<table>
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<tr>
<th>I&amp;C Program</th>
<th>Date: 2/25/2011 1:48:08 PM</th>
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<tr>
<td>LP Number: NIA97C000703</td>
<td>Rev Author: DANIEL R. REED</td>
</tr>
<tr>
<td>Title: Flow Control Valves</td>
<td>Technical Review: De Dea, Thomas J(Z31735)</td>
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<td>Duration: 30 HOURS</td>
<td>Teaching Approval:</td>
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INITIATING DOCUMENTS

None

REQUIRED TOPICS

None

CONTENT REFERENCES

Instrument Engineer's Handbook, Liptak 1969

Instrumentation for Process Measurement and Control, Anderson 1980

Process Instruments and Controls Handbook, Considine 1974

SOER 85-02 "Valve Mispositioning Events Involving Human Errors"

SOER 85-03 "Excessive Personnel Radiation Exposures"

REVISION COMMENTS

Feb 25, 2011    Jeff De Dea    changed evaluation from LPE to a written Exam
The following tasks are covered in Flow Control Valves:

<table>
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<tr>
<th>Task or Topic Number*</th>
<th>Task Statement</th>
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<tr>
<td>PRO43</td>
<td>Maintain valve positioner</td>
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<tr>
<td>PRO052</td>
<td>Calibrate valve actuator</td>
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Total task or topics: 2
TERMINAL OBJECTIVE:

1 Given appropriate equipment and procedures, the I&C Technician will calibrate and maintain flow control valves in accordance with all applicable standards. Mastery will be demonstrated by successful completion of a written Exam with a score of 80% or better.

1.1 Describe how Procedure Use & Adherence applies to calibrating control valves

1.2 Describe the function of the various subassemblies of a pneumatic control valve

1.3 Contrast the various valve types including design, flow characteristics and applications

1.4 Determine the failure position of a pneumatic valve

1.5 Describe the theory of operation of valve positioners

1.6 For a valve having red and green position indicators, explain the operation of the position indicators including the appropriate limit switch contact arrangement

1.7 Calibrate the control valve to include the following:

a. Bench set
b. Valve stroke
c. Valve seating
d. Limit switches
e. Positioner
TO: 1

Given appropriate equipment and procedures, the I&C Technician will calibrate and maintain flow control valves in accordance with all applicable standards. Mastery will be demonstrated by successful completion of a written Exam with a score of 80% or better.
EO: 1.1  Describe how Procedure Use & Adherence applies to calibrating control valves

Main Idea

Procedure Use & Adherence

Increasingly procedures are guiding our activities concerning valve setup and calibration where before technician knowledge was relied on.

Methods & Activities

Expectations:

- Follow procedures as they are written.
- Understand the procedure level of use, when to STOP for resolution and use of sign-offs and place keepers.
- Determine a level of use for all procedures (procedure owners)
- Actively participate in procedure improvement.
- Ensure activities are completed as provided for in procedures, regardless of level of use.

Standards

When: During performance of work that is guided by procedures.

How:

- STOP and resolve the issue if a procedure can not be followed as written. Notify your leader to assist in resolution.
- Validate that you have the current revisions.
- Use place keepers and sign-offs as required.
- Provide procedure enhancements, training or
Ensure we know the level of use.

feedback to create a continuous improvement loop.

Use procedures according to level of use:
Continuous Use – The procedure is used “in-hand,” with steps completed as provided for in the document.
Reference – Reviewed prior to or referred to periodically during performance of activities.
Information – Refer to as needed based on frequency of use, individual knowledge and proficiency.
Combined Use – Use each procedure section according to the level identified. (Some procedures contain multiple usage levels).
EO: 1.2  Describe the function of the various subassemblies of a pneumatic control valve

Main Idea

Control Valve

Optional Methods & Activities:

Prevent Events: Hazard

Assessment – Beware of Potential of Injury from Pinch points, Hi Energy mechanical components, and Hi Stress Loading when working on Control Valves.

A. Components/Function

1. Valve - controls fluid flow through piping

   a. Body
   b. Bonnet
   c. Stem
   d. Plug
   e. Seat

2. Actuator – controls mechanism for moving the valve stem

   a. Stem

   Prevent Events: Hi Stress Loading, possible / pinch point, missile hazard. - Actuator stem connected, with coupling device, to valve stem. Exercise extreme causing whenever uncoupling Actuator stem from valve stem.

   b. Diaphragm
   c. Diaphragm case
d. Tensioning spring

Prevent Events: Hi Energy mechanical components. — pinch point, missile hazard. Exercise extreme causing whenever working around or with Tensioning Spring.

3. Positioner

Ask why we use positioners and where we need them. Where do we not need them?

a. Receives a low volume position signal from an I2P or other source

1. Delivers a high volume pneumatic signal to the actuator

b. Receives a position feedback signals from the valve stem
Main Idea

II. Types of Valves

A. Globe Valve TP02
   1. Throttling or fine flow control
   2. High Head Loss

B. Gate Valve TP03
   1. Poor throttling, almost full flow for small opening
   2. Lower head loss, turbulence from sharp edges

C. Plug Valve TP04
   1. Isolation or flow control
   2. Similar to ball valve 90° for full open

D. Check Valve TP05
   1. Limits flow to one direction
   2. Variations include lift check, ball check, swing check, articulated swing check

E. Needle Valve - Very fine flow control for small amounts of fluid TP06

F. Ball Valve TP07
   1. Used for isolation
   2. Not used for throttling
   3. Open/Close in 1/4 turn
   4. Relatively low head loss

G. Butterfly Valve TP08
1. Usually Isolation
2. Flat Disc connected to shaft
3. Disc is in center of flow path when open
4. Throttling creates impingement forces on the disc

**Prevent Events: Use Operating Events**

*Discuss Event in Unit 1:*
Valve in circ water discharge from condenser. Approx. 10 ft. Diameter valve. Flow caused oscillation of disc which caused key way to shear. The valve slammed shut causing a pressure excursion which burst circ water piping in the turbine building and damage to condenser tubes

III. Diaphragm Operated Actuator

A. Air is applied to a surface area of several hundred in²
B. Air opposes and overcomes spring pressure
EO: 1.4  Determine the failure position of a pneumatic valve

Main Idea

C. Determining Fail Position

1. Which way does the stem need to move to seat valve

2. Is Air admitted to top or bottom of actuator
EO: 1.5  Describe the theory of operation of valve positioners

Main Idea

IV. Valve Positioners: Fisher model 3582 Valve Positioner, the most common valve positioner on site

A. Principles of operation

1. Feed back from valve actuator comes in via positioner linkage and cam

2. Cam acts as both balancing input and beam pivot

3. Tension wire pivot is opposite end of effective lever

4. Movement appears in two planes 90 degrees apart

5. Gain is adjusted by varying angle of flapper on floating lever - changes degree of effect of each link on floating beam

6. Use opposite quadrant to change to reverse acting

B. Operation for increase in input pressure

1. Input bellows lifts input pressure

2. Flapper moves closer to nozzle

3. Relay output pressure rises

Optional Methods & Activities:

Prevent Events: Hazard Assessment – Beware of Potential of Injury from Pinch points, Hi Energy mechanical components, and Hi Stress Loading when working on Control Valves and Positioners

PPT slides on valve positioners

Note the many new digital or Milliamp input positioners we are getting.

The positioner takes a direct 4-20 ma input and outputs a valve position. No separate I2P is needed as the I2P is built into the positioner.
4. Actuator moves

5. Position feeds back to reposition cam to lower cam height

6. Baffle moves out slightly to new equilibrium - system balanced

7. Make zero adjustment by varying nozzle clearance and span adjustment by varying position of pivot on D-ring

Potential Problems: D-ring jumps off pivot points, cam and roller get worn spots or even get cut through on valves in high vibration environments or on poorly adjusted control loops.
For a valve having red and green position indicators, explain the operation of the position indicators including the appropriate limit switch contact arrangement

Main Idea

V. Valve Limit Switches – provide remote indication of valve position

A. Indications
   1. Red light – valve open
   2. Green light – valve shut
   3. Both lights – valve intermediate

B. Operation
   1. Generally two switches per valve
   2. Open switch
      a. Closed from the time the valve leaves the open seat until approximately 90% or 95% open
      b. Power being supplied to the green light during this valve stroke
   3. Closed switch
      a. Closed from the time the valve is approximately 5% or 10% open
      b. Power being supplied to the red light during this valve stroke
   4. Intermediate position
      a. Between 5% and 95%, or 10% and 90%
      b. Power being supplied to both lights

VI. Stroking Valves
A. Benchset - Pressure needed to fully stroke the valve without process pressure

B. Valve Stroke - Distance stem travels full open to full close

C. Positive Seat - Firm contact between seat and disc

VII. Industry Events

Prevent Events: Use Operating Experiences – Read SOER’s 85-2 & 85-3

A. SOER 85-2 Valve Mispositioning Events Handout

B. SOER 85-3 Excessive Personnel Radiation Exposures Handout
EO: 1.7 Calibrate the control valve to include the following:

   a. Bench set
   b. Valve stroke
   c. Valve seating
   d. Limit switches
   e. Positioner

Main Idea

Using Laboratory Practical Exercise’s NIA97L001811, NIA97L001911 and NIA97L002011, calibrate a control valve to include bench set, valve positioner and limit switches.

Observe the precautions and general conditions on the LPE.

During initial instructor lab demonstration and pre job brief PPE is not required as long as there are no actual safety hazards. During training, practice and evaluations simulating work in the field, personal protective equipment and electrical protective equipment are required in designated areas of the lab. PPE may be required in non-designated areas as deemed necessary by the instructor.

All requirements of the LPE must be met to satisfy this objective.
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.