## PALO VERDE
### NUCLEAR GENERATING STATION

**Mechanical Maintenance Training**

**Classroom Lesson**

<table>
<thead>
<tr>
<th>Mechanical Maintenance Training</th>
<th>Date: 5/7/2009</th>
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<tbody>
<tr>
<td>LP Number: NMS01C000201</td>
<td>Rev Author: CURT CLUFF</td>
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<tr>
<td>Title: Mechanical and Hydraulic Snubbers</td>
<td>Technical Review: Cluff, Curt D(Z25211)</td>
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<tr>
<td>Duration : 4 HOURS</td>
<td>Teaching Approval: Steinmetz, Tim P(Z99348)</td>
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Digitally signed by Cluff, Curt D(Z25211)
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Reason: Reviewed by Mike D’Amato, 6/11/2007
Date: 2009.05.07 14:26:36 -07'00'

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Reason: I am approving this document
Date: 2009.05.07 17:27:08 -07'00'
INITIATING DOCUMENTS

Task Analysis of Tasks

REQUIRED TOPICS

None

CONTENT REFERENCES

VTM-I207-00002, ITT Grinnell Mechanical Shock, Sway Suppressors and Associated Equipment
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:

<table>
<thead>
<tr>
<th>Task or Topic Number*</th>
<th>Task Statement</th>
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<tbody>
<tr>
<td>SNUB002</td>
<td>Assist with test of hydraulic snubbers</td>
</tr>
<tr>
<td>SNUB004</td>
<td>Remove/reinstall mechanical snubbers</td>
</tr>
<tr>
<td>SNUB005</td>
<td>Disconnect/reconnect hydraulic snubbers</td>
</tr>
<tr>
<td>SNUB003</td>
<td>Inspect mechanical snubbers</td>
</tr>
<tr>
<td>SNUB001</td>
<td>Inspect hydraulic snubbers</td>
</tr>
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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**

I. Motivation
   A. This lesson plan is all about the snubber, not about any of the tasks associated with snubber maintenance – **theory and parts only**
   B. Understanding how the snubber works can assist in inspection.
   C. Removal and replacement of snubbers safely and without damaging parts requires understanding their construction

II. Lesson Introduction
   A. Lesson Terminal Objective
      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.
   B. Lesson Enabling Objectives
      EO01 Explain the basic operation of mechanical snubbers.
      EO02 Identify the major components of mechanical snubbers.
      EO03 Explain the basic operation of hydraulic snubbers.
      EO04 Identify the major components of hydraulic snubbers

**METHODS & ACTIVITIES**

Focus student attention on “What’s In It For Me”.

Introduce the lesson material

Read and/or discuss the lesson objectives
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

I. 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.

METHODS & ACTIVITIES

Identify the purpose of snubbers
CONTENT

2. ACTIVATION LEVEL - the amount of acceleration which causes the snubber to resist movement.
   
   a. Below the activation level
      
      (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

METHODS & ACTIVITIES

Ask if anyone can give the basic operation.

Slide and Training Aids
CONTENT

c. PSA 35.

C. ¼ & ½

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.

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.

E. PSA 35

1. Activation level of 25,000 lbs
2. Planetary gear assembly

METHODS & ACTIVITIES

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

Slide – Refer to training aids as necessary.
EO: 1.2  Identify the major components of mechanical snubbers

CONTENT

I. Major Components

A. PSA ¼ & ½ components

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 - Refer to TA05 as necessary.

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

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

METHODS & ACTIVITIES

Slide

Use Training Aid to show the planetary drive
EO: 1.3  Explain the basic operation of hydraulic snubbers

**CONTENT**

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

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 rate of motion after restraining load is reached. Slide

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

II. Hydraulic Snubber/Shock Strut

III. Steam Generator (650 KIP)
   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
   B. Fluid
      1. Steam Generator snubber uses Fyrquel GT by Stauffer Chemical

IV. Reactor Coolant Pump (850 KIP)
   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

METHODS & ACTIVITIES

Slides showing snubbers on location

Slide
CONTENT

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.