later).
  - c) Mark the motor lead even with the end of the terminal. Refer to page 2 of VTM-C150-0031.
  - d) Remove the terminal and plate.
  - e) Measure 1½ inches back from the mark and cut the cable. (Cutting may not be required if this is a new cable )
  - f) Skin 1 inch from the cable end.
  - g) Hold the adapter in tongs with pigtail down. Apply flux to inside adapter. Heat adapter until flux bubbles. Fill hole in adapter with 50-50 Tin - Lead solder.
  - h) Slip adapter onto cable end and hold until solder sets. Additional solder may be applied to fill gaps.

Note 1: Care must be taken so that cable and adapter remain concentric and in a straight line. If not, later assembly will be difficult.

Note 2: Cable insulation may bubble and turn black. This is normal and will be trimmed later.

- i) When cable-adapter assembly has cooled, clean excess solder from adapter, especially at the threads and at the sealing surface near where the bushing comes in contact.
- j) Taper insulation from cable end and remove black carbonization. Clean cable and adapter. Any foreign matter will degrade the insulation to be applied.
- k) Paint area around cable-adapter joint with epoxy.
- l) Apply glass tape (with clean hands) in layers until joint is well insulated as shown in sketch below (note maximum diameter)'.
  - i) Coat each successive layer of tape with epoxy. Avoid creating voids.
  - ii) Apply tape with some tension to insure good bonding with copper and with cable insulation. Allow insulated joint to cure.

## **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.