

PALO VERDE NUCLEAR GENERATING STATION

Instructor Training

Classroom Lesson



Program: I & C Program	Technical Review:
LP Number: NID32C000302	
Title: Sensor Rebuild	Line Approval:
Duration : 2 Hours	
Date: 4/30/2008	Teaching Approval:
Rev Author: Harry W. Gahagen	

INITIATING DOCUMENTS:

Site Maintenance Training Program Description

REQUIRED TOPICS

NONE

CONTENT REFERENCES

Orbisphere Diagnostic and Service Center Manual

36ST-9GR02 : Gaseous Radwaste Explosive Gas Monitoring System Calibration

74OP-9SS03 : Gaseous Waste System Sampling

VTM-O115-00001 Vendor Tech Manual for Orbisphere Oxygen Analyzer

Lesson Plan Revision Data

Apr 13, 2008 Harry Gahagen Record created

Tasks and Topics Covered

The following tasks are covered in Sensor Rebuild:

Task or Topic Number*	Task Statement
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Lesson: [Sensor Rebuild](#)

GR03	Troubleshoot GR system
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Total tasks or topics: 1

TERMINAL OBJECTIVE:

- 1.1 Given the appropriate references,, DESCRIBE when and how to rebuild an Analyzer sensor
 - 1.1.1 STATE the conditions that determine when a sensor may need to be rebuilt
 - 1.1.2 DESCRIBE a sensor rebuild to include sensor disassembly and reassembly
 - 1.1.3 DESCRIBE the methods of cleaning a sensor

Lesson Introduction: Sensor Rebuild

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

NOTE

Method of instruction will be lecture and discussion of referenced transparencies or slides and handout pages, unless otherwise specified.

NOTE

Before class, ensure your equipment is operable and place the following on the board:

- Instructor's Name
- Instructor's work phone number
- Course name
- Course length

*******INTRODUCTION*******

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I. Attention Step.

I. Get the attention of the students on you rather than outside interests. Any appropriate means is acceptable.

II. Self Introduction

II. Introduce yourself and present your background and experience, if applicable. This is the best opportunity to have students introduce themselves, if you use this technique to "open up" the class.

III. Classroom Guidelines

III. Refer to the CLASS GUIDELINES at the front of the handout and in front of this lesson plan. Read them or discuss them as applicable to the particular group in your class.

A. Attendance Sheet

A. Pass the attendance sheet around and have it signed in black ink. If applicable, have students add their mail station numbers to the attendance sheet for use when mailing out course certificates. If needed, now is a good time to fill out a seating chart or individual name cards.

B. Materials

B. Ensure that student materials needed for the class are available for each student. For materials required, refer to the list of materials on the cover page. Describe the handout format, if applicable, and stress the importance of taking good notes for future

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reference, both in the field and for the remainder of the course.

C. Questions and Participation

C. Discuss the importance of participation and your philosophy on asking or answering questions (i.e., do they need to raise their hand, etc.), if applicable.

IV. Lesson Introduction

A. Topic Introduction

1. Determine when a sensor needs to be rebuilt
2. Rebuild a sensor
3. Methods of cleaning a sensor

A. Give a brief statement which introduces the specific lesson topic(s).

B. Motivation

1. Inform the class that when rebuilding a sensor that there are radiological and chemical precautions that must be considered
2. The rebuilding of a sensor is a frequent occurrence

B. Relate the specific lesson topic to the students' future and present needs.

C. Lesson Pre-summary

1. Objectives review
Given the appropriate references, DESCRIBE when and how to rebuild an Analyzer sensor
2. Topic summary
 - a. State the conditions that determine when a sensor may need to be rebuilt
 - b. Describe a sensor rebuild include sensor disassembly and reassembly
 - c. Describe the methods of cleaning a sensor

1. Read and discuss the lesson terminal objective. Refer to T002.
2. Briefly preview the lesson topic outline and introduce the major points to be covered. The objective review may be sufficient.

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T.Obj 1.1	Given the appropriate references,, DESCRIBE when and how to rebuild an Analyzer sensor
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EO 1.1.1	STATE the conditions that determine when a sensor may need to be rebuilt
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1.1.1.1 Main Idea

I. Sensor Rebuild

A. Introduction

1. Wear and chemical reactions will require that the sensor be serviced
2. Servicing includes a membrane and electrolyte change
3. Sensor Rebuild Indication
 - a. Noisy or drifting readout under constant O₂ concentration condition
 - 1.) 1% and 4% cal gas during a calibration
 - 2.) Normal operations - verify the other analyzer indications
 - b. Long stabilization time when changing O₂ concentration
 - c. Difficulties with the calibration or the functional test
 - d. Micro indication of CALIBRATION OUT OF BOUNDS after a sensor rebuild.
4. Requirements
 - a. Rebuild will be done in the plant east hot sink located in the hot lab
 - b. Radiological and chemical precautions associated with the rebuild - safety requirements are:
 - 1.) Safety glasses
 - 2.) Surgical gloves
 - 3.) Lab coat
 - c. Obtain the recharge kit Display the recharge kit
 - 1.) Electrolyte

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- 2.) Polishing powder
- 3.) Polishing cloth
- 4.) Membranes
- 5.) Masks
- 6.) Tools

EO 1.1.2	DESCRIBE a sensor rebuild to include sensor disassembly and reassembly
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1.1.2.1 Main Idea

B. Sensor Rebuild

1. Disassembly

a. Sensor removal

- 1.) Loosen the sensor collar and remove the sensor from the flow chamber
- 2.) Disconnect the cable from the back of the micro
- 3.) Special FME cover supplied by the vendor

b. Pry off the membrane holding ring with the ring removal tool

- 1.) Avoid contact with electrolyte
- 2.) Not highly caustic - can irritate skin
- 3.) Any irritation - rinse with water

Lecture using Powerpoint and refer to the student handout Sensor Components

Prior to describing a sensor rebuild, briefly cover the sensor components and sensor internals.

c. Remove and discard the membrane and mask

d. Shake out the electrolyte and rinse with demin water

e. Dispose of material in accordance with Rad Protection and Chemistry

f. Remove the membrane support ring

- 1.) Match up the prongs of the membrane support tool to two of the holes in the support ring
- 2.) Turn counter clockwise to remove the support ring

NOTE: Each support ring is individually machined at the factory to match its sensor. It is essential when servicing several sensors at a time to keep the appropriate support ring matched to its respective sensor

- g. Rinse the support ring and sensor reservoir with demin water Reservoir Rinse

- h. If the support ring is discolored:
 - 1.) clean with concentrated nitric acid (70% by weight)
 - 2.) rinse with demin water

EO 1.1.3 DESCRIBE the methods of cleaning a sensor

1.1.3.1 Main Idea

2. Cleaning

- a. Three methods:
 - 1.) Purely chemical
 - 2.) Polishing
 - 3.) Electrochemical
- b. Chemical cleaning
 - 1.) Use a 25% by weight ammonium hydroxide solution (NH₄OH)
 - 2.) The solution sits in the sensor reservoir up to 10 minutes, then rinsed with demin water
 - 3.) Electrodes should be shiny and of a uniform color, if not, repeat the procedure
 - 4.) If still discolored, use a few drops of nitric acid (70% by weight) for 10 sec.
 - 5.) Rinse and repeat chemical cleaning - let set for 5 min and rinse.
- c. Polish cleaning
 - 1.) Used if electrochemical or standard chemical do not remove all the deposits
 - 3.) The powder is added to water, on the cloth located in the plastic dish, until a loose watery mixture is made Cleaning Powder
 - 4.) Avoid skin contact
 - 5.) Hold the sensor vertical and use a gentle circular motion for at least 30 seconds Sensor Polishing
 - 6.) Cathode and guard ring should be clean and shiny - rinse with demin water Sensor Rinse
- d. Electrochemical cleaning Preferred method @ PVNGS
 - 1.) Uses the Diagnostic and Service Center

Per Orbisphere it is recommended that all three methods be used when cleaning a detector by the order stated under letter "a"

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- 2.) Used for general purpose
 - 3.) Reverses the chemical reaction that occurs during normal operations
 - 4.) Highly efficient
3. Assembly
- a. Replace the membrane support ring
 - 1.) No more than finger tight
 - 2.) Safety feature - the support ring will skip if over tightened
 - b. Fill the sensor head with electrolyte Filling the Sensor
 - 1.) Fill the sensor through the support ring using the syringe
 - 2.) Tilt the sensor slightly, fill from the lowest of the four holes - forces air through the top hole
 - 3.) Continue filling the sensor and return to the vertical position
 - 4.) Overflow electrolyte until a meniscus is formed on the sensor face
 - c. Install the membrane
 - 1.) Use the mounting tool which is in two parts
 - a.) Plunger
 - b.) Hollow cylindrical guide
 - 2.) Slide the holding ring on the beveled edge of the plunger Holding Ring Placement
 - 3.) Place a membrane on the inside lip of the guide Membrane Placement
 - 4.) Place a mask on top of the membrane inside lip of the guide
 - 5.) Slide the guide over the sensor head so it rests on the sensor shoulder Holding Ring Installation
 - 6.) Insert the plunger into the top of the guide and push down until it stops

- 7.) Remove the entire mounting tool and inspect the sensor for:
 - a.) No air bubbles trapped under the membrane or mask
 - b.) a smooth membrane and mask surface
 - c.) a properly seated holding ring
- 8.) If these conditions are not met, repeat the procedure using a new membrane and mask

*****SUMMARY*****

****SUMMARY****

- I. Summary of Main Principles
 - A. Objectives review
 - 1. STATE the conditions that determine when a sensor may need to be rebuilt
 - 2. DESCRIBE a sensor rebuild to include sensor disassembly and reassembly
 - 3. DESCRIBE the methods of cleaning a sensor
 - B. Topic review
 - II. Questions and Answers
 - A. Oral questions
 - III. Problem Areas
 - IV. Lessons Learned
 - V. Concluding Statement
- A. Review the lesson enabling objectives
 - B. Restate or review the main principles or ideas covered in the lesson
 - A. Ask questions which implement the objectives. Discuss students' answers as needed to ensure the objectives are being met.
 - III. Review any problem areas discovered during the oral questioning. Use this opportunity to solicit final questions from the students (last chance).
 - IV. Read or have the students read applicable SER's, EER's, etc.; especially those which deal with PVNGS. Have students discuss the reports and decide what actions were incorrect, and what actions should have occurred.
 - V. Review the motivational points which apply this lesson to the students' future and present needs. Use this opportunity to address an impending exam.

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 student's 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.