PALO VERDE
NUCLEAR GENERATING STATION

HVAC

Classroom Lesson

HVAC Training	**Date: 01/13/2005**
LP Number: NMH10X000502	**Rev Author: Paula Stapleton**
Title: PAMU AC Units	**Technical Review:** Digitally signed by: Sherman, John L(Z85359) Date: 01/14/2005 13:37:15 Reason: I have reviewed this document Location: PVNGS
Duration : 1.5 Hours	
	Teaching Approval: Digitally signed by: Edmunds, Derek S(Z99318) Date: 01/18/2005 08:16:41 Reason: I am approving this document Location: PVNGS

INITIATING DOCUMENTS:

15DP-OTR69 Training and Qualification Administration

HVAC Technician Training Requirements

Training Program Description for HVAC Maintenance

REQUIRED TOPICS

NONE

CONTENT REFERENCES

13-N997-902-2 PAMU Control Wiring

Maintenance Standard and Expectations handbook

System Training Manual vol. 55 Radiation Monitoring System (SQ)

VTD-G080-0612-1 PAMU GE A/C Unit

VTD-G080-0613-1 PAMU GE A/C Unit

VTD-G080-0614-1 PAMU GE A/C Unit

VTD-Gk020-0669 PAMU Kaman Panel

VTD-H260-0282 PAMU Temp Contrl

VTD-H260-0283 PAMU Switching Relays

VTD-H260-0284 PAMU T'stat

VTM K020-00001

WO Task# 034293 Inspect, clean, lubricate, and verify proper operation of ACU#1 & ACU#2

Maintenance Prevent Events Strategy

Palo Verde Safety Manual

Lesson Plan Revision Data

Jan 13, 2005	Paula Stapleton	Developed LP for CBT

TCSAI# 2688996 Revision includes more P.E., Standards & Expectations.

Moved task ACU25- Troubleshoot the PAMU A/C unit to HVAC General 2.

Tasks and Topics Covered

The following tasks are covered in PAMU AC Units:

Task or Topic Number*	Task Statement
Lesson:	PAMU AC Units
ACU24	Check the operation of the PAMU A/C unit

Total tasks or topics: 1

TERMINAL OBJECTIVE:

1.1 Given a CBT presentation, describe the purpose, operation and good maintenance practices of the PAMU A/C 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 PAMU A/C Unit

1.1.2 Identify the controls and safety devices used on the PAMU A/C circuitry.

1.1.3 Describe the operation of the PAMU A/C system in the normal mode.

1.1.4 Describe the operation of the PAMU A/C system in the failure mode

1.1.5 Identify good maintenance practices when working on the PAMU A/C Unit

Lesson Introduction: PAMU AC Units

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

T.Obj 1.1	**Given a CBT presentation, describe the purpose, operation and good maintenance practices of the PAMU A/C 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 Introduction

Describe the purpose, operation, and good maintenance practices for the PAMU Air Conditioning Units.

1.1.2 Main Idea

What is the task I am going to perform?
TERMINAL OBJECTIVE:
Describe the purpose, operation and good maintenance practices of the PAMU AC.
Do you understand it?
The enabling objective that are going to help you understand the terminal objectives are;
State the purpose of the PAMU A/C Unit
Identify the controls and safety devices used on the PAMU A/C circuitry.
Describe the operation of the PAMU A/C system in the normal mode.
Describe the operation of the PAMU A/C system in the failure mode.
Identify good Maintenance practices when working on the PAMU A/C Unit
What is the worst thing that could happen and how can I prevent it?
The power to the A/C Units is controlled by a local disconnect and the control cabinet inside the PAMU is powered from a different source in the Turbine Building 140 foot. Verify that the clearance boundaries are adequate for the work scope prior to starting the task. If the work scope changes you progress through the work activity, STOP and review the Prevent Event questions again.
What else could go wrong?
The PAMU, (JSQNC04) is a NEMA 12 electrical enclosure located at ground level near the main steam support structure, turbine building breeze way. You will need a ladder to access the A/C Units which are on the top of the electrical enclosure. Pigeons have been seen in the area. This could present you with additional conditions to consider.

What safety and/or radiation protection equipment is needed?
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, and a pair of work gloves.

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 PAMU A/C Unit

1.1.1.1 Main Idea

The radiation monitoring system (SQ) monitors radiation levels of designated systems and areas of the plant during all modes of plant operation. The system is composed of three sub-systems:

the safety related radiation monitoring system (SRMS)
the post accident radiation monitoring system (PAMS)
the digital radiation RMS server, in the main control room, chemistry hot lab, and in the RMS/effluents office.

Data is also sent to the emergency response facility and data acquisition display system (ERFDADS).

The PAMS is a series of radiation monitors that provide long-term accident and post accident monitoring of effluent gases and particulates for condenser effluent and plant vent. This system is used to keep the operators informed of abnormal radiation increases in designated plant areas.

The micro-computer (RU) and its associated sampling and detection equipment is a single assembly or skid, referred to as the field unit.

Post accident area and process radiation monitors that are part of PAMS have their field units located in the post accident monitoring unit (PAMU).

The PAMU, (JSQNC04) is a NEMA 12 electrical enclosure located at ground level near the main steam support structure, turbine building breeze way.

This structure is designed to house the field units in a clean, cool environment.

The PAMU A/C system is designed to maintain 70° F internal temperature with 120° F external temperature.

EO 1.1.2	Identify the controls and safety devices used on the PAMU A/C circuitry.

1.1.2.1 Main Idea

The A/C system consists of the following:

two 3 ton package units mounted on top of the enclosure.

cooling system control panel.

The local disconnect for each A/C unit is located next to the respective unit.

Control circuit power is supplied from the 140' turbine building from a lighting panel.

The control panel, located inside the PAMU, provides the following features:
normal operation of the primary unit.
alternate operation of the backup unit.
an alarm that will sound locally in the event of a failure of the primary unit.

Cabinet temperature is set via a Honeywell thermostat located next to the control panel.

Since the calibration of the micro-computers housed within the PAMU are referenced to performance at 72°F, the set point should be no higher than 75°F.

Setting the cabinet temperature below 70°F is not recommended due to possible icing of the indoor coil.

A paragon timer is used to initiate alternate operation, lead or lag status of the second A/C unit.

Setting the pins on the timer wheel will provide the desired alternate operation by completing the circuit through relay R-1 to one of two switching relays.

Duct mounted temperature controllers (DA #1 and DA #2) activate the control circuit to the backup A/C unit in the event of a failure of the primary unit.

The controller sensing elements are located in the discharge air duct of the alternate unit.

The controllers are set 5 °F below the thermostat setting.

In the event that the primary cooling unit fails to maintain cooling, the circuit between R and W of the alternate controller will close.

A solid state delay-on-make timer is used to delay the backup A/C unit from starting, this delay also reduces nuisance alarms.

R-2 provides the horn and horn silencing circuits.

When the alarm horn is silenced, a holding relay, R-3 will remain in the alarm condition until a time clock mode change occurs.

R-3 provides a set of contacts for an alarm signal to a computer monitoring system which is not being used since the RMS stations will show trouble alarms in Loop 3 should the enclosure become overheated.

The alarm, which will sound locally, can be silenced by momentarily pressing in the button on the face of the control panel.

EO 1.1.3	Describe the operation of the PAMU A/C system in the normal mode.

1.1.3.1 Main Idea

NORMAL OPERATION, A/C UNIT # 1 LEAD UNIT:

With power applied to the unit the paragon timer is energized, timer contacts PT are closed, relay R1 is energized. (R1 - NO contacts 1 & 3 are closed, NO contacts 6 & 8 are closed, NC contacts 1 & 4 are open, NC contacts 8 & 5 are open)

To continue the start sequence for A/C unit #1 the temperature in the cabinet rises above the cabinet thermostat set point. The temperature in the discharge duct of A/C #2 is most likely above the set point. Since it is set 5 F below the thermostat setting.

When the thermostat closes the following sequence occurs:

The cabinet thermostat R to Y closes completing the circuit through R1's contacts 1 & 3 and the discharge air controller DA #2 contacts R to W. This energizes the A/C #1 control relay and the A/C #1 "ON" light.

When AC#1 control relay energizes its NO contacts close. this completes the 24 volt control circuit R to Y and R to G starting A/C unit # 1.

Although, the circuit to the time delay was made when the thermostat contacts closed, the discharge air temperature in the duct will decrease enough to open the contacts of controller DA #1, R to W before the timer circuit closes. This de-energizes the time delay during normal operation.

A/C unit #1 will cycle on and off as needed by the cabinet thermostat until the paragon timer initiates a change for A/C unit #2 to be in lead.

NORMAL OPERATION, A/C UNIT # 2 LEAD UNIT:

With power applied to the unit the paragon timer is energized, timer contacts PT are open, relay R1 is de-energized. (R1 - NO contacts 1 & 3 are open, NO contacts 6 & 8 are open, NC contacts 1 & 4 are closed, NC contacts 8 & 5 are closed)

To continue the start sequence for A/C unit #2 the temperature in the cabinet rises above the cabinet thermostat set point. The temperature in the discharge duct of A/C #1 is most likely above the set point. Since it is set 5 F below the thermostat setting.

When the thermostat closes the following sequence occurs:

The cabinet thermostat R to Y closes completing the circuit through R1's contacts 1 & 4 and then through the discharge air controller DA #1 contacts R to W. This energizes the A/C #2 control relay and the A/C #2 "ON" light.

When AC#2 control relay energizes its NO contacts close. this completes the 24 volt control circuit R to Y and R to G starting A/C unit # 2.

Although, the circuit to the time delay was made when the thermostat contacts closed, the discharge air temperature in the duct will decrease enough to open the contacts of controller DA #2, R to W before the timer circuit closes. This de-energizes the time delay during normal operation.

A/C unit #2 will cycle on and off as needed by the cabinet thermostat until the paragon timer initiates a change for A/C unit #1 to be in lead.

EO 1.1.4	Describe the operation of the PAMU A/C system in the failure mode

1.1.4.1 Introduction

A/C UNIT #1 FAILURE TO COOL
Unit #1 is in the cooling mode, but not providing adequate cooling, the following sequence occurs:
The A/C unit #1discharge air temperature increases above the controller set point, closing DA #1 R to W, energizing the time delay circuit.
when the time delay is timed out:
the A/C #2 control relay energizes,
it's NO contacts close.
This completes the 24volt control circuit R to Y and R to G starting A/C unit # 2.
A/C #2 unit "ON" light energizes
the local horn, red "lead A/C failure light", and the remote alarm relay R3 energize
soon after A/C unit #2 starts, its discharge air temperature decreases and DA #2 contacts R to W open
the A/C #1 control relay de-energizes
deenergizing the 24volt control circuit R to Y and R to G
A/C#1 "ON" light will also de-energize
to silence the horn, momentarily press the alarm silence button on the face of the control panel, this:
closes the silence horn switch
energizes R2, closing R2 holding contacts 3 to 1
opening R2 contacts 8 to 5, de-activating the horn
At this point A/C #2 will remain running through the time delay relay circuit as the lag unit.
When the paragon timer initiates a mode change A/C #2 will become the lead unit.

A/C UNIT #2 FAILURE TO COOL
Unit #2 is in the cooling mode, but not providing adequate cooling, the following sequence occurs:
The A/C unit #2 discharge air temperature increases above the controller set point,
closing DA #2 R to W, energizing the time delay circuit.
when the time delay is timed out:
the A/C #1 control relay energizes,
it's NO contacts close,
This completes the 24 volt control circuit R to Y and R to G starting the A/C #1 unit
A/C #1 unit "ON" light energizes
the local horn, red "lead A/C failure light", and the remote alarm relay R3 energize
soon after A/C unit #1 starts, its discharge air temperature decreases and DA #1 contacts R to W open
the A/C #2 control relay de-energizes
de-energizing the 24 volt control circuit R to Y and R to G.
A/C#1 "ON" light will also de-energize
to silence the horn, momentarily press the alarm silence button on the face of the control panel, this:
closes the silence horn switch
energizes R2, closing R2 holding contacts 3 and 1
opening R2 contacts 8 and 5, de-energizing the horn
At this point A/C #1 will remain running through the time delay relay circuit as the lag unit.
When the paragon timer initiates a mode change A/C #1 will become the lead unit.

EO 1.1.5	Identify good maintenance practices when working on the PAMU A/C Unit

1.1.5.1 Main Idea

HVAC performs yearly PM tasks on the PAMU to verify the following:
- that the A/C units have maintained the correct refrigerant charge
- the timer and control circuitry alternate the lead and lag status
- the indicator lights and horn operate properly during control circuit sequencing

The local disconnect next to each package unit is usually used to isolate the power supply to the air conditioners during maintenance activities.

The control cabinet inside the PAMU is powered from a different source in the Turbine Building 140 foot lighting panel. 1,2,3EQAND02E, 5224, LTG. AND OUTLETS for SQN-C04, Drawing # 13-E-ZTC-013

When verifying the control circuitry for the alternate unit during low ambient temperatures it may be necessary to adjust the discharge air duct controllers.

Remember to restore the controller setting to the "as found" position

The air conditioning units are required to support the post accident monitoring system operability. If for any reason the air conditioning is not operating properly and needs to be removed from service notify the Control Room. If the air conditioners are to be inoperative for extended periods of time during high ambient temperatures temporary cooling may need to used. Failure to maintain the cabinet within the required temperature range can cause the (RU) micro-computer and its associated equipment to fail.

Performing a Two-minute drill at the job site to assess the hazards and conditions present will better prepare you for the work activity.
Some thing to consider:
pigeons could be an additional condition to consider since the location of the PAMU unit is in the turbine building breeze way.

a ladder is needed to access the A/C Units located on the top of the electrical enclosure.

assess the PPE needed; Hard hats, safety glasses with side shields, and a pair of work gloves.

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.