

**PALO VERDE
NUCLEAR GENERATING STATION**

Mechanical Maintenance Training

Classroom Lesson



Mechanical Maintenance Training	Date: 5/7/2009
LP Number: NMS01C000201	Rev Author: CURT CLUFF
Title: Mechanical and Hydraulic Snubbers	Technical Review:
Duration : 4 HOURS	Teaching Approval:

INITIATING DOCUMENTS

Task Analysis of Tasks

REQUIRED TOPICS

None

CONTENT REFERENCES

- VTM-I207-00002, ITT Grinnell Mechanical Shock, Sway Suppressors and Associated Equipment
- VTM -P-970-00001: Paul Monroe S/G & RCP Snubbers [P209-B, P209-B2, 50-3, 51-1, 52-1]
- Station Manuals Procedures 73ST-9ZZ10, 73ST-9ZZ21, 73ST-9ZZ22, 73ST-9ZZ23, 31MT-9ZZ15, 73DP-9ZZ16
- VTM-P029-00001, PSA snubber Tech. Manuals [PSA-192, 193, 194, 141.]
- VTM-P-970-00002, Installation-Operation-Maintenance for C-E System 80 Pump Shock Struts
- VTM-P-970-00004, Installation-Operation-Maintenance for D-E System 80 Steam Generator Snubber

LESSON PLAN REVISION DATA

May 07, 2009 Curt Cluff Revised to reflect new hydraulic snubber status (TCSAI 3324454)

Tasks and Topics Covered

The following tasks are covered in Mechanical and Hydraulic Snubbers :

Task or Topic Number*	Task Statement
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Lesson: Mechanical and Hydraulic Snubbers

SNUB002	Assist with test of hydraulic snubbers
SNUB004	Remove/reinstall mechanical snubbers
SNUB005	Disconnect/reconnect hydraulic snubbers
SNUB003	Inspect mechanical snubbers
SNUB001	Inspect hydraulic snubbers

Total task or topics: 5

TERMINAL OBJECTIVE:

- 1 Given a maintenance situation on a snubber, the student will , describe the construction and operation of mechanical and hydraulic snubbers as demonstrated by passing the final written examination with a minimum of 80% correct.
 - 1.1 Explain the basic operation of mechanical snubbers
 - 1.2 Identify the major components of mechanical snubbers
 - 1.3 Explain the basic operation of hydraulic snubbers
 - 1.4 Identify the major components of hydraulic snubbers

Lesson Introduction: Mechanical and Hydraulic Snubbers

The following items are things to consider in your Lesson Introduction. They are not mandatory.

CONTENT**METHODS & ACTIVITIES**

- | | |
|---|---|
| <p>I. Motivation</p> <p>A. This lesson plan is all about the snubber, not about any of the tasks associated with snubber maintenance – theory and parts only</p> <p>B. Understanding how the snubber works can assist in inspection.</p> <p>C. Removal and replacement of snubbers safely and without damaging parts requires understanding their construction</p> | <p>Focus student attention on “What’s In It For Me”.</p> |
| <p>II. Lesson Introduction</p> <p>A. Lesson Terminal Objective</p> <p style="padding-left: 40px;">Given a maintenance situation on a snubber, the student will describe the construction and operation of mechanical and hydraulic snubbers as demonstrated by passing the final written examination with a minimum of 80% correct.</p> <p>B. Lesson Enabling Objectives</p> <p style="padding-left: 40px;">EO01 Explain the basic operation of mechanical snubbers.</p> <p style="padding-left: 40px;">EO02 Identify the major components of mechanical snubbers.</p> <p style="padding-left: 40px;">EO03 Explain the basic operation of hydraulic snubbers.</p> <p style="padding-left: 40px;">EO04 Identify the major components of hydraulic snubbers</p> | <p>Introduce the lesson material</p> <p>Read and/or discuss the lesson objectives</p> |

TO: 1 Given a maintenance situation on a snubber, the student will , describe the construction and operation of mechanical and hydraulic snubbers as demonstrated by passing the final written examination with a minimum of 80% correct.

EO: 1.1 Explain the basic operation of mechanical snubbers

CONTENT

METHODS & ACTIVITIES

- | | |
|--|---|
| I. Purpose of Snubbers | Identify the purpose of snubbers |
| A. Restrain movement during seismic event | |
| 1. Ensure safety systems can still perform their safety function | |
| 2. Ensure adequate movement is allowed during normal operations | |
| B. Mechanical snubbers limit acceleration of movement | |
| C. Hydraulic snubbers limit velocity of movement | |
| D. How this is done differs greatly between the two types | |
| II. Operation of mechanical snubber | |
| A. DEFINITIONS: | |
| 1. KIP - 1000 pounds of either compressive or tensile force. | Ask if anyone can define KIP.
See if anyone has worked with or inspected snubbers. |

CONTENT**METHODS & ACTIVITIES**

2. **ACTIVATION LEVEL** - the amount of acceleration which causes the snubber to resist movement.

Ask if anyone can give the basic operation.

- a. Below the activation level

Slide and Training Aids

- (1) Normal expansion and contraction of the restrained component is accommodated by the extension and retraction of the telescoping cylinder within the support cylinder assembly.

- b. Activation level exceeded

- (1) Force is applied to the telescoping cylinder attempting to accelerate the cylinder in a linear motion.

- (2) The attempted rapid acceleration is resisted by the inertia mass which lags behind the rest of the components.

- (3) This resistance causes compression of the capstan spring on the support cylinder and thereby acts to brake the rotary motion of the torque drum.

- (4) The restricting mechanism of the snubber is completely symmetrical in design. Therefore, the capstan spring will apply braking action when either extending or retracting.

B. Construction

1. All our mechanical snubbers are built by PSA (formerly Pacific Scientific)
2. Three basic construction groups by size
 - a. PSA ¼ & ½
 - b. PSA 1,3, & 10

CONTENT

METHODS & ACTIVITIES

c. PSA 35.

C. $\frac{1}{4}$ & $\frac{1}{2}$

1. Activation levels of 175 lb and 325 lb respectively.
2. Rod and bearing assembly
3. Pivot Bearings
4. Guide plate
5. Strokes of 4 & 2.5 in.

NOTE: activation levels identified are the tested values at 50% or maximum design force

Slide – Refer to training aids as necessary.

D. PSA 1, 3 & 10

1. Activation levels of 750 lbs, 3,000lbs, & 7,500 lbs respectively
2. Ball screw and nut assembly
3. Strokes of 4, 5, & 6 in.

Slide Refer to training aids as necessary

E. PSA 35

1. Activation level of 25,000 lbs
2. Planetary gear assembly
3. Stroke of 6 in.

Slide

EO: 1.2 Identify the major components of mechanical snubbers

CONTENT

METHODS & ACTIVITIES

I. Major Components

A. PSA ¼ & ½ components

Slide - Refer to TA05 as necessary.

1. Tube/Housing
2. Ball bearing
3. Inertia mass
4. Clutch spring
5. Torque carrier and shaft assembly
6. Capstan spring
7. Support washer
8. Inner tube
9. Anti rotation key
10. Outer Tube
11. Rod and bearing assembly
12. Guide plate

B. PSA 1, 3, & 10 components

Slide

1. Housing
2. Name Plate
3. Inertia mass
4. Clutch spring
5. Torque Drum

CONTENT

METHODS & ACTIVITIES

- 6. Capstan spring
- 7. Ball Bearing Screw Assembly
- 8. Telescoping Cylinder
- 9. Cylinder support
- 10. Anti Rotation Key
- 11. End Plug Assembly
- 12. Position Indicator Tube
- C. PSA 35 components
 - 1. Items 1-12 are the same
 - 2. Additional items
 - a. Planetary Gear
 - b. Pinion Gear

Slide

Use Training Aid to show the planetary drive

EO: 1.3 Explain the basic operation of hydraulic snubbers**CONTENT****METHODS & ACTIVITIES**

I. Operation of hydraulic snubbers

A. Overview

1. Two types
 - a. 2 RCP snubbers on each RCP
 - b. 2 S/G snubbers on each S/G
2. Same manufacturer, Paul-Munroe Enertech
3. Some differences in construction, but same principles of operation

B. Below activation level

Slide

1. Hydraulic fluid is forced from one side of the snubber piston to the other via a control valve and an orifice or passage through the valve seating surface.
2. This allows for a bleed and a continuous minimum **Slide** rate of motion after restraining load is reached.
3. The fluid reservoir maintains a positive head on both the tension and the compression side of the piston.

C. Activation level exceeded

1. Initial motion is taken up by any clearance in the pins and bearings.
2. Motion in excess of lock-up velocity closes the poppet valve creates a hydraulic lock. (Flow through the bleed orifice is negligible).

EO: 1.4 Identify the major components of hydraulic snubbers

CONTENT

METHODS & ACTIVITIES

II. Hydraulic Snubber/Shock Strut

**Slides showing
snubbers on location**

III. Steam Generator (650 KIP)

Slide

A. Components

1. Tube
2. Nameplate
3. Piston Rod
4. Rod Head
5. Chevron Packing
6. Bleed and Drain Plug
7. Control Valves
8. Reservoir

Slide

B. Fluid

1. Steam Generator snubber uses Fyrquel GT by Stauffer Chemical

IV. Reactor Coolant Pump (850 KIP)

Slide

A. Components

1. The only major differences besides the physical size of the snubbers, is the attached reservoir and the hydraulic fluid used.
2. Reservoir
3. Bleed plug

Slide

CONTENT

METHODS & ACTIVITIES

- 4. Quick disconnect
 - 5. Pressure relief
 - 6. Fluid indicator
 - 7. Limit switch for reservoir level alarm
- B. Fluid
- 1. Reactor Coolant pump snubbers use General Electric SF-1154 hydraulic fluid

SUMMARY OF MAIN PRINCIPLES

The following items are things to consider in your lesson summary. They are not mandatory.

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

Ask questions that implement the objectives. Discuss student's answers as needed to ensure the objectives are being met.

Concluding Statement

If not done in the previous step, review the motivational points that apply this lesson to students needs. End with a statement leading to the next lesson.