PALO VERDE
NUCLEAR GENERATING STATION

Valve Services
Rotork Actuator PM Inspection
Classroom Lesson

Valve Services	**Date: 8/9/2010 1:02:53 PM**
LP Number: NMV08C000102	**Rev Author: FRED ANGENEY**
Title: Rotork Actuator PM Inspection	**Technical Review:** Feria, David J (Z35199) Digitally signed by Feria, David J (Z35199) DN: cn=Feria, David J(Z35199) Date: 2010.08.10 13:40:30 -07'00'
Duration : 30 HOURS	**Teaching Approval:** Steinmetz, Tim P(Z99348) Digitally signed by Steinmetz, Tim P(Z99348) DN: cn=Steinmetz, Tim P(Z99348) Reason: I am approving this document Date: 2010.08.10 14:04:59 -07'00'

INITIATING DOCUMENTS

Maint. TPD

VS 1000 Perform I & T (Rotork)

VS 1001 Troubleshoot Rotork MOV Actuator

REQUIRED TOPICS

None

CONTENT REFERENCES

13-J-ZZI-004 Control Motor Operator Data Base

32MT-9ZZ49 PM Inspection of Rotork Valve Motor Operators

01DP-0IS13 Electrical Safety Work Practices

LESSON PLAN REVISION DATA

Aug 09, 2010	Fred Angeney	1. Made minor changes to line up with current revision of 32MT-9ZZ49. 2. Updated Pre-Job Brief & Two Minute Drill to match changes to Standards and Expectations. 3. Added a new performance objective which replaced the old LPE. 4. Added OE FW102 failure to stroke in Unit 3. 5. Updated the method of setting the closed limit switch to match lessons learned in continuing training per CRAI 3381651.

Tasks and Topics Covered

The following tasks are covered in Rotork Actuator PM Inspection :

Task or Topic Number*	Task Statement
Lesson:	Rotork Actuator PM Inspection
VS 1000	Perform I & T (Rotork)
VS 1001	Troubleshoot Rotork MOV Actuator

Total task or topics: 2

TERMINAL OBJECTIVE:

1 When presented with training aids and classroom instruction the Maintenance Technician will , demonstrate their knowledge of P.M. inspections on Rotork actuators as demonstrated by scoring 80% or more on a written examination.

1.1 Discuss Pre-Job Brief & Two Minute Drill

1.2 Discuss Electrical Safety

1.3 Identify the external components of Rotork actuators.

1.4 Identify the components contained in the limit switch compartment and identify the components that make up the limit switch assembly of Rotork actuators.

1.5 Identify the differences between the A-range limit switches and NA or nuclear grade limit switches, and where they are used.

1.6 Given a Rotork drawing of actuator sizes from 5-AB through 13-A, identify the components and state the principles of operation

1.7 Given Rotork drawings of actuator sizes from 13-A, through 95-A, explain the differences between the different actuators

1.8 Describe the visual inspection of the actuator

1.9 Describe the inspection criteria for the termination compartment and describe common problems found.

1.10 Describe the main gear box lubrication inspection criteria. Explain the shop expectation of taking an oil sample.

1.11 Describe the inspection criteria for limit switch/torque switch compartment.

1.12 Describe the difference between rising non-rotating and rising rotating stems, proper cleaning and lubrication.

1.13 Identify the components of a simple electrical elementary drawing. Explain how and where to install a jumper and a temporary local control switch.

1.14 Identify what document is used to find limit switch set points and identify as found limit switch settings.

1.15 Describe limit switch adjustment on Rotork actuators in conjunction with ZZI-004 and the contact development chart on the electrical elementary.

1.16 Describe how to adjust local and remote indication

1.17 Adjust Limit Switches per Instructor's Set Points

TO: 1	**When presented with training aids and classroom instruction the Maintenance Technician will , demonstrate their knowledge of P.M. inspections on Rotork actuators as demonstrated by scoring 80% or more on a written examination.**

EO: 1.1 Discuss Pre-Job Brief & Two Minute Drill

Main Idea

METHODS & ACTIVITIES

CONTENT

1) **Pre-Job Briefs & Two Minute Drills**
   a) Use the graded approach in Standards & Expectations.
   b) At a minimum we always focus on five.
   - Identify critical steps.
   - Identify error likely situations.
   - Identify the worst thing(s) that can happen.
   - Identify specific error prevention defenses to be used.
   - Identify actions to assure proper configuration control.
2) **Key Points to Consider**
   - Are your qualifications up to date?
   - Be sure you are signed onto the permit and verify the boundaries are adequate.
   - Ensure all persons working with you are signed onto Appendix C.
   - Complete FME form and discuss how you plan to maintain proper FME.
   - Are there confined space concerns associated with the job?
   - What are the radiation protection considerations?
   - Radiation Protection now requires you to know dose rates and contamination levels of the area you plan to work in prior to checking in with them.

METHODS & ACTIVITIES

CONTENT

3) Two Minute Drill

- **Why?**
- Acquaint workers with the immediate work area.
- Locate, identify Safety Equipment i.e., eyewash stations, fire extinguishers, etc.
- Identify and address unexpected conditions.
- Identify and address hazards in the immediate area.
- Enhance worker's situational awareness.
- Ensure right unit, right train, right component, etc.
- Ensure conditions are consistent with procedure/work instructions and pre-job brief.
-
- **When?**
- Upon arriving at the physical work location.
- After extended breaks or work interruptions.
-
- **How?**
- Explore the job site by walking and looking around the work area and surrounding areas to identify:
- Industrial safety, radiological, and / or environmental hazards
- Trip – sensitive equipment.
- Critical parameters or indicators.
- **Additional error precursors.**
- Talk with coworkers or your leader about unexpected hazards or conditions and the precautions to take.
- Eliminate hazards, install appropriate defenses (including physical barriers), or develop contingencies before proceeding with the task.
-

EO: 1.2 Discuss Electrical Safety

Main Idea

CONTENT

1) Prior to accepting a permit you must verify that it covers all aspects of the task you are performing. It is your responsibility to ensure that the proper boundaries are established before you sign onto the permit.

2) Using your electrical drawing identify all power sources affecting your valve. These power sources can be for indication, both lights and VPI. It can be 120VAC or 130VDC. It can be low voltage 48VDC for ERFDADS or other computer points. It can also be an interlock to start a fan, pump or even an other valve. This power will come from separate power sources and not the feeder breaker for your valve.

3) Power for computer points can not be isolated. Use care when working with these wires and always tape them up when determed. If they short to ground the Control Room can get an alarm.

4) At times during the testing on Rotork valves it will be necessary to work with energized wires. Extreme caution should be used. Your safety will be better protected if you know and understand the control logic. This will help identify what part of the circuits that may be energized and when they are not. When the breaker is energized, control power will be present in the limit switch compartment and the termination compartment. 480 volts will only be in the termination compartment when the motor is energized.

METHODS & ACTIVITIES

CONTENT

METHODS & ACTIVITIES

5) Conduct a two minute drill using Standards & Expectations.
   a) Reference: 01DP-OIS13 PVNGS Electrical Safe Work Practices. Know what PPE/EPE is required prior to opening the cabinet of the MCC.
6) Contact OPS to obtain permission to De-energize the breaker for this actuator and hang your SOD tag.
7) Open the breaker using a 4 foot extension breaker manipulation tool, or proper PPE/EPE, Hearing Protection, Arc Flash Shield, VR Gloves, and FR Coveralls.
8) All electrical equipment and circuits 50 volts or greater shall be considered energized at full voltage potential until tested (Live-Dead-Live) or otherwise determined to be de-energized.
9) Live-Dead-Live voltage checks shall be performed prior to starting work, each instance (e.g. start of shift, after breaks, after lunch), or as needed to maintain positive control.
10) Live-Dead-Live voltage checks shall be performed whenever changes to the isolation boundaries (permit) are made which reduces protection (e.g. permit tag (s) removed, closing a breaker or disconnect, etc…..). Always utilize the latest revision of design output documents to identify potential sources of electrical energy.
11) Live-Dead-Live verification testing shall not be performed using a multimeter in the “auto-range” mode on AC/DC voltages, instead set to the range of the voltage expected on the circuit which work is to be performed and verified against a known energy source. Set meter on maximum voltage expected.
12) The Live-Dead-Live check shall be used to test each and every exposed electrical conductor or circuit part within the restricted approach boundary, AC and DC.

EO: 1.3 Identify the external components of Rotork actuators.

Main Idea

A. 5-AB Through 13-A

1. Main housing and name plate
   a) Name plate data.
   b) Serial number.
   c) Actuator size.
   d) Enclosure WP,EP,FLP,WT.
   e) Wiring diagram number.
   f) Output speed.
   g) Lubrication type. SAE-80-EP Is stamped into the nameplate.
      (1) At Palo Verde, We generally use Shell Omala-150 in all Rotork actuators. However this must be verified by the Lube Screen in SWMS.
   h) Motor rating.
   i) Motor supply- 460-3-60
2. From the nameplate we get the information that we need to order new parts or to identify which tech manual to use. We can also use motor information when troubleshooting.

Direct student's attention to the location of the Actuator nameplate location and information contained on it.

3. Handwheel assembly and valve stem protector.
    a) The smaller actuators only have top mounted hand wheels. Side mounted optional hand wheels start at 14-A size and above.
4. Limit switch compartment cover.
    a) Contains the local position indication.
5. Hand auto lever.
6. Termination compartment.
7. 5-AB actuators have a rectangular shaped termination compartment. The larger sizes have round compartments more commonly called Bungs.
8. Motor housing.
9. Pipe plugs.

EO: 1.4 Identify the components contained in the limit switch compartment and identify the components that make up the limit switch assembly of Rotork actuators.

Main Idea

A. Switch mechanism

1. Open and close limit/torque switches.

a) Rotork has a unique set of switches, because they can be set to torque or limit in either direction. The dials for selecting torque or limit are just behind the front plate.

b) The switches have two options, normally open and normally closed. These switches are rotors 1 and 2.

2. Add on pack.

a) Adds two more sets of switches which are used for open torque switch bypass, alarms and indication. These switches are identified as AS1, AS2 and AS3 for rotor 3 and AS4, AS5 and AS6 for rotor 4.

b) These switches are driven by a set of gears and spacers; which can be made from metal or plastic. The number of gears and spacers match the valve stroke length.

c) A variable resistor (pot) geared to the add-on pack controls remote indication. The resistor (pot) is connected to a voltmeter in the control room. This meter operates on 0 to 10 volts, which equates to 0 to 100 percent valve stroke.

3. Space heater, to eliminate moisture from the compartment.

4. Local Position Indication.

c) An arm assembly located on the back end of the add-on pack controls local indication. This arm connects with the indicator inside of the limit switch compartment cover.

EO: 1.5 Identify the differences between the A-range limit switches and NA or nuclear grade limit switches, and where they are used.

Main Idea

A. NA- range actuators are environmentally qualified. The difference in actuators is easily spotted. NA actuators are white with a heavy duty limit switch compartment cover, verses the gray A-range actuators with a light weight limit switch compartment cover.

1. The limit switches are somewhat different.

a) The NA torque adjustment front plate is brown fibrite plastic and the adjustment knobs are brass.

b) The A-range torque adjustment front plate is blue plastic and the adjustment knobs are red and green plastics.

c) The NA-range limit switch inner traveler is anchored to over travel arm. The A-range inner traveler has a grove to fit the over travel arm.

d) The NA open switch stop nut is larger than the A-range and the NA uses two stop nuts on the limit shaft to set the close switches. The A-range uses a single spanner clutch nut/Colette arrangement.

e) The vendor wiring insulation on NA-range actuators is composed of braided insulation over regular insulation, verses no braided insulation on A-range actuators.

EO: 1.6 Given a Rotork drawing of actuator sizes from 5-AB through 13-A, identify the components and state the principles of operation

Main Idea

A. Components.

1. Main housing or gear case (1).
2. Limit switch worm (2).
3. Center column (3).
4. Pipe plugs (8).
5. Hand/auto lever (9).
6. Lever return, spring (11).
7. Hand/auto jack (12).
8. Hand/auto lever stop (13).
9. Spring finger (14).
10. Torque plunger (23).
11. Limit switch wheel (26).
12. Clutch ring (28).
13. Clutch keys (29).
14. Clutch spring (30).
15. Plastic bung (33). (retaining pin thread protector)
16. Type A drive, bushing retainer (37).
17. Drive bushing (39).
18. Wormwheel (56).
19. Motor.
20. Belleville Washers.

21. Torque Switch.
22. Handwheel.
23. Finger Stud.
24. Allen Cap Screws/Handwheel.

B. Principles of operation.

1. Motor operation.

a) The motor is energized rotating the rotor and wormshaft. The worm meshes with the wormwheel.

b) The lugs of the wormwheel engage with the clutch keys. The clutch keys are held into keyways in the center column by the clutch ring. Pressure from the clutch spring hold the keys in contact with the lugs, thus rotating the center column.

c) The drive bushing is threaded to match the threads of the valve stem. It also has groves machined into it to mate with the lugs on the bottom of the center column. It is held into the center column by a retainer, threaded to the bottom of the center column. As the drive bushing is rotated the valve stem is threaded up and down the bushing to open or close the valve.

d) At the end of the open stroke the limit switches break the electrical connection to the motor and it stops. At the end of the close stroke the valve is driven into the seat and the center column stops. The motor continues to run and the wormshaft starts to walk off the worm. This compresses the Belleville washers in the end of the motor and drives the torque plunger into the torque switch, breaking the electrical connection to the motor.

2. Manual operation.

a) The hand/auto lever is depressed rotating the hand/auto jack upward against the clutch ring, compressing the clutch spring and forcing the clutch keys up toward the hand wheel. The keys disengage from the wormwheel and engage with the Allen cap screws on the hand wheel. The finger stud of the hand/auto jack rest on the wormwheel holding the actuator into manual operation.

b) Motor overrides manual operation.

The motor is energized and the wormwheel starts to rotate, kicking the finger stud off the wormwheel. The clutch spring forces the clutch ring and keys down to contact the lugs of the wormwheel and the valve is stroked electrically.

EO: 1.7 Given Rotork drawings of actuator sizes from 13-A, through 95-A, explain the differences between the different actuators

Main Idea

A. The larger size actuators from 14-A and above have the option of a worm driven side mounted hand wheel.

B. They have a thrust base and the lower thrust bearing which is much heavier.

C. The worm wheel has drive pins to replace the lugs on small actuators and the worm wheel is held in place by a thrust pad.

1. The hand/auto jack that are on the small actuators is replaced with a hand/auto cam and yoke assembly.

EO: 1.8 Describe the visual inspection of the actuator

Main Idea

1) Verify you are on the correct valve for your work order and record the position of the valve. Ops may want you to return the valve to the as found position after testing.

2) At any time during your inspection you find any thing that does not meet inspection criteria, contact your team leader. It is usually a good idea to complete the inspection if possible because there may be multiple problems that need attention.

3) Visually inspect the following;
   a) External grease/oil leaks.
   b) Cracks or other damage to the actuator housing.
   c) Fasteners in place and tight.
   d) No obvious distortion of actuator, yoke or stem.
   e) Actuator position aligned with the stem and packing.
   f) T-drains present, if required, and unobstructed.
   g) Grease relief acceptable, if required.
   h) Packing gland area and gland bolts.
   i) Inspect anti-rotation devise for damage, wear or looseness.

EO: 1.9 **Describe the inspection criteria for the termination compartment and describe common problems found.**

Main Idea

CONTENT

METHODS & ACTIVITIES

1) Inspect the terminal cover o-ring for damage, replace if damaged or deformed.

2) Inspect for presence of oil, moisture and cleanliness of the compartment. If needed clean the interior of the compartment.
   a) A major problem with Rotork actuators is o-ring and seal leakage. Due to the actuator orientation, oil may show up in the termination compartment from leakage from other locations of the actuator.
3) Inspect vendor and field wiring for brittle/cracking or damaged insulation and terminal integrity.

   a) If any rework of electrical components is required, perform applicable section(s) of Appendix G – Cable Repair / Rework of 32MT-9ZZ49.
   b) A common problem found is bad crimping of the lugs. The barrel not being crimped around the insulation properly exposing the conductor.
   c) Another problem is lugs being bent greater than 60 degrees. Per 13-EN-306 no lug shall be bent at an angle greater than 60 degrees and no more than two terminations can be made at any single point.
   d) If insulation is damaged and exposes the conductor it must be replaced or repaired. If insulation is damaged not showing conductor it is still a good work practice to Heat Shrink IAW procedure over the damage.
   e) Verify all terminations are secure. In most cases barrel nuts are used and are difficult to get tight. Inspect the terminal bung for broken arc barriers.

This course will not qualify to install Heat Shrink. You must have Small Terminations.

EO: 1.10 Describe the main gear box lubrication inspection criteria. Explain the shop expectation of taking an oil sample.

Main Idea

METHODS & ACTIVITIES

CONTENT

1) Inspect the oil level. Level should no more than one inch below the bottom of the fill hole. This allows for expansion of the oil in hot conditions.
2) Take a sample of oil as low as possible in the case. Only 2 or 3 ounces are required. If the oil level is too low to get a sample with the pump, remove a lower plug and get a sample.

    a) Be sure to label the sample bottle with the proper cup sticker. Cup sticker samples are in the shop.
    b) Perform initial examination observing for the following conditions.
    c) Wear metal (Metal filings or particles)
    d) Unusual color
    e) Visible dirt or other particles
    f) Signs of emulsification(milky or cloudy appearance)
    g) Pungent or burnt odor
3) If the sample shows signs of being bad contact your Team Leader.
4) Samples from QR / QAG actuators shall be sent to the lubrication lab for analysis.
5) After sample is taken the oil level is low then add approved lubricant to the proper level. Refer to SWMW CPXCOMP lube points.

EO: 1.11 Describe the inspection criteria for limit switch/torque switch compartment.

Main Idea

CONTENT

METHODS & ACTIVITIES

1) Remove the limit switch cover and inspect the o-ring, replace if needed.

2) Inspect for the presents of oil, moisture and cleanliness.

3) Inspect vendor wiring for insulation damage and terminal integrity.
   a) The space heaters on Rotork actuators have caused damage to vendor wire insulation.
   b) The cover can pinch the insulation during reinstallation, be sure the wires are properly trained to avoid damage.
   c) The fast-on connectors can be improperly installed with the insulation holding the connector next to the spade, making the electrical connection. It might be necessary to pull gently on the connection to verify proper installation.
4) Inspect the switches for damage.
   a) Individual switched are connected together into groups of three. The switch block is mounted to the assembly with spring tension holding studs into sockets, some times the blocks become loose.
   b) Inspect the switches for cracks around the area where the terminal comes out or the switch.
5) Inspect the Limit/Torque components for damage.
   a) Inspect mounting hardware for looseness.
   b) Inspect the gear clusters for the add-on-pack, they are plastic on non class and metal on QR/QAG.

CONTENT

METHODS & ACTIVITIES

6) Inspect the torque switch settings. Record the open and closed settings. Rotork actuators can be set up to operate on limit or torque. At Palo Verde Rotork Actuators are set to Torque Closed & Limit Open.
   a) The open torque switch should not be set on BOOST, this eliminates open torque protection. If you find the open set on BOOST contact your Team Leader.
   b) Take care to read the setting accurately the minimum setting on both open and closed is located inboard and work to the maximum setting outboard.

7) FW 102 failed to stroke in Unit 3

   a) On 4/7/2009 OPS contacted Valve Services and asked for assistance because 3JFWNHV0102 failed to completely close.
   b) A Valve Services Technician went to the control room and had a brief with OPS.
   c) The Board Operator attempted to close the valve using the hand switch. The board showed dual indication.
   d) The Technician went to the valve and found **THE ACTUATOR HAD BROKEN OFF THE MG SET AND WAS HANGING BY THE FLEXABLE CONDUENT AND GROUNDING WIRE.**
   e) A plan was established to secure the actuator. The actuator was de-terminated and removed and transported to Valve Services Shop for troubleshooting.
   f) During troubleshooting we found that the latch that keeps the torque switch form relaxing had come loose and had moved out of position to the point that is kept the flapper form making contact with the closed switches.
   g) This would keep the red light form going out giving dual indication. The latch would not hold the torque switch close allowing it to relax after torquing out.

CONTENT

METHODS & ACTIVITIES

h) When the operator tried to close the valve from the control room the valve did close however the light indication did not change and the torque switch relaxed.
i) When he tried to close the valve repeatedly the motor would apply more torque with each manipulation of the switch.
j) This created excessive thrust to the valve forcing the stem nut within the MG set upward breaking the cast iron casing allowing the actuator for fall.

This is a great example on the importance of a good PM inspection of the Limit/Torque Assembly.

EO: 1.12 Describe the difference between rising non-rotating and rising rotating stems, proper cleaning and lubrication.

Main Idea

CONTENT

1) Rising non-rotating stems. The drive bushing (stem nut) has machined lugs that fit into the center column (drive sleeve). The bushing is held in place by a retainer that threads onto the bottom of the center column. The bushing is threaded internally to match the external threads of the stem. As the actuator rotates the center column and drive bushing, the stem is threaded up and down the drive bushing to open or close the valve.
2) Rising rotating stems. The stem nut is not threaded to the stem it is bolted to the stem and splined to the I.D. of the center column. The stem is threaded to the valve yoke. The stem nut rotates with the center column; this rotates the stem, threading it up and down the threads in the yoke.
3) **QR or QAG Rotork may require LLRT and diagnostic testing. This work should be performed prior to PM Testing. Verify as found testing has been performed prior to cleaning and lubricating the stem.**
4) Inspect the stem for any unusual particles, such as dirt or metal. Inspect the threads for burrs or other damage. If any UNSAT condition is found, contact Team Leader.
5) Clean the threads of all-old grease and dirt using alcohol and rags and apply approved lubricant (refer SWMS CPXCOMP lube points).
6) Cycle the valve and clean any excess grease from the stem.
7) For rising rotation stem valves be sure to grease the inside of the center column (drive sleeve) where the stem nut splines ride up and down.

METHODS & ACTIVITIES

EO: 1.13 Identify the components of a simple electrical elementary drawing. Explain how and where to install a jumper and a temporary local control switch.

Main Idea

CONTENT

METHODS & ACTIVITIES

1) We have two types of electrical drawings to work from at Palo Verde

   a) Most commonly used to perform a PM inspections is the “B”. It contains most of the information needed, however it may not contain all sources of power going to the valve actuator.

   b) The “F” drawing contains more detailed information. It will show every contact point from the MCC to the actuator. All interlocks and sources of power.

   c) “F” drawing are good for locating termination points when determing wires and troubleshooting

2) Review an electrical elementary diagram (01-E-CDB-014)

   a) Breaker, Transformer, Reversing Contacts, Heaters, and Motor

   b) Fuse and Ground

   c) Open Control Circuit
      i) CS-1 Control Room Switch Open
      ii) OT/LS 24 & 25
      iii) Open Bypass 1AS4 21 &22
      iv) Close Interlock
      v) Open Relay
      vi) Thermal Overload Contact

Have Students locate the “B” & “F” on their drawings.

Prior to using any plant document the current revision must be verified

CONTENT

METHODS & ACTIVITIES

d) Close Control Circuit
   i) CS-1 Control Room Switch Closed
   ii) CT/LS 26 & 27
   iii) Open Interlock
   iv) Close Relay

e) Indication
   i) Red Light at the breaker and control room.
   ii) Resistors
   iii) CAS2 8 & 9

f) Heater
   i) Space heater in the actuator

g) Position Indication
   i) Resistor at the breaker
   ii) Potentiometer
   iii) Fine tuning resistor at the breaker
   iv) Volt meter in the control room

h) Spare Contacts

i) Contact Development Chart

j) Aux Contacts

k) Cable Scheme

l) Notes

CONTENT

METHODS & ACTIVITIES

3) Explain proper use of a determ/reterm sheet and why they are used.

   a) Be legible, you may not be the person doing the reterm.

   b) Use common shop terms (BK=Black WH=White RD=red GR=Green OR=Orange BL=Blue WH/BK=White Black etc,,,,,,

   c) Complete signoffs (initials) promptly

   d) Verify wire termination points and second party verification prior to lifting any wires.

   e) Determ/reterm sheets are used to maintain plant configuration.

CONTENT

METHODS & ACTIVITIES

4) Explain when a jumper is required and where to install it and how to install a local control switch (deadman)

   a) When the space heater is not wired in the circuit and not being used, you must install a jumper in the MCC to feed control power to the valve so that a temporary control switch can be used to stroke the actuator during testing.

   b) Insure the breaker is open. From the print identify a power source (normal X1) and the open control wire going to the valve. These will be the two points that will be jumpered.

   c) You must secure the jumper to prevent accidental contact if the jumper was to come loose.

   d) **CAUTION!!!! Before closing breaker insure that the open and close control leads have been lifted at the valve.**

5) Knowledge of the wire color code used at Palo Verde is vital when lifting and landing any wires. Review the color code with the students.

   a) BK, WH, RD, GR, OR, BL, WH/BK, RD/BK, GR/BK, OR/BK, BL/BK then the colors are repeated with a White Tracer.

6) Not all termination points are identified on the bung. Extra care must be taken when lifting and landing leads. The termination I.D. chart is located on the inside cover of the termination compartment. Also the numbers are molded into the bung at the beginning and end or each row.

CONTENT

METHODS & ACTIVITIES

7) Explain how to install a temporary control switch (Deadman)

   a) A temporary control switch (Deadman) has three leads, a power lead, open lead, and closed lead.
   b) The power lead is connected to the heater circuit (in most cases point 5 on the Bung). If there is no heater in the circuit you connect to the wire you jumped to at the MCC (normally the open wire lifted form contact 25).
   c) The open lead is connected to the open contact 25.
   d) The closed lead is connected to the closed contact 27

8) When stroking the valve for the first time using a deadman, place the valve in mid position, bump the switch to verify you have it installed correctly.
9) While stroking the valve for the first time, monitor the open bypass to be sure it is set correctly. Watch the open limit, if the limit opens and the valve still strokes get off the deadman. It's a good idea to isolate the open bypass by determing the switch. Log the wire removed on a determ/reterm sheet.
10) It's a good practice to bump the actuator into the seat and verify the torque switch stops the motor. Them full open to verify the open limit.

Mid position means room to bump the MOV without coming in contact with the seat or back seat.

Perform a torque switch functional test first

EO: 1.14 Identify what document is used to find limit switch set points and identify as found limit switch settings.

Main Idea

CONTENT

1) 1,2 or 3-JZZI-004 is the controlled document that we use to get our rotor set points.

   a) It gives the as found and as left set points.

   b) It contains information about the set points, operator set up and rotor configuration in the form of notes.

   c) Insure that you use the as-found for the as-found and the as-left for the as-left. This has caused problems in the past were actuators had to have switches reset. The as found band is larger than the as-left to allow for a small amount of drift.

2) The contact development chart at the lower left hand corner of the elementary drawing give the configuration of the contacts from the close to open position. This is very important in that the rotors may be changing at the right time but the contacts are 180 out.
3) Limit switch settings are taken from the electrically close position to the full open position.

METHODS & ACTIVITIES

Prior to using any plant document verify the current revision using SWMS.

EO: 1.15 Describe limit switch adjustment on Rotork actuators in conjunction with ZZI-004 and the contact development chart on the electrical elementary.

Main Idea

METHODS & ACTIVITIES

CONTENT

1) Close limit switch adjustment. A range actuators. **(<u>These instructions are for a clockwise closing actuator, for counterclockwise closing actuator read open as close etc.)</u>**
   1. Place the valve in a position just off the seat. Break lock nuts 17&18 and run them down the shaft away from the actuator. Loosen clutch nut 22 about three turns.
   2. Turn the screwed shaft 15 CCW until the travel nut 16 comes in contact with the backstop 19. Pull the over-travel guide 20 against the overrun stop 21 while continuing to turn the screwed shaft 15 until it hits the backstop 19. Hold in place and tighten clutch nut 22
   3. Manually stroke the valve closed. The closed limit will slip as you close the valve. Open the valve and verify the limit changes state per the set point document.
2) Open limit switch adjustment.

   a) Open the valve to desired position per ZZI-004.

   b) Pull the overtravel guide 20 over CW till it comes hard against the stop 21. Hold it there and run the lock nut 17 down the threaded shaft until it comes hard against the traveling nut 16.
   c) Push the washer 24 down the threaded shaft to the lock nut 17. Run locknut 18 down to meet the washer and lock nut 18 and tighten them together.
   d) **CAUTION !!!! Hold back on lock nut 17 when tightening 18 to prevent shearing off the little pin on the lock nut.**

CONTENT

METHODS & ACTIVITIES

3) Limit Switch adjustment for NA Type Actuator

   a) Place the actuator in the manual operation and place the valve of the seat a couple turns.
   b) Loosen locknut (6) from stop nut (5) and unscrew both away from the inner traveler.
   c) Loosen the shaft locknuts (7) and (8) and pull the outer screwed spindle assembly (2) forward until the roll pin disengages with the end of the outer screwed spindle.
   d) While holding the over travel guide (9) hard against the stop(1)(counterclockwise), turn the outer screwed spindle (4) until the inner traveler (3) contacts the close stop
   e) Slip the screwed spindle assembly back into position on the switch shaft. Align the roll pin on the limit switch shaft with the closest slot on the outer screwed spindle assembly.
   f) **CAUTION - item 7 must not be tightened against the switch shaft. It must be positioned to just touch the shaft. If it is tightened against the shaft damage will occur when the valve is opened or closed. The two nuts 7&8 are to be jammed against each other to provide a locking effect.**
   g) Run nut (7) up against the switch shaft, do not tighten. Run nut (8) up to nut (7) and tighten the two nuts together.
   h) Manually stroke the valve closed. The closed limit will slip as you close the valve. Open the valve and verify the limit changes state per the set point document.

4) Open limit switch adjustment for NA type actuators.

   a) Open the valve to the specified setting from ZZI-004. Hold the over travel guide (9) in the clockwise position hard against the open Stop.
   b) Run stop nut (5) down the outer screw spindle until it contacts the inner traveler (3). While holding the stop nut (5) engaged with the inner traveler tighten the lock nut (6) to the stop nut (5). The over travel guide (9) should stay in the fully open position.

CONTENT

METHODS & ACTIVITIES

c) Stroke the valve close then open and verily correct operation of the open contacts. Use a continuity tester as needed to prove out the contacts.

5) Auxiliary switch adjustment (Add-on pack).

a) Always ensure the local position indication is set prior to adjusting the add-on pack. Because adjusting the indication after adjusting the add-on pack will throw the add-on pack off.

b) You must know the direction of rotation of the cams when the valve is going open.

c) Open the valve to the desired actuation point per ZZI-004. Loosen the cam shaft nut and rotate the cam to set rotor 3 to actuate and tighten the cam shaft nut.

d) You must use a meter to check continuity of the switches along with the contact development chart on the electrical elementary. **CAUTION MUST BE TAKEN TO ENSURE THE SWITCHES ARE NOT MAKING WHEN THEY SHOULD BE BREAKING.**

e) Rotor 4 is set in the same way. The cam shaft nut holds both cams in place, so after setting rotor 4 you must check rotor 3 again.

f) **CAUTION !!!!! DO NOT OVER TIGHTEN THE CAN SHAFT NUT, IT HAS A TORQUE VALUE OF 10 INCH POUNDS.**

EO: 1.16 Describe how to adjust local and remote indication

Main Idea

METHODS & ACTIVITIES

CONTENT

1) Local Indication

2) LOCAL INDICATION MUST BE ADJUSTED PRIOR TO ADJUSTING ROTORS THREE AND FOUR.
3) With the valve completely closed verify the inside arm closest to the actuator is hard against the upper stop, if not loosen the cam shaft nut and make proper adjustment.
4) Loosen the scale adjustment screw and fully open the valve to the open limit switch setting. Adjust the second slotted arm out from the actuator so the bottom of the arm is just off the bottom stop, no more than 1/6” gap. Install the cover and verify the indication tracks properly.
5) Remote indication

6) Fully open the valve. Note the indicator pin on the local position indication arm at the end of the add-on pack. Note the number it lines up with 1 through 4.
7) Loosen the potentiometer and place it in mid travel. Mesh the gear that corresponds with the number the pin is on. The smallest gear being 1 and the largest 4. Tighten the potentiometer and fully close the valve. When the valve goes closed the potentiometer will zero itself.

EO: 1.17 Adjust Limit Switches per Instructor's Set Points

Main Idea

METHODS & ACTIVITIES

CONTENT

1) This student activity shall be preformed in pairs of two. Each student shall adjust the open and closed limit switches for both A-range and NA-range type limit switches. The add on pack for the torque switch bypass shall also be set. This activity replaces the lab practical evaluation from the past.
2) Close limit switch adjustment. A range actuators. **(<u>These instructions are for a clockwise closing actuator, for counterclockwise closing actuator read open as close etc.)</u>**
    4. Place the valve in a position just off the seat. Break lock nuts 17&18 and run them down the shaft away from the actuator. Loosen clutch nut 22 about three turns.
    5. Turn the screwed shaft 15 CCW until the travel nut 16 comes in contact with the backstop 19. Pull the over-travel guide 20 against the overrun stop 21 while continuing to turn the screwed shaft 15 until it hits the backstop 19. Hold in place and tighten clutch nut 22
    6. Manually stroke the valve closed. The closed limit will slip as you close the valve. Open the valve and verify the limit changes state per the set point document.
3) Open limit switch adjustment.

    a) Open the valve to desired position per ZZI-004.

    b) Pull the overtravel guide 20 over CW till it comes hard against the stop 21. Hold it there and run the lock nut 17 down the threaded shaft until it comes hard against the traveling nut 16.
    c) Push the washer 24 down the threaded shaft to the lock nut 17. Run locknut 18 down to meet the washer and lock nut 18 and tighten them together.

CONTENT

METHODS & ACTIVITIES

d) **CAUTION !!!! Hold back on lock nut 17 when tightening 18 to prevent shearing off the little pin on the lock nut.**

4) Limit Switch adjustment for NA Type Actuator

a) Place the actuator in the manual operation and place the valve of the seat a couple turns.
b) Loosen locknut (6) from stop nut (5) and unscrew both away from the inner traveler.
c) Loosen the shaft locknuts (7) and (8) and pull the outer screwed spindle assembly (2) forward until the roll pin disengages with the end of the outer screwed spindle.
d) While holding the over travel guide (9) hard against the stop(1)(counterclockwise), turn the outer screwed spindle (4) until the inner traveler (3) contacts the close stop
e) Slip the screwed spindle assembly back into position on the switch shaft. Align the roll pin on the limit switch shaft with the closest slot on the outer screwed spindle assembly.
f) **CAUTION - item 7 must not be tightened against the switch shaft. It must be positioned to just touch the shaft. If it is tightened against the shaft damage will occur when the valve is opened or closed. The two nuts 7&8 are to be jammed against each other to provide a locking effect.**
g) Run nut (7) up against the switch shaft, do not tighten. Run nut (8) up to nut (7) and tighten the two nuts together.
h) Manually stroke the valve closed. The closed limit will slip as you close the valve. Open the valve and verify the limit changes state per the set point document.

5) Open limit switch adjustment for NA type actuators.

a) Open the valve to the specified setting from ZZI-004. Hold the over travel guide (9) in the clockwise position hard against the open Stop.

CONTENT

METHODS & ACTIVITIES

b) Run stop nut (5) down the outer screw spindle until it contacts the inner traveler (3). While holding the stop nut (5) engaged with the inner traveler tighten the lock nut (6) to the stop nut (5). The over travel guide (9) should stay in the fully open position.

c) Stroke the valve close then open and verily correct operation of the open contacts. Use a continuity tester as needed to prove out the contacts.

6) Auxiliary switch adjustment (Add-on pack).

a) Always ensure the local position indication is set prior to adjusting the add-on pack. Because adjusting the indication after adjusting the add-on pack will throw the add-on pack off.

b) You must know the direction of rotation of the cams when the valve is going open.

c) Open the valve to the desired actuation point per ZZI-004. Loosen the cam shaft nut and rotate the cam to set rotor 3 to actuate and tighten the cam shaft nut.

d) You must use a meter to check continuity of the switches along with the contact development chart on the electrical elementary. **CAUTION MUST BE TAKEN TO ENSURE THE SWITCHES ARE NOT MAKING WHEN THEY SHOULD BE BREAKING.**

e) Rotor 4 is set in the same way. The cam shaft nut holds both cams in place, so after setting rotor 4 you must check rotor 3 again.

f) **CAUTION !!!!! DO NOT OVER TIGHTEN THE CAN SHAFT NUT, IT HAS A TORQUE VALUE OF 10 INCH POUNDS.**

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.