Te Kāwanatanga o Aotearoa
New Zealand Government

MANATŪ HAUORA
MINISTRY OF HEALTH

# Code of Practice for Industrial Radiography

## ORS C7

For public consultation

**2024**

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# Contents

## List of Tables

# This consultation

This document sets out the revised Code of Practice for Industrial Radiography: ORS C7 (called here the 'revised C7') for the purposes of consultation. **Section 89(1)** of the **Radiation Safety Act 2016** (the Act) allows the Director for Radiation Safety (the Director) to amend or revoke a code of practice (code).

The Ministry of Health | Manatū Hauora has drafted this revised C7 following a review by the Director under **section 90(a)** of the Act. This requires the Director to review a code at least once every five years.

Section 89(2) of the Act requires the Director to consult with any person they reasonably consider is likely to be affected by a proposed amendment or revocation of a code; this document aims to fulfil that requirement.

There is a submission form at the end of this document you can use to help with this consultation process. The form is also available **online**. The form is intended as a guide only. You are welcome to submit any information that you consider to be relevant.

Following this consultation, the Director proposes to issue a potentially further revised C7, with amendments and revocations, under **section 86(1)** of the Act.

## Background

The current Code of Practice for Industrial Radiography: ORS C7 (C7) came into force on 7 June 2019. C7 and any amendments made to it are secondary legislation under sections 86(6) and 89(4) of the Act.

C7 applies to any person who 'deals with' a radiation source. The Act defines the term 'deal with' in **section 5** to mean: 'to manufacture, possess, control, manage, use, transport, store, export, import, sell, supply, or dispose of a radiation source; or to carry out any other activity or practice involving the radiation source'.

The revised C7 affects all regulated parties and other people and organisations with a professional interest in industrial radiography.

The Ministry of Health will review all feedback it receives as part of this consultation and use it to inform amendments and revocations to the revised C7.

# Summary of the proposed principal amendments in the revised C7

The Director's view is that the revised C7 is an evolution of technical requirements in the framework the Act has established to protect people's health and safety. The Director does not expect the proposed changes to significantly increase the compliance burden on regulated parties.

The revisions include deletions, new clauses and terms, changes to interpretations and rewordings. **Table 1** lists the principal proposed changes in the revised C7 and the main reasons for each change. Significant changes in the revised C7 include the following.

- An amendment has been made to align revised C7 with recently reviewed codes. For example, the term 'the holder of a source licence' replaces the term 'managing entity'.
- The revised C7 is the second currently issued code of practice that is intended to incorporate material by reference, under **section 64** of the Legislation Act 2019. This is because, to ensure safety, the Director has determined that the revised C7 needs to apply international standards to equipment and radioactive material used for industrial radiography.
- Revised C7 uses the term 'Person conducting a business or undertaking'. This is to better align with the Health and Safety at Work Act 2015. There is now a requirement that the holder of a source licence cooperates with a 'person conducting a business or undertaking'.
- There is now a requirement that the holder of a source licence cooperates with a 'person conducting a business or undertaking'.
- The specified maximum instantaneous dose rate has been deleted for a fixed facility, and the specified maximum instantaneous dose rates for site radiography has been reduced.
- A requirement has been added for the holder of a source licence to consult with a qualified expert on the radiation shielding of a fixed facility.
- A requirement has been added for people to dispose of radioactive material in accordance with conditions on a source licence.
- There is now an interpretation of the term 'overexposure of a person'. This term is used in **section 20(3)** of the Act.
- A requirement has been added to notify the Director of 'certain incidents involving equipment'.
- There is now a requirement that where a worker may receive a radiation dose exceeding three-tenths of a dose limit, to the extent practical, an appropriately accredited supplier carries out personal dose monitoring.
- Clause 30 of C7, 'Client', has been deleted. This is because the Director has determined that a 'client' is not dealing with a radiation source. Under section 86(1)(a) of the Act, a code applies to a person dealing with a radiation source.

- Appendix 4 ('Training requirements') of C7 has been amended. The revised training requirements are for a radiation safety officer. Also, the training requirements provide a basis for the holder of a source licence to devise training for other roles with the advice of a qualified expert.

**Table 1: Principal proposed amendments in the revised C7 and the main reasons for the changes**

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Terms throughout** | 'role' (clause 1(a)(vii)), 'roles' (clauses 1(b) and 1(b)(i)) and 'people' (clause 1(b)(ii)) have replaced 'delegate'. | Improved alignment with the Act |
| | 'exposure bay' has replaced 'enclosure bay'. | Clarity. |
| **Purpose and commencement** | 'technical requirements necessary for a person who deals with' has replaced 'the operational details necessary'. | Improved alignment with the Act |
| **Scope** | 'activities or practices' has replaced 'activities'. | Improved alignment with the Act |
| | A clearer definition of industrial radiography has been added. | Clarity |
| | The reference to aspects of activities has been replaced with a reference to aspects of 'deal with'. | Improved alignment with the Act<br>To avoid doubt. |
| | A paragraph has been added stating that the fundamental requirements listed in the Act apply to every person who deals with a radiation source. | To avoid doubt. |
| | 'holder of a source licence' (HSL) has replaced 'managing entity'. | Improved alignment with the Act.<br>'Holder of a source licence' is used in **section 20** of the Act; an HSL is responsible at all times for managing and controlling each radiation source to which the licence applies.<br>This amendment has no effect on how the Director has identified responsibilities in the revised C7 compared with C7. |
| | 'Electrical safety, occupational safety other than radiation safety' has been added. | To avoid doubt. |
| **Contact** | This section has been deleted. | This information is most reliably accessed through the Ministry's website. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Roles and responsibilities** | The term 'Client' has been deleted. | Improved alignment with the Act<br>See **note 1**. |
| | 'Director for Radiation Safety' has an amended description. | Improved alignment with the Act |
| | 'Industrial radiographer' has replaced 'Radiographer'.<br>The interpretation has been amended. | Clarity. |
| | 'Industrial radiographer's assistance' has replaced 'Technical assistance'. | Clarity. |
| | 'Holder of a source licence' has been added.<br>The interpretation of 'Managing entity' has been deleted. | Improved alignment with the Act.<br>Clarity. |
| | 'Person' has been added. | Clarity. |
| | 'Person conducting a business or undertaking' has been added. | Clarity.<br>Improved alignment with the Health and Safety at Work Act 2015. |
| | 'Radiation safety officer' has been amended. | Improved alignment with the Act.<br>Clarity. |
| | 'Standards dosimetry laboratory' has been deleted. | This term is not used in the revised C7 and was not used in C7. |
| **Interpretation**<br>(This term replaces 'Definitions' in C7, for improved alignment with the Act) | 'Absorbed dose' has been added. | Clarity. |
| | 'Guide tubes, control cables, remote controls' has been deleted from 'Ancillary equipment'. | Clarity.<br>These items are part of radiography equipment. |
| | 'Certain incidents involving equipment' has been added. | Clarity. |
| | 'Constraint' has been amended. It no longer includes the statement that the Director will establish or approve constraints. | Clarity. |
| | 'Emergency kit' has replaced 'Emergency equipment'. | Clarity. |
| | 'Fixed facilities' has replaced 'Facility'.<br>'Fixed facilities' has been amended. | Improved alignment with the Act. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| | ‘Occupational exposure’ has been amended. | Improved alignment with the Act. |
| | 'Occupationally exposed person' has been deleted. | This term is not used in the revised C7 and was not used in C7. |
| | ‘Overexposure of a person’ has replaced ‘Reportable incident’. | Improved alignment with the Act.<br>Clarity.<br>This relates to the requirements for ‘overexposure of a person’ in **section 20(3)** of the Act. |
| | ‘Personal alarm monitor’ has been added. | Clarity. |
| | ‘Place’ has been added. | Improved alignment with the Act. |
| | ‘Public exposure’ has been amended. | Improved alignment with the Act. |
| | 'Supervised area' has been added. | Clarity. |
| | ‘Radiation emergency’ has been deleted. | This term is not used in the revised C7. |
| | 'Risk assessment' has replaced 'Safety assessment'. | Clarity. |
| | 'Site radiography' has been amended. | Clarity. |
| | 'Use of a radiation source' has been added. | Improved alignment with the Act. |
| | 'X-ray radiography' has been deleted. | This term is not used in the revised C7 and was not used in C7. |
| **General**<br>**Clause 1**<br>(Clause 1 of C7) | Clause 1 has been added. This associates clause 1 with the Act. | Improved alignment with the Act. |
| | ‘of the organisation’ has replaced ‘at the facility’ in clause 1(a)(ii). | Clarity. |
| | Clause 1(a) of C7 has been deleted. | Improved alignment with the Act. |
| | The term ‘procedures’ has been included in clause 1(a)(iii). | Clarity. |
| | Clause 1(a)(iv) has been amended. | Improved alignment with the Act<br>The Act does not require that the HSL is an employer. |
| | Clause 1(a)(v) has been added. This requires the HSL to ensure that a | Clarity.<br>This replaces clause 24 of C7. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| | radiation safety officer has specified functions and duties. | |
| | A new clause 1(a)(vi) has been added.<br>This requires the HSL to ensure that a radiation safety officer has sufficient authority and resources. | Clarity. |
| | Clause 1(a)(vii) has replaced clause 1(a)(v). | Improved alignment with the Act.<br>Clarity. |
| | Clause 1(a)(ix) has been added. This requires the HSL to cooperate with a radiation safety officer and a qualified expert. | Clarity. |
| | Clause 1(a)(x) has been added.<br>This requires that, where practicable, the HSL ensures that a radiography procedure is carried out in an exposure bay. | Clarity. |
| | Clause 1(b) has replaced clause 1(c). | Improved alignment with the Act.<br>Clarity. |
| | Clauses 1(c) and (d) have replaced clause 1(d).<br>Clause 1(d) associates the clause with the Act. | Improved alignment with the Act.<br>Clarity. |
| **Risk assessment**<br>**Clause 2**<br>(Clause 2 of C7) | 'Risk' has replaced 'safety' in clause 2. | Clarity |
| | 'Likelihood' has replaced 'expected likelihood' and 'practicable' has replaced 'reasonable and practicable' in clause 2(b). | Clarity |
| **Fixed facilities**<br>**Clause 3**<br>(Clause 3 of C7) | 'Fixed facilities' has replaced 'Facilities'. | Clarity. |
| | 'Utilise radiation shielding where needed' has been added to clause 3(a)(i). | Clarity. |
| | New clauses 3(b) and 3(c) require that the HSL obtain the advice of a qualified expert. | Clarity. |
| | Clause 3(c) has replaced clause 3(e). | Clarity. |
| | Clause 3(d) has replaced clause 3(b). | Clarity. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| | 'Delineate' has been removed from clauses 3(d) and (e). | Clarity. |
| | 'Supervised area' has been deleted from clause 3(g)(i). | Clarity. |
| | Clause 3g(v) has been deleted. | Improved alignment with the Act<br>**Section 31(c)(i)** of the Act requires that the Director is notified. |
| | Clause 3(f) has replaced 3(d).<br>The reference to 15 µSv per hour in clause 3(d)(ii) of C7 has been deleted. | Clarity.<br>See **note 2**. |
| | 'Radioactive contamination' has been added to clause 3(h)(iii). | Clarity. |
| | Clause 3(g)(v) of C7 has been deleted. | Improved alignment with the Act<br>**Section 31(c)(i)** of the Act requires that a change in location of a radiation source is notified to the Director. **Section 35(1)(b**) allows the Director to request information. |
| **Equipment**<br>**Clause 4**<br>(Clause 4 of C7) | Clause 4(a)(iii) has been reworded. | Clarity. |
| | Clause 4(c) has been amended.<br>Clause 4(c) now refers to a 'person conducting a business or undertaking'. | Improved alignment with the Act.<br>'person conducting a business or undertaking' has the meaning given to it in the Health and Safety at Work Act 2015. |
| | Clause 4(d) has been amended.<br>A requirement for a movement log has been added. | Improved alignment with the Act |
| **Clause 5**<br>(Clause 5 of C7) | Clause 5 has been amended.<br>This includes a requirement to dispose of radioactive material in accordance with a condition, if any, on a source licence. | Improved alignment with the Act |
| **Training and authorisation**<br>**Clause 6**<br>(Clause 6 of C7) | New clauses 6(a) and (b) have replaced clause 6(a).<br>Appendix 2 sets out training requirements for a radiation safety officer.<br>It also provides a syllabus to be used as the basis for other training.<br>The HSL must establish training in consultation with a qualified expert. | Clarity<br>Training requirements for an authorisation under the Act are specified by the Director. These requirements can be obtained by application to the Director. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Site radiography**<br>**Clause 7**<br>(Clause 7 of C7) | 'five working days' has replaced 'days' and '10 contiguous working days' has replaced 'two weeks'. | Clarity. |
| | 'health and safety issues' has replaced 'issues' in clause 7(b) of C7. | Clarity. |
| | Clause 7(e) has been added.<br>This requires that the HSL ensures the dose constraint in clause 24(a) is applied. | Clarity. |
| **Monitoring and measurement**<br>**Clause 9**<br>(Clause 9 of C7) | Clause 9(a) has replaced clause 9(a).<br>Clause 9(a) sets out requirements relating to a worker who occasionally works in a controlled area and may receive a significant dose. | Clarity. |
| **Clause 10**<br>(Clause 10 of C7) | 'and if needed calibrated' has been added to clause 10(a). | Clarity |
| | Clause 10(b) has replaced clause 10(b). | Clarity<br>This applies a graded approach following **section 86(1)(b)** of the Act.<br>See **note 3**. |
| **Clause 11**<br>(Clause 11 of C7) | Clause 11(a) has replaced clause 11(a).<br>'to the extent practicable' has replaced 'use best endeavours'. | Clarity |
| | Clause 11(c) has replaced clause 11(c). | Clarity<br>**Section 35(1)(b)** of the Act allows the Director to request records. |
| | Clause 11(d) of C7 has been deleted. | Improved alignment with the Act<br>The Act gives the Director powers to request information.<br>In the case of an overexposure of a person, clause 12 requires that notification of the Director.<br>Other legislation requires information to be released on request from a member of the public. |
| **Incidents, accidents and emergencies**<br>**Clause 12** | Clause 12 has been added.<br>This associates the clause with **section 20(3)** of the Act.<br>The clause includes reference to 'overexposure of a person'. | Improved alignment with the Act.<br>Clarity. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Clause 13**<br>(Clause 12 of C7) | Clause 13(f) has been amended to require that the HSL notifies the Director of 'certain incidents involving equipment'. | Improved alignment with the Act.<br>Clarity. |
| **Records**<br>**Clause 16** | Clause 16 has been added.<br>This associates the clause with **section 35(1)(a)** of the Act. | Improved alignment with the Act. |
| **Clause 17**<br>(Clause 15 of C7) | 'make them available as necessary' has been deleted. | Improved alignment with the Act.<br>**Section 35(1)(b)** of the Act requires that records are available to the Director. |
| | 'Radiation' has replaced 'medical' in clause 15(g) of C7 | Clarity.<br>Industrial radiography does not involve medical exposure. |
| **Quality assurance**<br>**Clause 18**<br>(Clause 16 of C7) | 'exposure device' has replaced 'all equipment', and 'qualified expert' has replaced 'specially trained operators'. | Clarity. |
| | Clause 16(b)(i) of C7 has been deleted. | Improved alignment with the Act.<br>Electrical safety is outside of the scope of revised C7. |
| | 'Monitoring equipment' has been added to clause 18(c). | Clarity. |
| **Industrial radiographer**<br>**Clause 19**<br>(Clause 17 of C7) | 'Industrial radiographer' has replaced 'Radiographer'. | Clarity. |
| | Clause 19(a) has been amended.<br>It requires that the industrial radiographer is responsible for the planning and delivery of radiography procedures. | Improved alignment with the Act.<br>Clarity. |
| | 'practical' has replaced 'reasonable' in clause 19(b). | Clarity. |
| | Clause 17(d) of C7 has been deleted. | Improved alignment with the Act.<br>Clarity.<br>Requirement is in clause 6(d). |
| | Footnote 1 of C7 has been deleted. | Clarity. |
| **Site radiography**<br>**Clause 25**<br>(Clause 23 of C7) | Clause 24(b) has been amended to specify that a maximum instantaneous dose rate 20 µGy per hour. Clause 23(a) in C7 specified a dose rate of 25 µSv per hour. | Clarity.<br>See **note 2**. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| | Clause 25(b) has been reworded. | Clarity. |
| | Clause 25(d) has been deleted. | Clarity.<br>The requirement is in clause 25(a). |
| | Clauses 25(r) and (s) of C7 have been deleted. | Clarity.<br>The requirements are in clauses 22 and 23. |
| **Manufacturer/supplier**<br>**Clause 26**<br>(Clause 27 of C7) | 'national and international' has been added to clause 26(a)(ii). | Clarity. |
| **Servicing engineer**<br>**Clause 28**<br>(Clause 29 of C7) | Clause 28(b) has been amended. | Clarity. |
| (Clause 24 'Radiation safety officer' of C7) | Clause 24 has been deleted.<br>Appendix 1 sets out what was previously clause 24 of C7. | Improved alignment with the Act.<br>Clause 1(a)(v) requires that the HSL ensures that a radiation safety officer carries out the functions and duties set out in Appendix 1. |
| (Clause 25 'Radiation safety officer' of C7) | Clause 25 of C7 has been deleted. | Clarity.<br>A requirement for a radiation safety officer to cooperate with a qualified expert has been added to clause 1 of Appendix 1. |
| (Clause 26 'Qualified expert' of C7) | Clause 26 of C7 has been deleted. | Improved alignment with the Act.<br>A new clause 1(a)(vix) requires that the HSL cooperates with a radiation safety officer and a qualified expert. |
| (Clause 30 'Client' of C7) | Clause 30 of C7 has been deleted. | Improved alignment with the Act.<br>See **note 1**. |
| (Appendix 1: Cross-reference to Radiation Safety Act 2016 of C7) | Appendix 1 of C7 has been deleted. | The appendix is not needed for revised C7. |
| **Appendix 1:** | Clause 25 of C7 has been reworded in clause 1(a) of Appendix 1 to be 'liaising and cooperating with qualified experts as needed'. | Improved alignment with the Act.<br>Clarity. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Functions and duties of a radiation safety officer** | 'Verifying' has replaced 'ensuring' in clause 1(g). | Clarity.<br>Clause 6(a) requires the HSL to ensure that a person is appropriately trained. |
| | 'notify the holder of a source licence' has been added to Clause 1(k). | Clarity. |
| **Appendix 2: Fixed facility requirements**<br>(Appendix 2 of C7) | 'Fixed facility' has replaced 'facility'.<br>Clause 10 has been added. This applies to the roof of an exposure bay. | Clarity. |
| **Appendix 3: Equipment requirements**<br>(Appendix 3 of C7) | Radioactive source:<br>Clauses 1, 2 and 3 have been reworded.<br>Interpretations of 'special form radioactive material' and 'specifications for performance, design and tests' have been added. | Clarity.<br>See **note 4**. |
| | Radiation source assembly (the 'pigtail'):<br>Clauses 4, 5 and 6 have been reworded. | Clarity. |
| | Exposure device:<br>Clause 7 now specifies that exposure devices must have ' control cables and guide tubes of a length that meets the manufacturer's recommendations.' This has been moved from 'Ancillary equipment'. | Clarity. |
| | Clause 8 has been reworded. | Clarity. |
| | X-ray equipment:<br>'Conform to national and international electrical safety standards' in C7 has been deleted.<br>'For X-ray generators up to 300 $kV_p$ and longer for higher-voltage equipment' has been added.<br>Clause 16 has been reworded. Maximum leakage rates are specified as being 'to the extent practicable'. | Improved alignment with the Act<br>Electrical safety is outside the scope of the revised C7.<br>Clarity. |
| | Ancillary equipment:<br>Clauses 17(a), 19(a) and 20(b) have been reworded. | Clarity. |

| Section or clause | Principal amendment | Reason |
|---|---|---|
| **Appendix 4: Training requirements for radiation safety officers**<br>(Appendix 4 of C7) | 'Appendix 4: Training requirements for a radiation safety officer' has replaced 'Appendix 4: Training requirements'. | Clarity.<br>The training requirements are taken from the International Atomic Energy Agency's *Radiation Safety in Industrial Radiography*.[1] |
| | 'As low as is reasonably achievable, taking into account economic, social and environmental factors', 'Management of radiation protection and safety (including requirements of the Radiation Safety Act)', and 'considerations for spent sealed radioactive sources' have been added. | Clarity. |

**Note 1**
Clause 30 'Client' of C7 has been deleted. This is because the Director has determined that a 'client' is not carrying out an activity or practice involving a radiation source.

Clause 4(c) has replaced clause 30; it requires that the holder of a source licence cooperates with a 'person conducting a business or undertaking'.

**Note 2**
In clauses 3(f) and 25(a), the effective dose constraints have been set to be approximately one-third of the public dose limit specified in **Schedule 3** of the Act.

The dose constraint in clause 3(f) means the dose rate requirement in clause 3(d)(ii) of C7 is not required.

In clause 25(b), for site radiography, the maximum instantaneous dose rate at a barrier has been lowered to 20 μGy per hour. This aligns with typical values given by the International Atomic Energy Agency.1

**Note 3**
There is now a requirement that where a worker receives a radiation dose exceeding three-tenths of a dose limit, to the extent practical, an appropriately accredited supplier carries out dose monitoring.

**Note 4**
References to the incorporation of material by reference to the International Organisation for Standardization standards and the International Atomic Energy Agency's transport regulations have been added. **Section 64** of the Legislation Act 2019 defines 'incorporating material by reference'.

[1] International Atomic Energy Agency. 2011. *Radiation Safety in Industrial Radiography* (IAEA Safety Standards Series No SSG-11). Vienna: International Atomic Energy Agency.

# How to provide feedback

We will consider all written submissions that fall within the scope of this consultation and are received before the closing date for the consultation: 11:00 pm on Wednesday 5 June 2024.

Our preferred method of submission is our online consultation tool, CitizenSpace.

You can also send submissions by email, to:
ors.codes@health.govt.nz

Alternatively, mail submissions to:
Office of Radiation Safety C7
Ministry of Health
PO Box 5013
Wellington 6140.

# What happens after the consultation?

The Ministry will analyse and respond to feedback. After analysing in-scope submissions, we will consider further drafting improvements of the revised C7.

The remainder of this document sets out revised C7, then provides a submission form.

# Introduction

## Purpose and commencement

This Code of Practice for Industrial Radiography: ORS C7 (this code) is issued by the Director for Radiation Safety (the Director) under **section 86** of the Radiation Safety Act 2016. This code provides technical requirements necessary for a person who deals with a radiation source to comply with the fundamental requirements in sections 9 to 12 of the Radiation Safety Act 2016. The requirements in this code do not limit the general nature of the fundamental requirements.

## Scope

This code applies to activities or practices in industrial radiography that are carried out for purposes of non-destructive testing. This includes industrial radiography work that utilises irradiating apparatus and radioactive material, both in a fixed radiation shielded place that has effective engineering controls (fixed facility) and outside such a place using mobile radiation sources (ie, site radiography). Imaging carried out in a cabinet which a person cannot enter is excluded.

This code does not absolve the holder of a source licence from having to comply with the fundamental requirements in sections 9 to 12 of the Radiation Safety Act 2106, which apply to every person who deals with a radiation source.

To 'deal with', in relation to a radiation source, includes to manufacture, possess, control, manage, use, transport, store, export, import, sell, supply or dispose of a radiation source.

The security of radioactive material used in industrial radiography is subject to the **Code of Practice for the Security of Radioactive Material: ORS C5**.

Activities or practices in industrial radiography associated the safe transporting of radioactive material are subject to the **Code of Practice for the Safe Transport of Radioactive Material: ORS C6**.

Compliance with this code does not imply compliance in related areas, such as electrical safety, occupational safety other than radiation safety, hazards in the workplace, resource management and the transport of hazardous substances.

# Roles and responsibilities

The following individuals and bodies have roles and responsibilities in relation to this code.

**Director for Radiation Safety**: a person appointed under **section 76** of the Radiation Safety Act 2016 to carry out the functions and duties and exercise the powers conferred or imposed by the Radiation Safety Act 2016, including the power to issue this code.

**Holder of a source licence**: as in **section 20** of the Radiation Safety Act 2016 the person responsible at all times for the management and control of each radiation source to which the licence applies.

**Industrial radiographer**: a person who is competent to independently undertake **use of a radiation source** in industrial radiography procedures.

**Industrial radiographer's assistant**: a person who is competent to assist an industrial radiographer in an industrial radiography procedure.

**Manufacturer/supplier**: a person or organisation that designs, manufactures, produces, constructs, assembles, installs, distributes, sells, exports or imports radiation sources or develops software that could influence the delivery of exposures.

**Person**: includes a corporation sole, a body corporate and an unincorporated body (as defined in **section 13** of the Legislation Act 2019), unless the context otherwise requires.

**Person conducting a business or undertaking**: may be an individual or an organisation; this term has the meaning given to it in the Health and Safety at Work Act 2015.

**Qualified expert**: an individual who is recognised as having expertise in a relevant field of specialisation, such as the design of radiography facilities, radiation shielding calculations or the testing and maintenance of radiation survey meters.

**Radiation safety officer**: a person who is competent in radiation protection and safety who is designated by the holder of a source licence to oversee the application of regulatory requirements for occupational and public radiation protection and safety.

**Servicing engineer**: a person who has expertise in installing, servicing and maintaining X-ray equipment and exposure devices.

# Interpretation

Defined terms are identified in **bold** and have the following meanings.
**Absorbed dose**: the fundamental dosimetric quantity $D$, defined as:

$$D = \frac{d\bar{\varepsilon}}{dm}$$

where $d\bar{\varepsilon}$ is the mean energy imparted by ionising radiation to matter in a volume element and $dm$ is the mass of matter in the volume element.

**Accident**: any unintended event, including operating errors, equipment failures and other mishaps, the consequences or potential consequences of which are not negligible from the point of view of **protection and safety**.

**Ancillary equipment**: equipment other than **radiography equipment** that is important to the safe performance of **radiography procedures**, such as radiation survey meters, radiation monitoring devices, collimators, local shielding, image receptors, boundary markers, **emergency kits**, notices and devices to warn of impending or current exposures.

**Certain incidents involving equipment**: incidents in which a failure in equipment used for industrial radiography results in a radioactive source failing to return to its safe position at the end of an intended exposure period.

**Constraint**: a prospective and source-related value of individual dose (dose constraint) or of individual risk (risk constraint) that is used in **planned exposure situations** as a parameter for the **optimisation** of **protection and safety** for the source, and that serves as a boundary in defining the range of options in **optimisation**.

**Controlled area**: a defined area in which specific measures for **protection and safety** are or could be required for controlling exposures in normal working conditions and preventing or limiting the likelihood and magnitude of **potential exposures**.

**Dose limit**: the value of **effective dose** or **equivalent dose** set out in Schedule 3 of the Radiation Safety Act 2016.

**Effective dose**: the tissue-weighted sum of **equivalent doses** in all specified tissues and organs of the body.

**Emergency**: any non-routine situation that necessitates prompt action, primarily to mitigate actual or perceived hazards or adverse consequences for human health and safety, quality of life, property or the environment. This includes radiation emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms and earthquakes.

**Emergency kit**: equipment other than **radiography equipment** and **ancillary equipment** for use in an **emergency** such as bags of lead shot, extra lead sheet, suitable tool kits, source recovery equipment, spare shielded containers, communication equipment, spare batteries, pens, paper, calculators, incident logbooks and equipment manuals.

**Employer**: the legal entity that employs **workers**. A self-employed person is regarded as being both an employer and a worker.

**Equivalent dose**: the radiation-weighted **absorbed dose** in a tissue or organ of the body.

**Exposure bay**: a radiation shielded enclosed area within a **fixed facility** used for **in-house radiography**.

**Exposure device**: a shielded device that includes a remote wind-out mechanism and guide tube, which can house a radioactive source for **gamma radiography**.

**Fixed facility**: the **place** where radiography equipment is installed, used, handled or stored and has effective engineering controls. It does not include a **place** where **site radiography** takes place.

**Gamma radiography**: radiography using a **gamma source**.

**Gamma source**: a radioactive source that emits gamma rays for the purpose of industrial radiography together with any **exposure device** in which it is enclosed.

**Incident**: any **accident** or other unintended event, including initiating events, accident precursors, near misses or other mishaps; or unauthorised acts, malicious or non-malicious, the consequences or potential consequences of which are not negligible from the point of view of **protection and safety**.

**Individual monitoring**: **monitoring** using equipment worn by individuals.

**In-house radiography**: radiography performed in an **exposure bay**.

**Investigation level**: the value of a quantity such as effective dose, intake or contamination per unit area or volume at or above which an investigation would be conducted.

**Justify**: to determine that the expected benefits to individuals and society from introducing or continuing a practice outweigh the harm, including the radiation detriment, resulting from the practice. 'Justifies', 'justified' and 'justification' have corresponding meanings.

**Medical exposure**: exposure to ionising radiation experienced by patients for the purposes of medical or dental diagnosis or treatment, by comforter/carers while caring for, supporting or comforting patients, and by volunteers in a programme of medical research.

**Member of the public**: for purposes of **protection and safety**, any individual in the population except when subject to **occupational exposure** or **medical exposure**.

**Monitoring:** the measurement of dose or dose rate to enable the assessment or control of exposure due to radiation, and interpretation of the results.

**Occupational exposure**: as in **section 5** of the Radiation Safety Act 2016, exposure to ionising radiation experienced by workers during the course of their work.

**Operational limits and conditions**: limits and conditions that are established or approved by the Director and, if established, are published in compliance guides issued under this code.

**Optimise**: to implement a level of **protection and safety** that results in the magnitude of individual doses, the number of individuals (**workers** and **members of the public**) subject to exposure and the likelihood of exposure being as low as reasonably achievable, with economic and social factors being taken into account. 'Optimises', 'optimised' and 'optimisation' have corresponding meanings.

**Overexposure of a person**: when:

a) a **dose limit** has been exceeded

b) there is an unpredicted or unintended observable deterministic effect such as skin erythema

c) no dose was intended

d) a person has received a dose that was significantly greater than intended.

**Personal alarm monitor**: a small electronic radiation detector that emits a warning signal when a pre-set dose and/or dose rate is exceeded.

**Place**: as in **section 5** of the Radiation Safety Act 2016 , 'includes any dwelling, premises, vehicle, ship, craft, or aircraft; and a building or a structure; and part of a place'.

**Planned exposure situation**: a situation of exposure that arises from the planned operation of **radiography equipment** or from a planned activity that results in an exposure due to **radiography equipment**.

**Potential exposure**: possible future exposure that may result from an anticipated operational occurrence or **accident** at a source or due to an event or sequence of events of a probabilistic nature, including equipment faults and operating errors.

**Protection and safety**: the protection of people against exposure to ionising radiation and the safety of **radiography equipment**, including the means for achieving this, and the means for preventing **accidents** and for mitigating the consequences of **accidents** if they do occur.

**Public exposure**: as in **section 5** of the Radiation Safety Act 2016, exposure to ionising radiation experienced by a member of the public; this does not include **occupational exposure**.

**Radiography equipment**: **gamma source** or **X-ray equipment** and any associated software used to perform **radiography procedures**.

**Radiography procedure**: a procedure delivered by **radiography equipment** for the non-destructive testing of items of equipment and structures.

**Risk assessment**: assessment of all aspects of a practice that are relevant to **protection and safety** to determine the adequacy of provisions for **protection and safety**.

**Site radiography**: radiography performed outside of a **fixed facility**.

**Special form radioactive material**: either a non-dispersible solid radioactive material or a sealed capsule containing radioactive material. Certification requirements are given in the International Atomic Energy Agency's *Regulations for the safe transport of radioactive material* (IAEA Safety Standards Series No SSR-6 (Rev.1)).[2]

**Specifications for performance, design and tests**:

a) International Organization for Standardization, Radiation Protection — Apparatus for Industrial Gamma Radiography — Specifications for Performance, Design and Tests, ISO 3999:2004

b) International Organization for Standardization, Radiological protection — Sealed radioactive sources — General requirements and classification ISO 2919:2012.

**Storage room**: an enclosed room within a **fixed facility** used to store **radiography equipment**.

**Supervised area**: an area other than a **controlled area** for which occupational exposure conditions need to be kept under review, even though specific measures for **protection and safety** are not normally needed.

**Use of a radiation source**: as in **section 21(3)** of the Radiation Safety Act 2016, includes the use of radiation emitting from a radiation source and causing the radiation source to emit radiation.

**Worker**: an individual who works, whether full time, part time or temporarily, for the holder of a source licence or another **employer** and who has recognised rights and duties in relation to occupational radiation protection. A self-employed person is regarded as being both an employer and a worker.

**Workplace monitoring**: **monitoring** carried out in the working environment.

**X-ray equipment**: equipment that emits X-rays for the purpose of industrial radiography.

[2] International Atomic Energy Agency. 2018. *Regulations for the safe transport of radioactive material* (IAEA Safety Standards Series No SSR-6 (Rev.1)). Vienna: International Atomic Energy Agency.

# The holder of a source licence

## General

1. **Section 20(1)** of the Radiation Safety Act 2016 provides that 'The holder of a source licence is responsible at all times for the management and control of each radiation source to which the licence applies.' The holder of a source licence must therefore take prime responsibility for protection and safety of each radiation source. The holder of a source licence must:

    a) establish a management system to enhance protection and safety that includes:

        i) effectively integrating protection and safety into the overall management system of the organisation

        ii) making a commitment to protection and safety from the highest level of management of the organisation, and providing all required resources

        iii) implementing procedures for promoting continuous improvement and a safety culture

        iv) appointing at least one person as a radiation safety officer. Where practicable, this must be an employee

        v) ensuring that a radiation safety officer has the functions and duties set out in Appendix 1

        vi) ensuring that a radiation safety officer has sufficient authority and resources to fulfil the functions and duties in Appendix 1

        vii) ensuring that an industrial radiographer has the role of planning and delivery of radiography procedures

        viii) consulting with and engaging the services of qualified experts and interested parties as necessary

        ix) cooperating with a radiation safety officer and a qualified expert on radiation safety issues as needed

        x) ensuring that, where practicable, a radiography procedure is carried out in an exposure bay

    b) for all roles with duties in relation to protection and safety:

        i) fully document the roles

        ii) ensure people are notified of their duties and assume responsibility for performing them

c) ensure that:

   i) all activities associated with radiography equipment are justified and optimised for protection and safety

   ii) when objects to be radiographed cannot practicably be moved into an exposure bay, the work is carried out under 'site radiography' conditions.

d) in line with **section 9(3)** of the Radiation Safety Act 2016, which provides that 'A person who deals with a radiation source must ensure that any ionising radiation exposure that results from a planned operation or activity does not exceed the applicable dose limits set out in Schedule 3', be conversant with the requirements set out in Schedule 3 of the Radiation Safety Act 2016 and ensure that any radiation exposure that results from planned operations or activities does not exceed applicable dose limits.

# Risk assessment

2. The holder of a source licence must conduct, document and keep up to date a comprehensive risk assessment to:

   a) identify the ways in which occupational and public exposures could be incurred, including consideration of:

      i) dose rates from both shielded and unshielded radiation sources

      ii) limits and technical conditions for the operation of sources

      iii) ways in which external factors could affect protection and safety

      iv) ways in which operating errors and human factors could affect protection and safety

      v) evaluation and implications of any proposed modifications for protection and safety

   b) determine:

      i) the likelihood and magnitudes of exposures in normal operation and, to the extent practicable, assess potential exposures of industrial radiographers, other workers and the public, for a range of scenarios representing normal use and reasonably foreseeable incidents

      ii) ways in which structures, systems and components, as well as procedures relating to protection and safety, might fail or might otherwise lead to potential exposures, and the consequences of such failures

   c) assess the adequacy of provisions for protection and safety in respect of siting, design and operation.

# Fixed facilities

3. The holder of a source licence must:

   a) provide fixed facilities that

      i) are located, designed, manufactured, constructed, assembled, commissioned, operated, maintained and decommissioned adopting good engineering practice; utilise radiation shielding where needed; and minimise the need to rely on administrative controls and personal protective equipment for protection and safety

      ii) satisfy the requirements for fixed facilities set out in Appendix 2

   b) ensure that radiation shielding that forms part of the structure of fixed facilities in which industrial radiography is carried out, such as walls, doors and windows, is approved to be adequate for protection and safety by a qualified expert

   c) in consultation with a qualified expert, verify and document the adequacy of the shielding required by clause 3(b) whenever circumstances change that could increase the risks

   d) designate areas as controlled areas or supervised areas

   e) periodically review the designations set out in clause 3(d)

   f) shield an exposure bay and a store enclosure against radiation by applying a dose constraint of an effective dose of 0.3 mSv per year for a member of the public and a person occupationally exposed

   g) prominently display signs:

      i) specifying the actual or potential presence of ionising radiation using the international ionising radiation symbol (ie, trefoil) at access points to controlled areas and at appropriate locations within controlled areas

      ii) controlling unauthorised access to controlled areas and supervised areas

   h) formally decommission any fixed facility if there are no plans to use it again in the foreseeable future, including by:

      i) dealing with all radiography equipment in accordance with clause 5

      ii) removing all radiation trefoils and notices from the fixed facility

      iii) conducting a comprehensive radiation survey to confirm that no radiography equipment has been left on the site and that there is no radioactive contamination

      iv) preparing a final decommissioning report that includes the final radiation survey and details of the storage, transfer or disposal of radiography equipment.

# Equipment

4. The holder of a source licence must:

   a) ensure that radiography equipment, radiation survey meters, personal alarm monitors and ancillary equipment are provided, routinely inspected, maintained, tested, calibrated, serviced and safely managed so that:

      i) the equipment is appropriate for the radiography procedures to be performed and enables those procedures to be carried out safely and effectively

      ii) the equipment remains capable of fulfilling its design requirements for protection and safety throughout its lifetime

      iii) equipment is not modified without a prior assessment, that must be reviewed by a qualified expert of the supplier of the equipment, of the implications of the modification for protection and safety

   b) ensure that the requirements set out in Appendix 3 are satisfied

   c) cooperate with a person conducting a business or undertaking, a manufacturer or supplier to:

      i) ensure that the requirements in clauses 4(a) and 4(b) are met

      ii) ensure that radiography equipment is used only if it conforms to the applicable standards of the International Electrotechnical Commission and the International Organization for Standardization

      iii) share information on use and operating experience that may be important for protection and safety

      iv) apply the principles of optimisation in the design, planning and operation and decommissioning of a source

   d) maintain an accurate inventory and log of the movements of all radiation sources, including current location, date first at that location, person relocating and description

   e) maintain a record of maintenance for each item of radiography equipment, including:

      i) a fault log and remedial actions taken (interim and subsequent repairs)

      ii) the results of testing before an item is reintroduced to use

      iii) any reports from servicing engineers.

5. On cessation of operations, the holder of a source licence must, in addition to the requirements set out in clause 3(h), ensure that:

   a) a radioactive source such as a gamma source and an exposure device containing depleted uranium is:

      i) disposed of in accordance with a condition of the source licence, or

      ii) returned to the supplier, manufacturer's agent or manufacturer, or

iii) transferred to another person who is authorised to possess, manage or control the radioactive source under the Radiation Safety Act 2016, or

iv) appropriately stored by a person authorised to possess, manage or control the radioactive source under the Radiation Safety Act 2016.

b) all irradiating apparatus such as X-ray equipment is:

i) transferred to another person who is authorised to possess, manage or control the irradiating apparatus under the Radiation Safety Act 2016, or

ii) exported, or

iii) made inoperable.

# Training and authorisation

6. The holder of a source licence must ensure that:

a) all people with roles for protection and safety are qualified, educated and trained in protection and safety so that they understand their duties and can perform them competently

b) all people with roles for protection and safety have training:

i) that is regularly updated. and

ii) that satisfies the requirements set out in Appendix 4 if a person is appointed as a radiation safety officer, or

iii) that takes account of the training set out in Appendix 4 and is established in consultation with a qualified expert.

c) all industrial radiographers hold a use licence under the Radiation Safety Act 2016

d) an industrial radiographer's assistant uses radiography equipment only under the direct supervision of an industrial radiographer.

# Site radiography

7. Prior to the commencement of site radiography, the holder of a source licence must:

a) notify the Director at least five working days in advance of any work involving industrial radiography that is expected to last for 10 contiguous working days or more with details of:

i) the responsible radiation safety officer

ii) the proposed dates of the radiography

iii) the physical address of the site where radiography will be carried out

iv) the radiation sources to be used

b) identify, in consultation with a person conducting a business or undertaking where needed, any site-specific health and safety issues that need to be addressed

c) ensure that industrial radiographers are aware of those site-specific issues

d) consult with a person conducting a business or undertaking on the preparation and planning of the radiography procedures, including:

   i) agreeing the planned timescale of the work and the duration of the period over which radiography work will be performed

   ii) informing a person conducting a business or undertaking about the type of radiography equipment to be used

   iii) ensuring if necessary that any radiography equipment can be stored safely

   iv) providing a person conducting a business or undertaking with a copy of the holder of a source licence's local rules and emergency plans

e) ensure the public dose constraint specified in clause 25(a) is applied

f) further to clause 1(a)(vii), ensure that an industrial radiographer is supported by at least one other person whenever industrial radiography equipment is used.

# Policies, procedures and local rules

8. The holder of a source licence must establish, implement and maintain policies, procedures and local rules to meet the requirements of this code, including, without limitation, policies, procedures and local rules to:

   a) control access to areas where people can be exposed to radiation

   b) describe locations to be subject to workplace monitoring, the frequency of monitoring and the records to be kept

   c) carry out site radiography only when it is not practicable to perform the work in an exposure bay. Clause 1(a)(x) sets out requirements that apply to a management system

   d) use constraints to optimise protection and safety

   e) prevent accidents and emergencies and mitigate the consequences of any that occur

   f) report on and learn from accidents and other incidents

   g) comply with operational limits and conditions relating to public exposure

   h) provide protection and safety by applying preventive measures in the following hierarchy:

      i) engineered controls

      ii) administrative controls

      iii) personal protective equipment

i) set investigation levels and establish procedures to follow if those levels are exceeded

j) ensure that information on the safe use of equipment is provided to users

k) implement procedures for verification of compliance with this code

l) periodically review the overall effectiveness of measures for protection and safety.

# Monitoring and measurement

9. The holder of a source licence must establish and maintain:

   a) for any worker who usually works in a controlled area, or who occasionally works in a controlled area and may receive a significant dose from occupational exposure, such as exceeding an investigation level, individual monitoring where appropriate, adequate and feasible

   b) a programme of workplace monitoring for radiography in an exposure bay:

      i) around walls and doors and other openings of the exposure bay under a range of operating conditions, to ensure that an adequate level of shielding is maintained

      ii) at the entrance to the exposure bay and around the exposure device after completion of each gamma radiography exposure, to confirm that the gamma source has been satisfactorily returned to the exposure device or that X-ray emission has stopped

      iii) around the gamma source store, to ensure that an adequate level of shielding is provided

   c) a programme of workplace monitoring for site radiography work:

      i) around barriers during test exposure (or first exposure, depending on the circumstances) to confirm that the barriers are correctly positioned

      ii) at the operator position during wind-out of a gamma source or when an X-ray generator is energised, to confirm that radiation levels are not unacceptable

      iii) around barriers during routine exposures, to confirm that dose rates remain below values specified in this code

      iv) at the operator position during wind-in of a gamma source or termination of exposure of an X-ray generator

      v) around the exposure device after each exposure, to ensure that the source has been fully returned to the shielded position

      vi) around any source store used on-site, to ensure that an adequate level of shielding is provided

      vii) around the site on completion of the radiography work, to confirm that no gamma sources have been left on the site

      viii) around vehicles used to transport gamma sources prior to departure to and from the site

d) a monitoring programme for all workers who could be subject to exposure due to contamination, which is sufficient to:

   i) demonstrate the effectiveness of the measures for protection and safety

   ii) assess intakes of radionuclides and committed effective doses

e) programmes of source monitoring or environmental monitoring that are sufficient to assess public exposure arising from radiography equipment under the responsibility of the holder of a source licence

f) a capability that is sufficient to monitor unexpected increases in radiation levels due to an incident attributed to a source or a fixed facility for which the holder of a source licence is responsible

g) other monitoring or measurement programmes as necessary to verify compliance with the requirements in this code.

10. To satisfy the monitoring and measurement requirements in clause 9, the holder of a source licence must:

    a) use appropriate and if needed calibrated monitoring equipment

    b) where a worker receives a radiation dose exceeding three-tenths of a dose limit, ensure that individual monitoring of the worker is continuous and, to the extent practicable, is carried out using an external provider or internal capability that has a current accreditation to an appropriate standard, such as the International Organization for Standardization's General Requirements for the Competence of Testing and Calibration Laboratories (ISO/IEC 17025:2017).

11. The holder of a source licence must:

    a) to the extent practicable, obtain previous dose records of individual monitoring of a worker

    b) maintain records of all monitoring and verification of compliance, including:

       i) records of occupational exposure during and after each worker's working life, at least until the worker attains or would have attained the age of 75 years, and for not less than 30 years after the worker's ceasing work where that worker was subject to occupational exposure

       ii) records and estimated doses to members of the public

       iii) records of the tests and calibrations carried out

    c) to the extent practicable, provide records of occupational exposure to:

       i) individual workers in respect of their own exposure

       ii) subsequent employers of workers, subject to satisfying regulatory requirements applying to confidentiality and data security and protection.

# Incidents, accidents and emergencies

12. **Section 20(3)** of the Radiation Safety Act 2016 sets out what the holder of a source licence must do if they believe an incident has occurred that has resulted in an overexposure of a person to radiation. Section 20(3)(a) states that 'if the holder of a source licence believes that an incident has occurred that has resulted in unintended loss or release of radiation, or overexposure of a person to radiation, the holder must notify the Director as soon as practicable'. 'Overexposure of a person' has the interpretation given in this code.

13. The holder of a source licence must:

    a) take all practicable steps to minimise the likelihood of accidents, including by implementing a multilevel system of sequential, independent provisions for protection and safety, commensurate with the likelihood and magnitude of potential exposures

    b) take timely action to mitigate the consequences of any accident and restore radiography equipment to a safe condition after an accident

    c) promptly investigate any incident, including by:

        i) calculating or estimating the doses a person has received and, if applicable, the dose distribution within them

        ii) identifying corrective actions required to prevent a recurrence of the incident

    d) implement all corrective actions identified in clause 13(c)(ii)

    e) keep a written record of the incident, noting:

        i) the cause or suspected cause

        ii) the calculations made under clause 13(c)(i)

        iii) the corrective actions identified under clause 13(c)(ii)

        iv) the details of corrective actions implemented under clause 13(d)

    f) as soon as practicable, notify the Director of certain incidents involving equipment.

14. If the risk assessment required by clause 2 indicates that there is a reasonable likelihood of an emergency affecting either workers or members of the public, the holder of a source licence must prepare and maintain an emergency plan for the protection of people and the environment, which specifies:

    a) arrangements for promptly identifying an emergency

    b) a method for determining the correct level of emergency response

    c) provision for individual monitoring, area monitoring and arrangements for medical treatment

    d) arrangements for assessing and mitigating the consequences of an emergency.

15. The holder of a source licence must:

    a) conduct emergency exercises at appropriate intervals

    b) ensure that external parties know what the holder of a source licence expects of them if they are part of the emergency plan.

# Records

16. **Section 35(1)(a)** of the Radiation Safety Act 2016 provides that 'a person who has management or control of a radiation source must keep records that contain sufficient information to enable the Director to ascertain whether the person is complying with the radiation safety requirements'. To meet this requirement, the holder of a source licence must maintain records that verify compliance and are not occupational health records where other legislation applies for not less than 10 years. Clause 11(b)(i) sets out requirements that apply to occupational exposure.

17. The holder of a source licence must maintain adequate records, including of:

    a) the management structure as it relates to radiation safety

    b) the delegation of responsibilities of the holder of a source licence and the radiation practitioner

    c) the names of all people with responsibility for protection and safety, including details of their qualifications, education and training

    d) the design and shielding of exposure bays and storage rooms

    e) the quality assurance programme

    f) information necessary for the retrospective assessment of doses

    g) reports on investigations of unintended and accidental radiation exposures

    h) exemptions from this code granted under **section 86(3)** of the Radiation Safety Act 2016.

# Quality assurance

18. The holder of a source licence must establish a comprehensive quality assurance programme, which as a minimum addresses the following requirements:

    a) maintenance of the exposure device used for gamma radiography by a qualified expert at least annually, including detailed inspection of all the components

    b) a complete and detailed inspection and testing of X-ray equipment and its components at least annually, including:

        i) cleaning or replacement of any filters in cooling systems

        ii) checks to ensure that all cables are in good condition with no fraying or bare wires

iii) other routine checks and maintenance as recommended by the manufacturer

iv) tests on all interlocks and emergency cut-out switches

v) tests on any permanently installed radiation detectors inside the exposure bay (ensuring that this is done while no one is inside the exposure bay)

c) testing and maintenance of monitoring equipment, exposure bays and storage rooms to ensure the requirements in this code are satisfied, including requirements for appropriate safety systems and warning systems

d) maintaining records of relevant procedures and results.

# Industrial radiographer

## General

19. The industrial radiographer:

    a) is responsible for the planning and delivery of a radiography procedure

    b) must work safely and take all practical actions to minimise exposure to themselves and to other workers and members of the public by:

        i) following local rules and relevant procedures established by the holder of a source licence

        ii) wearing their individual dosemeters in the correct positions at all times during radiography work and source manipulation

        iii) using radiation monitors and radiation survey meters properly and in a systematic manner

        iv) performing routine operational checks of radiation monitors and radiation survey meters in collaboration with the radiation safety officer to ensure that they are working properly

        v) cooperating with the radiation safety officer and qualified experts on all radiation safety issues

        vi) participating in training on radiation safety

        vii) abstaining from any wilful action that could put themselves or others in contravention of regulation requirements or of the holder of a source licence's requirements

        viii) using collimators and additional shielding as appropriate to minimise potential exposure

        ix) verifying before each exposure that no one is inside an exposure bay and closing the door before initiating an exposure

        x) locking off source containers and X-ray control panels between exposures and removing the keys

    c) in the event of a person receiving or potentially receiving a greater than expected radiation dose, must:

        i) promptly inform the radiation safety officer

        ii) as soon as practicable provide a written report to the holder of a source licence.

## Routine inspections

20. Before commencing gamma radiography, the industrial radiographer must carry out routine inspections of equipment to detect conditions that could lead to an incident if left uncorrected, including by inspecting:

a) the exposure device, to ensure that:
    i) fittings and fasteners are tight
    ii) the locking mechanism functions properly
    iii) radiation levels are normal
    iv) connections of the guide tube and the control mechanism are secure
    v) the source assembly connection and the drive cable are verified to be secure using a wear gauge
b) the remote controls, to ensure that:
    i) fittings are tight
    ii) there are no indications of crushing, kinks or dents
    iii) the drive cable can move freely
c) the source guide tubes, to ensure that:
    i) fittings are tight
    ii) there are no indications of crushing, kinks or dents
    iii) source tips are not worn through
d) additional ancillary equipment such as magnetic stands, vice grip clamps and collimator attachments, to ensure:
    i) there is freedom of movement
    ii) the equipment is in good working condition
    iii) the equipment is appropriate for use.

21. When performing a source exchange, the industrial radiographer must perform pre-operational checks to ensure that:
    a) lock assemblies function properly
    b) guide tube and transfer tube connections are secure
    c) there are no obstructions in the guide tubes or transfer tubes.

22. Before commencing radiography using X-ray equipment, the industrial radiographer must carry out routine inspections of equipment to detect conditions that could lead to an incident if left uncorrected, including by checking that:
    a) there is no visible damage to the equipment
    b) exposure factors are clearly indicated
    c) the X-ray tube and all bare ends of the cable are not affected by damage, wear, dirt or moisture
    d) any liquid cooling systems are not leaking
    e) all interlocks are operational.
    f) all warning indicators and lights are functioning properly
    g) fasteners are tight and threaded connections are secure.

23. If the industrial radiographer finds any faults during these inspections, the equipment must not be used until it has been repaired or replaced.

24. The industrial radiographer must:

    a) check the functionality of the survey meter

    b) measure dose rates outside the exposure bay at a range of positions, including the operator's position and adjacent occupied areas, and terminate exposures if they exceed reference levels set out in this code.

# Site radiography

25. The industrial radiographer must:

    a) apply a dose constraint for a member of the public of an effective dose of 0.3 mSv accumulated over one year

    b) designate and demarcate by physical means an area as a controlled area where the instantaneous dose rate at the boundary of the area with the radiation source exposed does not as a maximum exceed 20 µGy per hour. This requirement does not apply when the radiation source is being wound out or in through a guide tube

    c) ensure that no other work is permitted in this area until the radiography work has been finished and the controlled area is no longer so designated

    d) prevent unauthorised access to the controlled area

    e) position the gamma wind-out mechanism or X-ray equipment control panel in a position that minimises doses to themselves when initiating and ending an exposure

    f) issue a clearly visible and/or audible signal whenever radiation exposures are in progress

    g) display notices at suitable positions on the boundary of the controlled area:

        i) bearing the international ionising radiation symbol (ie, trefoil), warnings and appropriate instructions

        ii) explaining the meaning of the signals set out in clause 25(g)

    h) clear the controlled area of all people except industrial radiographers and industrial radiographers' assistants who will be involved in the procedure

    i) ensure that the boundary of the controlled area is clearly visible, well-lit and constantly patrolled during radiography exposures, to ensure that no unauthorised people enter the area

    j) measure dose rates around the barriers during a test exposure to confirm that the barriers are correctly positioned

    k) adjust the boundary to the controlled area if necessary to comply with the dose rate requirements set out in clause 25(a)

    l) check the functionality of the survey meter and personal alarm monitors prior to use

    m) use a radiation survey meter at all times when approaching a radiation source

n) wear personal dosemeters and personal alarm monitors during the entire period for which they may be exposed to radiation

o) use a radiation survey meter on completion of work to ensure that all gamma sources have been fully retracted into the exposure device and that no sources have been left in the exposed position or have become detached

p) carry out a visual inspection before leaving a site (for site radiography) to ensure that equipment has not been damaged.

# Other parties

## Manufacturer/supplier

26. The manufacturer/supplier of radiography equipment must:

    a) supply well-designed, well-manufactured and well-constructed radiography equipment that:

        i) provides for protection and safety in line with the requirements of this code

        ii) meets national and international engineering, performance and functional specifications

        iii) meets quality standards appropriate to the significance of systems and components, including software, for protection and safety

        iv) provides clear displays, gauges and instructions on operating consoles

    b) test radiography equipment to demonstrate compliance with relevant specifications

    c) provide information on how to properly install and use radiography equipment and on associated radiation risks, including performance specifications, instructions for operating and maintenance, and instructions for protection and safety

    d) optimise the protection provided by shielding and other protective devices

    e) supply all radiography equipment with all appropriate radiation protection tools as a default, rather than as optional extras.

27. The manufacturer/supplier must:

    a) make suitable arrangements with the holder of a source licence to share information on use and operating experience that may be important for protection and safety

    b) cooperate with the holder of a source licence in accordance with clause 4(c).

## Servicing engineer

28. The servicing engineer must:

    a) install and service radiography equipment competently, so that it complies with the requirements set out in clause 4

    b) cooperate with the holder of a source licence to ensure that radiography equipment cannot be used for another purpose while it is being installed or serviced

c) after installing or servicing the equipment:

   i) collaborate with the holder of a source licence to ensure necessary quality control tests are completed successfully

   ii) confirm that all radiation protection and safety features are in place and operating correctly before equipment is returned to use

   iii) provide a written report to the holder of a source licence describing equipment faults (if any), work done, parts replaced, adjustments made and any changes that may affect protection and safety.

# Appendix 1: The functions and duties of a radiation safety officer

1. The functions and duties of a radiation safety officer include:
    a) liaising and cooperating with qualified experts as needed
    b) maintenance of source inventory records
    c) inspection and maintenance of engineering controls, safety features and warning features
    d) oversight of access control for controlled areas
    e) establishment and periodic review of arrangements for personal dosimetry, including maintenance and review of occupational dose records
    f) performance of routine operational checks of radiation survey meters and personal alarm monitors in collaboration with industrial radiographers, to ensure that those instruments are working correctly
    g) verifying that industrial radiographers are suitably trained in the use of equipment and radiation protection, and that they receive regular refresher training
    h) ensuring that emergency plans are established and practised regularly
    i) supervision of workplace monitoring arrangements
    j) establishment, issue and periodic review of local rules
    k) notify the holder of a source licence and investigating higher-than-usual exposures and overexposures
    l) investigation and reporting of incidents, including accidents.

# Appendix 2: Fixed facility requirements

## Exposure bay

The exposure bay must:

1. be purpose designed for in-house radiography taking into account the outcomes of the risk assessment required in clause 2
2. enable radiography equipment to be controlled from outside the exposure bay
3. have access doors that are not exposed to the primary X-ray beam
4. use a physical means such as a lockable door to prevent access to the exposure bay during radiography procedures
5. have a mechanical or electrical interlock to ensure that:
    a) X-ray equipment cannot be energised when the door is open
    b) no one can access the exposure bay while an X-ray generator is generating X-rays
    c) the generation of X-rays is terminated immediately if the door is opened.
6. have unambiguous and distinguishable visible or audible warning signals to display immediately before and during radiography procedures. These signals must operate automatically when an X-ray exposure is initiated
7. have visible notices that clearly explain the significance of pre-warning and 'source exposed' signals posted at appropriate locations in and around a fixed facility
8. have means of rapid egress for people in the exposure bay if a radiography procedure is initiated
9. have emergency stop buttons or pull-cords with manual resets installed to enable any person within the exposure bay to trigger an alarm immediately and to terminate or prevent radiation exposure, either automatically or by attracting the attention of the industrial radiographer
10. where practicable, have appropriate radiation shielding in the roof or, in the absence of such shielding, controls to prevent access to the roof area of an exposure bay during a radiography procedure.

# Storage room

The storage room must be:

11. purpose designed for the storage of radiography equipment
12. fire resistant enough to minimise any loss of shielding and containment in the event of a fire in the vicinity
13. remote from explosion and corrosion hazards.

# Appendix 3: Equipment requirements

## Gamma sources

### Radioactive source

Radioactive sources must:

1. be certified as meeting the requirements for special form radioactive material
2. meet the requirements of the specifications for performance, design and tests
3. be leak tested in accordance with the specifications for performance, design and tests.

### Radiation source assembly (the 'pigtail')

Source assemblies must:

4. meet the requirements of the specifications for performance, design and tests
5. be compatible with the exposure device, ancillary equipment (such as guide tubes) and any source changer with which the assembly is used
6. be durably marked at a minimum with:
    a) the international ionising radiation symbol (ie, trefoil) and the legend 'RADIOACTIVE'
    b) the manufacturer's serial number.

### Exposure device

Exposure devices must:

7. have control cables and guide tubes of a length that meets the manufacturer's recommendations
8. satisfy the applicable requirements of the specifications for performance, design and tests
9. be permanently and clearly labelled with:

a) the international ionising radiation symbol (ie, trefoil)

b) the word 'RADIOACTIVE' in letters not less than 10 mm in height, together with a brief warning

c) the chemical symbol(s) and mass number of the radionuclide(s) for which the exposure device is suitable

d) the maximum source activity permitted in the exposure device, quoted for each radionuclide for which the exposure device is suitable

e) the international standard to which the exposure device and its accessories conform

f) the name of the manufacturer, model number and serial number of the exposure device

g) if applicable, the mass of the depleted uranium shielding, or the indication 'contains depleted uranium'

h) the name, address and telephone number of the holder of the source licence

10. display information in a durable fireproof label or tag about the radioactive source currently in the exposure device, including:

    a) the chemical symbol and mass number of the radionuclide

    b) the activity on a stated date

    c) the identification number of the sealed source

    d) the identity of the source manufacturer.

# X-ray equipment

X-ray equipment must:

11. have a cable length of not less than 20 m for X-ray generators up to 300 $kV_p$ and longer for higher-voltage equipment

12. be fitted with collimators for directional radiography

13. incorporate beam filters to enable filtration to be matched to the work to be undertaken

14. have a control panel that includes:

    a) a label incorporating the international ionising radiation symbol (ie, trefoil), a legend indicating that X-rays are emitted when the equipment is operating and a warning label prohibiting unauthorised use

    b) a key switch to prevent unauthorised use, and a key that is only removable when the switch is in off or standby positions

    c) a labelled warning light that indicates when the equipment is enabled

    d) a separate labelled warning light that indicates when the equipment is actually emitting X-rays

e) a timer that controls the exposure duration or an 'on' switch that requires continuous pressure by the industrial radiographer to maintain the generation of X-rays

f) indicators that show the kilovolts and the current in milliamperes when the X-ray beam is on

g) a clearly labelled means of immediately terminating the generation of radiation

15. have a means to prevent inadvertent movement of the X-ray tube head

16. to the extent practicable, have a maximum leakage radiation rate from the collimator system and X-ray tube assembly of 100 µGy per hour at 1 m from the X-ray tube's target.

# Ancillary equipment

17. All ancillary equipment must:

a) satisfy the applicable requirements of specifications for performance, design and tests

b) be compatible with the specific exposure device and source assembly with which it is used.

18. Collimators must be compatible with the source assembly.

19. Source changers must:

a) satisfy the applicable requirements of specifications for performance, design and tests

b) incorporate a system to ensure that the source is not accidentally withdrawn from the source changer when the connecting or disconnecting

c) include a lock or an outer locked container designed to prevent unauthorised or accidental removal of the sealed source from its shielded position.

20. Storage containers must:

a) allow for the safe storage of sealed sources when not in use

b) satisfy the applicable requirements of specifications for performance, design and tests.

# Appendix 4: Training requirements for a radiation safety officer

The following table sets out the levels of knowledge a radiation safety officer must have in relevant areas. In the 'Level of knowledge' column, '1' indicates general awareness and understanding and '2' indicates an ability to interpret and apply working knowledge in different situations.

| | Level of knowledge |
|---|---|
| **Fundamental concepts and measurements** | |
| Basic radiation concepts | 2 |
| Radiation quantities and units | 2 |
| Radiation detection instruments | 2 |
| Biological effects of radiation | 1 |
| **Principles of radiation protection** | |
| Justification, optimisation and limitation | 2 |
| Regulatory requirements | 2 |
| Designation of controlled areas and supervised areas | 2 |
| Dose limits and investigation levels | 2 |
| **Practical radiation protection and safety** | |
| Source outputs | 2 |
| Effects of time, distance and shielding | 2 |
| Individual monitoring | 2 |
| Practices to limit doses and maintain them as low as is reasonably achievable, taking into account economic, social and environmental factors | 2 |
| Storage of radioactive sources | 2 |
| Correct operation and maintenance of radiography equipment | 2 |
| Radiation protection programme | 2 |
| Local rules | 2 |

| | Level of knowledge |
|---|---|
| Emergency plans | 2 |
| Management of radiation protection and safety (including the requirements of the Radiation Safety Act 2016) | 2 |
| Considerations for spent sealed radioactive sources | 2 |
| Accidents and other incidents | 2 |
| Emergency preparedness and response | 2 |

# Submission form

## Your details

This submission was completed by: *(name)* _____

Address: *(street/box number)* _____

*(town/city and postcode)* _____

Email: _____

Organisation (if applicable): _____

Position (if applicable): _____

## Additional information

I am, or I represent an organisation that is, based in:

☐ New Zealand

☐ Australia

☐ other (please specify): _____

I am or I represent:

☐ a company engaged in industrial radiography

☐ an industrial radiographer

☐ a supplier of industrial radiography equipment

☐ a service engineer

☐ other (please specify): _____

## Privacy statement

The Ministry of Health | Manatū Hauora may publish submissions on its website. If you are submitting as an individual, the Ministry will remove your personal details and any identifiable information.
If you do not want your submission published on the Ministry's website, please tick this box:

☐ Do not publish this submission.

Your submission will be subject to requests made under the **Official Information Act 1982**. If you want your personal details removed from your submission in this context, please tick this box:

☐ Remove my personal details from responses to Official Information Act 1982 requests.

**Please return this form:**
By email to: **ors.codes@health.govt.nz**
By post to: Office of Radiation Safety C7
Ministry of Health
PO Box 5013
Wellington 6140

## Consultation questions

**The Director for Radiation Safety (the Director) is specifically seeking feedback and comments on the following questions.**

1. Is the description of industrial radiography in the scope of revised C7 appropriate?
   ☐ Yes
   ☐ No

   Comments:

2. Is the proposed interpretation of 'industrial radiographer's assistant' appropriate?
   ☐ Yes
   ☐ No

   Comments:

3. Are the references to the Health and Safety at Work Act 2015 and a 'person conducting a business or undertaking' necessary for clarity?
   ☐ Yes
   ☐ No

   Comments:

4. Is the proposed interpretation of 'overexposure of a person' appropriate and complete?

☐ Yes

☐ No

Comments:

5. Are the two standards included in the interpretation of 'Specifications for performance, design and tests' appropriate and comprehensive?

☐ Yes

☐ No

Comments:

6. Are the requirements in clauses 3(b) and (c) for the holder of a source licence to consult on radiation shielding with a qualified expert necessary for radiation safety?

☐ Yes

☐ No

Comments:

7 Clause 3(d)(ii) of C7 specified a maximum instantaneous dose rate of 15 µSv per hour. Is it appropriate that this has been deleted in the revised C7?

☐ Yes
☐ No

Comments:

8. Are the requirements in clauses 5(a) and (b) for the disposal of radioactive material and irradiating apparatus appropriate and adequate?

☐ Yes
☐ No

Comments:

9. Are the requirements in clauses 6(c) and (d) necessary to ensure safety?

☐ Yes
☐ No

Comments:

10. Is the proposed requirement in clause 7(1)(a) to notify the Director of extended periods of on-site radiography practicable? The purpose of the notification is to facilitate unannounced regulatory on-site visits at the discretion of the Director.

☐ Yes
☐ No

Comments:

11. Is the proposed requirement in clause 10(b) of the revised C7 that the holder of a source licence must use an accredited provider to provide a dose monitor to be used by an individual who is likely to exceed three-tenths of a dose limit justified to ensure protection and safety?

☐ Yes
☐ No

Comments:

12. Is the requirement to notify the Director of 'certain incidents involving equipment' in clause 13(f) appropriate and complete?

☐ Yes
☐ No

Comments:

13. Are the requirements for tests to carried out at least once per year in clauses 18(a) and (b) appropriate?

☐ Yes
☐ No

Comments:

14. Is there any requirement in clause 25, 'Site radiography', that could be more clearly stated if the requirement was included in clause 19, 'General'?

☐ Yes
☐ No

Comments:

15. Is the reduction from 25 μSv per hour to 20 μGy per hour in clause 25(b) appropriate?

☐ Yes
☐ No

Comments:

16. Is it appropriate to replace clause 26, 'Qualified expert', in C7 with clause 1(a) of Appendix 1 in revised C7?

☐ Yes
☐ No

Comments:

17. Is it appropriate to delete clause 30 of C7, 'Client'?

☐ Yes

☐ No

Comments:

18. Would the inclusion in revised C7 of a complete appendix setting out cross-references to the Radiation Safety Act 2016 be useful? **Section 87(b)** of the Act requires that a code of practice must state the fundamental requirement to which it relates. This statement is made in the section of revised C7 headed 'Scope'.

☐ Yes

☐ No

Comments:

19. In Appendix 1, is the description of the functions and duties of a radiation safety officer complete and appropriate?

☐ Yes

☐ No

Comments:

20. Is the requirement in clause 10 of Appendix 2, under 'Exposure bay', adequate for protecting a person from scattered radiation escaping from the roof of an exposure bay?

☐ Yes

☐ No

Comments:

21. Is an additional clause in Appendix 2 under 'Exposure bay' required to restrict the direction of a primary radiation beam to a downward direction?

☐ Yes
☐ No

Comments:

22. Are the training requirements for a radiation safety officer set out in Appendix 4 appropriate and comprehensive?

☐ Yes
☐ No

Comments:

23. Is it appropriate to replace 'Appendix 4: Training requirements' in C7 with 'Appendix 4: Training requirements for radiation safety officers' in revised C7?

☐ Yes
☐ No

Comments:

24. Do the training requirements set out in Appendix 4 of the revised C7 provide an adequate core of knowledge for those who have responsibilities for protection and safety specified by the holder of a source licence?

☐ Yes
☐ No

Comments:

25. Please list any other changes you would like to suggest to the revised C7 or make further comments.

Comments: