

## STANDARD PROCEDURE INSTRUCTION

Title		SPI
<b>Guidelines for Handling of Nuclear Gauges</b>		<b>34-36</b>
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<b>Safety Health and Environment</b>	<b>April 15, 2009</b>	<b>May 12, 2011</b>

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# **Guidelines for Handling of Nuclear Gauges**

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# STANDARD PROCEDURE INSTRUCTION

## **PURPOSE:**

To provide direction for the handling of nuclear gauges including entry to a vessel on which a nuclear gauge is installed.

## **CONTEXT:**

Numerous locations across the Manitoba Operations utilize nuclear gauges within their processes. These nuclear gauges are well suited to the harsh applications in which they are applied. Although the gauges are well designed to allow normal operation of the radioactive source without harm to personnel in the area, exposure to ionizing radiation must be considered when working around a nuclear device.

## **PERSONNEL**

Canadian Nuclear Safety Commission (CNSC)

Canadian regulatory authority for nuclear material.

Radiation Safety Officer (RSO) or Designate

The Radiation Safety Officer role will be held by the Instrumentation Engineering Supervisor as approved by the CNSC and is the onsite person responsible for the fixed gauge radioisotope license and regulated activities.

Authorized Employee:

Person that has completed the course titled "Radiation Safety Training for Nuclear Gauges" within the past two years and is permitted to work on or handle nuclear gauges as documented by the RSO.

Environment and Health

E&H manages the dosimetry program. Handles new dosimeter requests and maintain records.

## **EQUIPMENT**

Personal Protective Equipment (safety glasses, work gloves, mask, etc.)

Personal Dosimeter

Radiation Survey Meter

## **LIMITS**

- Annual whole body ionizing radiation dose of 1 mSv (100 mrem).
- Radiation field is maximum 0.05 mSv/hr or 50 microSv/hr (5 mrem/hr) at 30 cm from the source head with the shutter closed
- Storage Area: maximum dose rate of 2.5 microSv/hr (0.25 mrem/hr) at any occupied location around the area.

## **ALARA POLICY**

Vale feels that the health risks associated with fixed nuclear devices can be mitigated with proper procedures and training. The procedures in this SPI will be readily available to all employees via the company intranet and should be sufficient to ensure that radiation exposure of the employees is kept as low as reasonably achievable. The Radiation Safety Officer will be responsible for ensuring that personnel are aware of lock-out and emergency procedures. Periodic training covering basic radiation safety, procedures, and regulatory conditions will be provided to workers when there is a sufficient change in personnel to warrant such a course. In addition to this the RSO, by fulfilling his responsibilities ensures that regulations and licence conditions i.e., (signage, inventory control, leak testing etc.) are complied with.

## **GENERAL RULES**

- The Substation Operator and Surface First Aid Attendant shall be provided with the names of the current RSO, alternate and Authorized Employees.
- All employees who perform Radiation Surveys will be in possession of and will use, a suitable personal dosimeter during the period of these duties.
- All employees who perform radiation surveys will be familiar with the location and use of a radiation survey meter.
- Vale is not authorized to perform maintenance on the source holder.
- Maintenance on the detector can only be performed if the source shutter is closed, locked and verified with a survey meter and recorded.
- All nuclear gauges shall be stored in the assigned area. Any exception to this practice must be approved by the RSO.
- All source holders are stamped with a radiation warning sign and isotope details. A separate sign or label containing these details must be posted on or near the device.
- All areas where gauges are in use or in storage shall be posted with a separate radiation sign including emergency contact details.
- Personal dosimeter records may be viewed by the employee on request.
- Vessel doors shall be locked in the closed position. The supervisor of the Authorized Employee(s) for the area shall keep the key.
- Only authorized employees as documented by the RSO or employees under the direct supervision of an authorized employee may install, mount or dismount a fixed nuclear gauge.
- Minimize exposure to ionizing radiation by limiting time spent handling or near source containers.
- Prior to installation, mounting or dismounting inspect the source holder and verify that the source holder shutter is in the off/closed position. The source holder shutter must remain in this position until the work is complete.
- During installation or dismount DO NOT place your hands on the shutter opening until you have verified shutter closure using a calibrated survey meter.
- Keep sources in the shielded (closed) position unless being used for testing purposes.
- DO NOT direct radiation beam towards another individual or into normal occupied areas during handling or moving.
- During installation whenever possible, gauges shall be mounted such that the radiation beam is pointing away from the direction of normal traffic.
- All areas where gauges are in use or in storage shall be posted with a 'handling' sign referring to this SPI.
- Vessel doors shall have a radiation warning sign posted directly on the door.



Radiation Warning Sign

Prior to Working On or Around this  
Nuclear Gauge See SPI 34-36

Radiation Handling Sign

### DOSIMETERS

To obtain personal dosimeter or information on dosimeter contact the Environment and Health Department, or RSO.

### RADIATION SAFETY REQUIREMENTS FOR INSTALLATION, DISMOUNT OR ENTRY TO A VESSEL ON WHICH A NUCLEAR GAUGE IS INSTALLED

- File a Nuclear Fixed Gauge Work Permit (attached) **prior** to commencing work on the device, with the RSO.
- Complete a NUCLEAR SOURCE SHUTTER CLOSURE VERIFICATION FORM (attached) during the work.
- Radiation measurements must be taken before and after closing the shutter.  
***Note: measurements must be taken in a location that indicates a significant drop in dose rate after closing the shutter. Often the only location where shutter closure can be verified is on the detector side.***
- Send a copy of the NUCLEAR SOURCE SHUTTER CLOSURE VERIFICATION FORM to the RSO.

## **GAUGE ISOLATION**

### *Ronan SA-1*

- Locate metal lever on top of source holder.
- Toggle metal lever so that it is perpendicular with the face of the source holder (parallel to the radiation beam).
- Insert personal lock (with personal key) through lever and eyehole on the source holder. Tag out with appropriate tag.

### *TN5201 and TN5202*

- Locate metal lever on the right side of source holder.
- Push metal lever away from the marked ON position.
- Insert personal lock (with personal key) through hole on the source holder to impede the movement of the lever. Tag out with appropriate tag.

### *Berthold LB7442*

- Locate metal lever on back (opposite to radiation beam) of source holder.
- Toggle metal lever so that the lever arrow points at the closed position.
- Lock out with manufacturer installed lock (only one key should be available and should be held by person doing the locking out).
- Tag out with the appropriate tag.

### *Ohmart SH-F1B*

- Locate metal lever on top of source holder.
- Toggle metal lever so that it is in the OFF position
- Insert personal lock (with personal key) through hole on the source holder to stop lever movement. Tag out with appropriate tag.

## **INSTALLATION, MOUNTING AND DISMOUNTING PROCEDURES**

### *Ronan SA-1, Ohmart SH-F1B, TN-Tech 5201 and 5202, Berthold LB7442*

- Pipe Installation
  - Move the detector into the desired measurement position. Hold the detector in this position using either temporary (hoist, ect) or permanent (bracket, ect) means.
  - Move the source holder into the desired measurement position ensuring that it will be installed so that the radiation beam is pointed away from normal traffic areas. Hold the source holder in position using temporary or permanent means.
  - Insert bolts through the four holes in the source holder and detector and secure to pipe. Tighten so as to not damage the pipe or pipe insulation.
  - Bracing and brackets must be put into place to support the weight of the source holder and detector. These supports must not be in the path of the radiation beam.
  - Remove any temporary bracing.
  - Complete detector wiring and calibration as per the specific detector manual.

- Vessel Installation
  - Move the detector into the desired measurement position. Hold the detector in this position using permanent bracing. The detector must be as close to the vessel as possible while in a position where the detector will not move in relation to the vessel or source.
  - Source holder and detector should be aligned along a chord of the vessel (not the diameter) to allow for proper measurement.
  - Move source holder into the desired measurement position ensuring that it will be installed so that the radiation beam is pointed away from normal traffic areas. Hold the source holder in position using permanent bracing so that it will be as close as possible to the vessel but will not move in relation to the vessel or detector. Do not mount source holder to vessel in such a way that the vessel integrity will be compromised.
  - Complete detector wiring and calibration as per the specific detector manual.
- Pipe Dismount
  - Secure source holder and detector using temporary or permanent means to ensure that they will not shift or fall once the bolts are removed.
  - Undo and remove the four bolts that hold the source holder and detector together.
  - Lower source holder to the ground and move to RSO approved storage location. Source holder is not to be disposed of except by the RSO to a qualified consultant.
  - Lower detector to the ground and remove from work area.
- Vessel Dismount
  - Secure source holder and detector using temporary or permanent means to ensure that they will not shift or fall once they are removed from the permanent bracing.
  - Remove all connections between the source holder and permanent bracing so that it may be moved.
  - Lower source holder to the ground and move to RSO approved storage location. Source is not to be disposed of except by the RSO to a qualified consultant.
  - Remove all connections between the detector and permanent bracing so that it may be moved and remove from work area.

### **RECEIPT OF PACKAGES**

- The RSO will be required to sign off on the purchase order for any new nuclear devices that are to be brought to site.
- Radioisotope license amendment is required before obtaining any nuclear source not already listed in section IV of current license.
- Inventory will be updated if any nuclear sources are acquired, transferred or disposed of. Inventory will be updated if sources are moved to another location within company property.
- Radioactive packages will only be opened by Vale personnel who have attended Transportation of Dangerous Goods class 7 training or by a qualified consultant.
- Any damaged packages received will not be handled and will be immediately reported to the shipper emergency contact phone number listed on the Dangerous Goods Shipping Document.

### **CONTROL AND SECURITY**

- Nuclear gauges will only be handled and serviced by personnel who are an Authorized Employee or under the direct supervision of an Authorized Employee.

- Security coverage at each of the plant entrances will be provided 24 hours per day, 365 days per year.
- Gauges that are used to measure the process will be monitored by operators during normal operations and any device malfunctions will be investigated immediately as they are noticed.
- In the case of theft the following steps will be taken:
  - The person to discover the theft will immediately inform the RSO, providing the RSO with their name, employee number and details of the incident including the original location of the gauge.
  - The RSO will immediately inform the Canadian Nuclear Safety Commission, the local police and plant security.
  - The RSO will assemble the person to discover the incident as well as the site operator and foreman to perform an investigation.
  - Plant security will search each vehicle as it exits the plant site while the investigation is ongoing.
- Stored gauges will be handled as below.

### **STORAGE OF NUCLEAR GAUGES**

- When not in use nuclear gauges must be stored in the approved storage facility located above the Refinery Instrumentation Shop in the Central Shops building or in a temporary short-term storage location that is accessible only to authorized personnel (locked) and must be approved by the RSO.
- When a source has to be moved out of the way of a job in progress for a short period of time and then reinstalled, permission may be obtained from the RSO. Proper handling techniques are to be used and proper signage is to be posted no matter how short this time period may be.

### **DISPOSAL OF NUCLEAR DEVICES**

- No employees on the plant site are qualified for transportation or disposal of nuclear devices.
- The RSO must be informed of intent to dispose of any nuclear sources from the plant site so that they can be disposed of by a qualified person.
- Transfer or disposal records will be obtained for any sources removed from company property and given to the RSO.

### **LEAK TESTING**

- All fixed gauges that are in service will be leak tested by an approved consultant accompanied by the RSO or alternate once every twelve months under normal operating conditions.
- All fixed gauges that are in storage will be leak tested by an approved consultant accompanied by the RSO or alternate at least once every twenty four months under normal operating conditions.
- Any device that has been involved in an emergency incident will be leak tested before being returned to service.
- Any device that is returned to service after being in continuous storage will be leak tested before being returned to routine use.
- Leak test sampling is to be performed by an approved consultant according to the manufacturer's instructions. Vale personnel will only perform a wipe test under the direct supervision of an approved consultant.



- The leak tests will be analyzed by an approved consultant to determine if any radioactive material has leaked out.
- The results will be returned to the RSO and filed by the RSO.
- Any results above the acceptable levels will be immediately reported to CNSC.

### **INSPECTION PROGRAM**

- Audits shall be conducted every three months by the RSO or an alternate to ensure each device complies with CNSC requirements. The results of the audit will be filed by the RSO in the Radiation Compliance binder. The audits will include:
  - Verify nuclear inventory and locations
  - Verify proper signage at gauge locations
  - Verify all field gauges are in working order
  - Verify gauges have no obvious damage
  - Verify that a copy of the license and procedures are available at each plant that houses nuclear gauges
  - Verify the location map of nuclear gauges is available at each plant that houses nuclear gauges
  - Verify device nameplates are legible or that replacements are in place
- In addition every second year and in conjunction with the “Radiation Safety Training for Nuclear Gauges” training the following audits will also take place:
  - Radiation Survey of nuclear gauge storage area
  - Verify that dosimeters are being worn correctly
  - Verify that radiation survey meters are being used correctly and are calibrated
  - Verify maintenance records for gauges.

#### *Authorized Employees*

- Authorized Employees are permitted to install/mount, dismount and lock out fixed nuclear gauges. Authorized employees will be required to complete the Noremtech Radiation “Safety Training for Nuclear Gauges” every second year. Upon completion of this training the employee will be considered authorized for the next two years. This training will include:
  - Properties of radiation
  - Dose equivalents
  - Dose limits
  - Types of radiation
  - Long term and acute effects
  - Radiation protection
  - Emergency procedures
  - Regulatory requirements
  - Installation, dismount and vessel entry procedures
  - Transportation overview

#### *RSO and Alternates*

- The Radiation Safety Officer and alternates will be required to complete the course titled “Radiation Safety Officer Training – Sealed Source Users” provided by Stuart Hunt and Associates Ltd.
  - Record of this training must be entered into VIP.
  - The Radiation Safety Officer and alternates will also be required to complete the training for Authorized Employees every second year. This training will be documented and filed by the RSO.



- The Radiation Safety Officer role will be held by the Instrumentation Engineering Supervisor as approved by the CNSC.

#### *Non-Authorized Employees*

- Non-authorized employees are anyone who is employed by Vale and will be doing work on the plant site. Employees are required to complete a computer based training package prior to beginning work on the plant site. The computer based training will include:
  - Radiation exposure and effects
  - Signage and identification of nuclear devices
  - Overview on how gauges work
  - Emergency response procedures

#### *Visitors and Contractors*

- Visitors and contractors will be required to complete the same training as non-authorized Vale employees if they will be visiting an area with a nuclear gauge and will not be accompanied by a trained Vale employee.

## **RADIATION SURVEY METERS**

#### *Calibration and Maintenance*

- Vale employees will not conduct any radiation survey meter calibration or maintenance beyond battery installation.
- All maintenance and calibration will be done by qualified consultants.
- All radiation survey meters must be sent out for calibration annually.
- Do not use a radiation survey meter that is out of calibration.

#### *Ludlum Model 3 with Model 44-38 Detector*

- Care
  - Store Survey meter in a hard plastic case in a location that is dry and away from normal traffic.
  - Cleaning of detector can be performed with a damp cloth (water only) after the instrument has been off for at least one minute and the detector is disconnected.
- Use
  - Battery installation
    - Ensure range selector is in the OFF position.
    - Push down on the battery lid and turn the quarter-turn thumbscrew counter-clockwise.
    - Install two 'D' sized batteries noting the correct polarity.
  - Connecting the detector
    - Connect one end of the detector cable to the detector by firmly pushing the connectors together while twisting clockwise one quarter turn. Repeat the procedure on the instrument end.
  - Battery test
    - Test batteries prior to use.
    - Move the range multiplier switch to the BAT position.
    - Ensure the meter deflects to the battery check portion of the meter scale. If meter does not respond check battery installation and replace if necessary.
  - Instrument test
    - Test the instrument with a known check source prior to using.
    - Turn instrument range switch to the X100 position
    - Turn the AUD ON-OFF switch to ON

- Expose detector to check source and verify correct reading.
  - Measuring
    - Hold detector one to six inches from surface of the device to be tested. Move the detector slowly across the surface of the device listening for increased beeps and watching for the highest meter reading on the scale.

#### *Ludlum Model 192*

- Care
  - Store Survey meter in a hard plastic case in a location that is dry and away from normal traffic.
- Use
  - Battery installation
    - Ensure range selector is in the OFF position.
    - Push down on the battery lid and turn the quarter-turn thumbscrew counter-clockwise.
    - Install two 'D' sized batteries noting the correct polarity.
  - Battery test
    - Test batteries prior to use.
    - Move the range multiplier switch to the BAT position.
    - Ensure the meter deflects to the battery check portion of the meter scale. If meter does not respond check battery installation and replace if necessary.
  - Instrument test
    - Test the instrument with a known check source prior to using.
    - Turn instrument range switch to the X100 position
    - Turn the AUD ON-OFF switch to ON
    - Expose detector to check source and verify correct reading.
  - Measuring
    - Hold instrument one to six inches from surface of the device to be tested. Move the detector slowly across the surface of the device listening for increased beeps and watching for the highest meter reading on the scale.

#### *SE International Inspector*

- Care
  - Store Survey meter in a hard plastic case in a location that is dry and away from normal traffic.
- Use
  - Battery installation
    - Install a standard 9-volt alkaline battery in the battery compartment in the lower rear of the detector.
  - Instrument test
    - Set the top switch to micro seiverts per hour.
    - Set the bottom switch to ON
    - Wait 30 seconds for a short beep to indicate the detector is initialized.
  - Measuring
    - Hold instrument one to six inches from surface of the device to be tested. Move the detector slowly across the surface of the device listening for increased beeps and watching for the highest meter reading on the scale.

## **RECORD KEEPING**

- The RSO will maintain all records in accordance with the Nuclear Safety and Control Act and all associated regulations. The records will be maintained in either electronic or paper format as the situation dictates.

**NUCLEAR SOURCE SHUTTER CLOSURE VERIFICATION FORM** is included below.

## NUCLEAR SOURCE SHUTTER CLOSURE VERIFICATION FORM

As per CNSC regulations and Guidelines for Handling of Nuclear Gauges SPI this form MUST be completed and delivered to the Radiation Safety Officer immediately after a nuclear gauge has been installed or dismantled, or for entry to a vessel on which a nuclear gauge is installed.

PRESENT SOURCE LOCATION			
<b>Plant:</b>	<b>Application (include location):</b>		
SOURCE DATA			
<b>Manufacturer:</b>	<b>Model:</b>	<b>Isotope:</b>	<b>Serial Number:</b>
<b>Activity:</b>	<b>Date:</b>	<b>Notes:</b>	
SURVEY METER DATA			
<small>((NOTE SURVEY METER MUST HAVE BEEN CALIBRATED WITHIN A 1 YEAR PERIOD))</small>			
<b>Manufacturer:</b>	<b>Model:</b>	<b>Calibration Date:</b>	<b>Battery OK:</b>
			Yes   No
SURVEY RESULTS			
@ 30cm		<b>Shutter Locked:</b>	<b>Notes:</b>
<b>Shutter Open:</b>	<b>Shutter Closed:</b>		
(circle the correct units)		Yes   No	
mr/hr	mr/hr		
μr/hr	μr/hr		
mSv/hr	mSv/hr		
μSv/hr	μSv/hr		
<small>NOTE: IF SHUTTER DOES NOT CLOSE, DO NOT PROCEED WITHOUT FURTHER INSTRUCTIONS (DO NOT USE FORCE ON THE SHUTTER MECHANISM)</small>			
SURVEY CONDUCTED BY			
<b>Name(s):</b>	<b>Date:</b>	<b>Removal Date:</b>	<b>Installation Date:</b>

<b>NEW SOURCE LOCATION</b>			
<b>Plant:</b>	<b>Application (include location):</b>		

*Note: Measurements must be taken in a location that indicates a significant drop in dose rate after closing the shutter. Often the only location where shutter closure can be verified is on the detector side.*

<b>NUCLEAR FIXED GAUGE WORK PERMIT</b>
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**NOTIFICATION:** You are being notified of work on or around nuclear fixed gauges that will be commencing in your work area on the following date.

Plant	Date	Expected Duration

**AREA OF WORK:** The nuclear fixed gauge in the following area, will be handled as per SPI #34-36 Guidelines for Handling of Nuclear Gauges.

\_\_\_\_\_

<b>The following workers have been authorized to test and close the device in your area.</b>	

**NOTE:** All handling of the nuclear gauges must be completed under the direct supervision on an Authorized Employee as per SPI #34-36 Guidelines for Handling of Nuclear Gauges.

**DESCRIPTION OF WORK TO BE UNDERTAKEN:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**AUTHORIZATION:** The Radiation Safety Officer (or alternate) will grant authorization to commence activities after upon receipt and review of this Permit.

**RADIATION SAFETY OFFICER (signature):** \_\_\_\_\_

**DISTRIBUTION:** Bulletin/Tag Boards, Safety Supervision, Environment & Health, Control Room

Other: \_\_\_\_\_

Area Supervision: \_\_\_\_\_

Approved By Lovro Paulic	Title General Manager, Manitoba Operations
Date	