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**CODE OF SAFE PRACTICE FOR THE USE OF  
INDUSTRIAL GAUGES CONTAINING SEALED  
RADIOACTIVE SOURCES**

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# 1 INTRODUCTION

## 1.1 Purpose

The purpose of this *Code* is to provide mandatory requirements for the protection of personnel, visitors, and members of the public by ensuring that

- any exposure to radiation is justified;
- the risk from any actual or potential exposure to radiation is as low as reasonably achievable;
- the relevant dose limits are not exceeded (sections 4.1.2 and 5.2);
- there is sufficient documentation to enable verification of compliance.

## 1.2 Scope

- 1.2.1 This *Code* covers the use of sealed radioactive sources in industrial instrumentation. This includes all gauges fixed to industrial plant (pipeline density gauges, level gauges on vessels, fill height detectors, thickness gauges) and the storage of such gauges.
- 1.2.2 This *Code* does not cover the use of sealed radioactive sources in industrial radiography, portable nuclear density meters (moisture and/or density measurements), borehole logging and irradiation processing plant. These applications are covered elsewhere.
- 1.2.3 This *Code* does not cover installation or servicing of industrial gauges.
- 1.2.4 This *Code* deals with radiation safety only. Other legislation covering hazardous substances, transport, occupational safety, protection of the environment, local body planning and other issues may overlap with the radiation protection legislation. Compliance with this *Code* in no way implies that all or any of these other requirements have been satisfied.

### 1.3 Application of this Code

- 1.3.1 The ownership and use of radioactive material is controlled by the *Radiation Protection Act 1965* and *Radiation Protection Regulations 1982*. As well as mandatory compliance with the *Act* and *Regulations*, anyone licensed to use sealed radioactive sources for the purpose of industrial gauging will be required by a condition on the licence to comply with this *Code*.
- 1.3.2 This *Code* stipulates the specific way in which some parts of the *Act* and *Regulations* must be satisfied with respect to the use of industrial gauges. As well, there are further requirements that are recognised as good practice necessary for safety. All of these requirements are indicated by the word “**must**”. They are binding on **all** people licensed to use industrial gauges containing sealed radioactive material. Whenever a responsibility is shared by more than one licensee, to avoid ambiguity, one person must take the role of ensuring the responsibility is carried out. This licensee is referred to in this *Code* as the **principal licensee**.
- 1.3.3 Compliance with this *Code* includes compliance with any addenda or corrigenda that the National Radiation Laboratory (NRL) may issue at some future date. Such addenda or corrigenda will be sent to licensees whose licence conditions include compliance with this *Code*. The copy of the *Code* on the NRL website ([www.nrl.moh.govt.nz](http://www.nrl.moh.govt.nz)) will include all such changes. Any reference to the *Code of safe practice for the use of industrial gauges containing sealed radioactive sources, NRL C19*, will include any addenda or corrigenda subsequently issued.
- 1.3.4 General advice on the safe use of industrial gauges and compliance with the radiation protection legislation and this *Code* is given in *Guidance notes: Safe practice for the use of industrial gauges containing sealed radioactive sources*.
- 1.3.5 Where the terms “*effective dose*” and “*equivalent dose*” are used for protection purposes they have the meanings defined in ICRP Publication 60 (1990 *Recommendations of the International Commission on Radiological Protection*, Annals of the ICRP **21**(1-3) Pergamon Press, Oxford), and they can be practically represented by the ICRU operational quantities, including “*ambient dose equivalent rate*” (see *Quantities and units in radiation protection dosimetry*, ICRU Report 51, International Commission on Radiation Units and Measurements, Bethesda, Maryland).

## **1.4 Exemptions from requirements of the *Code***

- 1.4.1 If for purely technical reasons relating to a particular piece of equipment or procedure it is either not possible or deemed unnecessary to comply with any requirement or requirements in this *Code* then an exemption from the specific requirement or requirements for that piece of equipment or procedure may be granted on application to the NRL.
- 1.4.2 An application for exemption will need to demonstrate that the proposed alternative to the requirement does not compromise the intent of the relevant section of the *Code*.
- 1.4.3 Written evidence of this exemption **must** be retained (see section 2.1.3).

## 2 RADIATION SAFETY MANAGEMENT

### 2.1 Radiation Safety Plan

2.1.1 The principal licensee at each facility where industrial gauges containing sealed radioactive sources are used or stored **must** ensure that there is a *Radiation Safety Plan* for that facility.

2.1.2 The *Radiation Safety Plan* **must** be available for audit by the NRL.

2.1.3 The *Radiation Safety Plan* **must** comprise:

- a) details of responsibilities and authorisations to operate equipment containing radioactive sources;
- b) radiation protection induction and training requirements for personnel, and associated records;
- c) personal monitoring policy, procedures and records (see also section 4.2);
- d) a register and records of all radioactive sources at the facility.

The record of each source **must** show the following:

- i a unique identifying number or code
  - ii the make, model, serial number and any other relevant identification data for the equipment containing the source
  - iii the location of the equipment
  - iv the radionuclide(s)
  - v the activity of the source(s) with specified units (eg, GBq, mCi, etc)
  - vi the date at which the source had the activity shown
  - vii the date of source manufacture
  - viii the name of the licensee responsible for the source
  - ix the source serial number
- e) procedures for radiation safety audits (including inspections and wipe testing), and associated records (see sections 2.2 and 2.5 for details);

- f) written local rules for the safe use and/or storage of equipment containing radioactive sources (see also sections 2.4, 4.1.1, 5.1.1);
- g) written emergency procedures, including scenarios of a leaking source; loss of a source; mechanical damage to a source, its containment or shielding; and security and radiation protection aspects in event of fire, earthquake and other civil emergencies (see also section 6.4);
- h) incident and accident investigation records (see also section 6.2);
- i) records of maintenance and repair work on equipment containing radioactive sources (see also section 2.3);
- i) any exemptions granted under section 1.4.

2.1.4 All records required for the *Radiation Safety Plan* **must** be kept for 10 years.

2.1.5 The principal licensee **must** ensure that all persons involved in the use of radioactive sources at the facility are familiar with the *Radiation Safety Plan*.

## **2.2 Radiation safety audits**

2.2.1 The principal licensee **must** cause to be carried out on installation, after major maintenance, following an incident, and at least annually a radiation safety audit that verifies compliance with this *Code*.

## **2.3 Maintenance and servicing**

2.3.1 Any work on industrial gauges that results in an unshielded radiation beam from a radioactive source, or involves dismantling of the radioactive source mechanism or shutter mechanism, **must** be carried out only by a person appropriately trained and licensed under the *Radiation Protection Act* to carry out such work.

2.3.2 The principal licensee **must** ensure that all information necessary for the radiation safety of a contractor is fully disclosed and effectively communicated to the contractor prior to the commencement of any work.

## **2.4 Storage of industrial gauges**

- 2.4.1 Industrial gauges that have been removed from use **must** be stored appropriately (see also section 3.4).
- 2.4.2 The storage **must** be such that no person can receive an effective dose exceeding 0.3 mSv per year.

## **2.5 Requirements for inspection and wipe testing of sources**

- 2.5.1 A wipe test **must** be carried out following the installation of an industrial gauge containing a sealed radioactive source. For sources older than 10 years, inspections and wipe tests **must** be carried out at least once every 2 years. If there is any possibility that the radioactive material has been damaged or may be leaking, inspections and wipe tests **must** be carried out as soon as practicable. Exceptions to the wipe testing requirements are those gauges containing  $^{85}\text{Kr}$ .
- 2.5.2 If any damage is revealed by the inspection or wipe testing, all necessary measures **must** be taken to prevent the dispersal of radioactive material (see also section 6).
- 2.5.3 If there is any evidence of leakage the source **must** be taken out of service until further wipe tests of the actual source have established that the source is leak-tight. If the source is confirmed as not being leak-tight then the NRL **must** be notified as soon as practicable.
- 2.5.4 The wipe test activity assessment method **must** be approved by the NRL.

## **2.6 Disposal of redundant gauges**

- 2.6.1 If an industrial gauge needs to be disposed of then the licensee responsible **must** either:
  - a) re-export the source to the manufacturer or to another radioactive waste disposal agent; or
  - b) dispose of the radioactive source within New Zealand only after receiving approval from the NRL of the proposed disposal method.

### **3 FACILITIES AND EQUIPMENT**

#### **3.1 General requirements**

- 3.1.1 The principal licensee **must** ensure that any industrial gauge is of an appropriate type.
- 3.1.2 The principal licensee **must** ensure that, during normal operations, each industrial gauge is sufficiently well shielded so that the ambient dose equivalent rate at 1 metre from the gauge (at all accessible points, primary beam excluded) is less than 10  $\mu\text{Sv}$  per hour and, similarly, the ambient dose equivalent rate at 5 centimetres from the gauge is less than 300  $\mu\text{Sv}$  per hour.

#### **3.2 Warning signs**

##### **3.2.1 Labelling of indicators**

- 3.2.1.1 The “beam on” and “beam off” positions **must** be clear and unambiguous at all times.
- 3.2.1.2 Indicators **must** be protected against mechanical damage.

##### **3.2.2 Radiation warning signs**

- 3.2.2.1 In addition to the radiation warning sign on the gauge, a sign warning of the presence of radioactive material **must** be displayed on industrial plant close to each fixed gauge containing a radioactive source, in a position where it is prominently visible from all accessible positions.
- 3.2.2.2 In addition to 3.2.2.1, for remotely operated gauges the control panel **must** be marked with signs that identify the presence of radiation sources.

### **3.2.3 Labelling**

3.2.3.1 In addition to the requirements in Clause 3 of the Second Schedule of the *Regulations*, the label for each industrial gauge **must** include the manufacturer's name, gauge model and serial number.

### **3.3 Shutter mechanism**

3.3.1 The gauge **must** be provided with an effective shutter.

3.3.2 There **must** be a means to ensure that the shutter can be secured in the "beam off" position.

### **3.4 Security**

3.4.1 Every gauge containing a radioactive source, designed to operate unattended, **must** be firmly attached to fixed plant in such a manner that it cannot be removed without the use of tools.

3.4.2 Every store in which gauges containing radioactive sources are stored, not firmly attached to fixed plant, **must** be securely locked with access restricted to persons authorised by a licensee (see also section 2.4).

## 4 OCCUPATIONAL SAFETY

### 4.1 General requirements

- 4.1.1 The principal licensee **must** ensure that all persons using industrial gauges containing sealed radioactive sources are fully aware of the procedures (section 2.1.3f) designed to keep the radiation doses to all personnel as low as reasonably achievable, social and economic considerations being taken into account.
- 4.1.2 The principal licensee **must** ensure that the doses to all personnel whose duties involve working with radiation do not exceed the following dose limits:
- (a) an *effective dose* of 20 mSv per year averaged over any five-year period and 50 mSv in any one year;
  - (b) an *equivalent dose* of 500 mSv to the skin (at the nominal depth of 7 mg/cm<sup>2</sup>) averaged over 1 cm<sup>2</sup>, regardless of the total area exposed, in any one year;
  - (c) an *equivalent dose* of 150 mSv to the lens of either eye in any one year;
  - (d) an *equivalent dose* of 500 mSv to the hands and feet in any one year;
  - (e) for women who declare themselves pregnant, a dose of 2 mSv at the surface of the abdomen over the remainder of the pregnancy.
- 4.1.3 The principal licensee **must** ensure that the doses to all other personnel whose duties do not involve working with radiation do not exceed the dose limits for members of the public given in section 5.2 of this *Code*.

### 4.2 Personal radiation monitoring

- 4.2.1 The principal licensee **must** ensure that personal monitoring of personnel whose duties involve working with radiation is performed, to provide a continuous measure of effective dose or equivalent dose as appropriate, using a method approved by the NRL, unless it has been demonstrated, via documentation in the *Radiation Safety Plan*, that occupational doses will be less than one-tenth of the dose limits in section 4.1.2.

- 4.2.2 Records of personal monitoring **must** be provided to all monitored personnel, and copies held for at least 10 years.
- 4.2.3 If any person required to be monitored under this section receives more than one-quarter of the dose limits in section 4.1.2 (on a *pro rata* basis), the reason for this **must** be investigated by the principal licensee. If the dose is received under normal working conditions, procedures **must** be reviewed with the aim of reducing the operator dose. Full records of the result of the investigation and any resulting changes to standard practice **must** be kept in the *Radiation Safety Plan*.

## 5 PUBLIC SAFETY

### 5.1 Control of visitors

5.1.1 The principal licensee **must** ensure that there are written local rules controlling access of visitors or members of the public to areas where radiation is used (See *Radiation Safety Plan* section 2.1.3f).

### 5.2 Sources of exposure

5.2.1 The principal licensee **must** ensure that the radiation exposure to any member of the public or any personnel whose duties do not involve working with radiation is as low as reasonably achievable, social and economic considerations being taken into account, and does not exceed the following dose limits:

- (a) an *effective dose* of 1 mSv in any one year;
- (b) an *equivalent dose* to the skin of 50 mSv over any 1 cm<sup>2</sup>, regardless of the total area exposed, in any one year;
- (c) an *equivalent dose* of 15 mSv to the lens of either eye in any one year.

## 6 INCIDENTS, ACCIDENTS AND EMERGENCIES

- 6.1 If an incident or accident occurs involving an industrial gauge, every reasonable measure **must** be taken to minimise possible exposure of personnel to radiation, and to prevent the release, or additional release, of radioactive material from the source encapsulation.
- 6.2 The principal licensee **must** ensure that any person involved in an incident or accident, where persons may have been exposed to levels of radiation exceeding what normally would be expected, reports the details of the event to him/her immediately. The principal licensee **must** then:
- a) fully investigate the event in consultation with other personnel involved;
  - b) review the *Radiation Safety Plan* to see if any deficiency was a factor in the occurrence;
  - c) cause a record of the report and investigation to be kept for at least 10 years (see section 2.1.3h).
- 6.3 In the event of a suspected or actual exposure to radiation exceeding any of the dose limits given in section 4.1.2 and section 5.2.1, as appropriate, the principal licensee **must**
- a) immediately notify the NRL of the circumstances;
  - b) make available to the person exposed such medical examinations as may be appropriate to manage any injury.
- 6.4 There **must** be written emergency procedures (section 2.1.3g) for, at least, each of the following situations:
- a) leaking source;
  - b) loss of a source;
  - c) mechanical damage to a source, its containment or shielding;
  - d) security of radioactive sources and radiation safety in civil emergencies.

## CROSS-REFERENCE INDEX

The regulatory framework for this *Code* is provided by the radiation protection legislation.

This index provides references to specific parts of the legislation, some of which, while not directly cited in the *Code*, do provide the regulatory authority for its requirements. It also indicates where practical compliance information can be found in the *Guidance notes*.

The references are from this *Code of safe practice for the use of industrial gauges containing sealed radioactive sources, NRL C19* to:

- *Radiation Protection Act 1965*;
- *Radiation Protection Regulations 1982*;
- *Guidance notes: safe practice for the use of industrial gauges containing sealed radioactive sources* (NRL, April 2005).

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