MINISTRY OF HEALTH
MANATŪ HAUORA

New Zealand Government

Code of Practice for Unsealed Radioactive Material

ORS C11

2020

Released 2020

Citation: Ministry of Health. 2020. *Code of Practice for Unsealed Radioactive Material: ORS C11*. Wellington: Ministry of Health.

Published in July 2020 by the Ministry of Health
PO Box 5013, Wellington 6140, New Zealand

ISBN 978-1-99-002904-2 (online)
HP 7421

MINISTRY OF HEALTH
MANATŪ HAUORA

This document is available at health.govt.nz

Contents

Introduction

Purpose and commencement

This Code of Practice for Unsealed Radioactive Material ('code') is issued by the Director for Radiation Safety ('the Director') under section 86 of the Radiation Safety Act 2016 ('the Act'). It provides the operational information necessary to comply with the fundamental requirements in sections 9 to 12 of the Act. Appendix 1 sets out cross-references between clauses in this code and those fundamental requirements. The requirements in this code do not limit the general nature of the fundamental requirements. This code comes into force on 31 July 2020.

Scope

This code applies to all activities associated with the use of unsealed radioactive material but excluding activities in the specific codes:

- ORS C9: Code of Practice for Veterinary Radiation
- ORS C2: Code of Practice for Nuclear Medicine.

Activities can include the dispensing, possession, control, management, use, storage, import, export, sale, supply, discharge and disposal of radioactive material and equipment.

The following issues are dealt with in separate codes of practice:

- safety of radioactive material in transport: ORS C6
- security of radioactive material in use, storage or transport: ORS C5.

Compliance with the code does not imply compliance in related areas such as occupational safety, hazards in the workplace and resource management.

Contact

The Director's contact details are:

Office of Radiation Safety
PO Box 5013
Wellington 6140

Email: **orsenquiries@health.govt.nz**
Fax: 04 496 2340

Roles and responsibilities

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

Director for Radiation Safety – the individual appointed under section 76 of the Act to perform functions and duties and exercise powers set out in the Act, including the power to issue this code.

Managing entity – the legal entity that manages or controls radiation sources and must, therefore, obtain a source licence as required by section 13(a) of the Act. This could be, for example, an independent company providing science services or an educational organisation.

Manufacturer/supplier – the person or organisation that designs, manufactures, produces, constructs, assembles, installs, distributes, sells, exports or imports unsealed radioactive material, sealed sources used for calibration and quality control tests, or ancillary equipment that could influence the successful outcome of a radiation procedure.

Qualified expert – an individual who is recognised as having expertise in a relevant field of specialisation such as health physics or radiation safety.

Radiation safety officer – a person competent in radiation protection and safety who the managing entity designates to oversee the application of regulatory requirements.

Definitions

Defined terms are identified in **bold** and have the following meanings.

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 **protective equipment** that has an impact on the successful outcome of a **radiation procedure**, such as activity meters, contamination meters, radiation measurement equipment and sealed sources used for calibration and quality control tests.

Committed effective dose – the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the **committed equivalent doses** to those organs or tissues.

Committed equivalent dose – the **equivalent dose** to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

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**. Constraints for **occupational exposure** and **public exposure** are established or approved by the Director and, if established, are published in a compliance guide issued under this code.

Controlled area – an area in which specific protection measures and safety provisions are or could be required for controlling exposures in normal working conditions, and preventing or limiting the extent of **potential exposures**.

Dose limit – the value of **effective dose** or **equivalent dose** set out in Schedule 3 of the Act.

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 or earthquakes.

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 dose in a tissue or organ of the body.

Facility – the location at which **radiation procedures** are performed and **radiation sources** and **ancillary equipment** are installed, used, handled or stored.

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-room protective equipment – equipment used to reduce exposure to radiation but not worn on the person, such as shields for bench tops, vials, syringes, activity meters, and equipment to prepare radioactive material; tools to remotely handle radioactive material, including tongs and forceps; containers to transport radioactive waste and sources; and fume hoods.

Investigation level – 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 – 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 diagnosis or medical treatment, by comforters/carers while providing care, support or comfort to patients undergoing **radiation procedures**, and by volunteers in a programme of biomedical 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 radioactive contamination, dose or dose rate to enable the assessment or control of exposure due to radiation, and the interpretation of the results.

Occupational exposure – exposure of **workers** incurred in the course of their work.

Occupationally exposed person – any person who is subject to **occupational exposure**.

Optimise – 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, taking economic and social factors into account. 'Optimises', 'optimised' and 'optimisation' have corresponding meanings.

Personal protective equipment – equipment worn on the person to reduce their exposure to radiation, such as a protective apron, or to prevent the transfer of contamination, such as a laboratory gown, waterproof gloves, overshoes and respiratory protection.

Planned exposure situation – situation of exposure that arises from the planned use of **radiation sources** or from a planned activity that results in an exposure due to a **radiation source.**

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, the safety of **radiation sources**, including the means for achieving this, and the means for preventing **accidents** and the mitigation of consequences of **accidents** if they do occur.

Protective equipment – **personal protective equipment** and **in-room protective equipment**.

Public exposure – exposure to ionising radiation experienced by a **member of the public** but excluding any **occupational exposure** or **medical exposure**.

Radiation emergency – an emergency in which there is, or is perceived to be, a hazard due to radiation exposure.

Radiation procedure – a procedure involving the use of a **radiation source**.

Radiation source – a source that spontaneously emits ionising radiation, including unsealed radioactive material or a sealed source used for calibration and quality control tests.

Reportable incident – an **incident** resulting in (a) a **dose limit** being exceeded or (b) **radiation sources** that are lost, missing or beyond regulatory control.

Safety 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**.

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

Unsealed radioactive material – radioactive material that is neither permanently sealed in a capsule nor closely bonded in solid form.

Worker – an individual who works, whether full time, part time or temporarily, for the managing entity 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.

Managing entity

General

1. The managing entity must:

   (a) take prime responsibility for protection and safety

   (b) 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 at the facility, and by providing all required resources

      (iii) promoting continuous improvement and a safety culture

      (iv) appointing a radiation safety officer to oversee the application of regulatory requirements for radiation protection and safety

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

   (c) for all appointments under subclause 1(b)(iv):

      (i) ensure appointees are notified of their duties in relation to protection and safety and assume responsibility for performing them

      (ii) fully document the appointments

   (d) ensure that:

      (i) all activities associated with radiation sources are justified and optimised for protection and safety

      (ii) dose limits[1] for occupational and public exposure are not exceeded as a result of those activities

   (e) establish an annual review of the protection and safety management system to assess its effectiveness and to verify compliance with the requirements in this code.

[1] Appendix 3 sets out annual limits on intake for common radionuclides. These limits are the levels that, if ingested or inhaled, would give a total committed effective dose of 20 millisieverts in an average adult.

Safety assessment

2. The managing entity must conduct, document and keep up to date a safety assessment to:

   (a) identify the ways in which occupational and public exposures could be incurred

   (b) determine the expected likelihood and magnitudes of exposures in normal operation and, to the extent reasonable and practicable, assess potential exposures

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

Facilities

3. The managing entity must:

   (a) provide facilities that are sited, located, designed, manufactured, constructed, assembled, commissioned, operated, maintained and decommissioned in accordance with good engineering practice, taking into account workload and minimising the need to rely on administrative controls and personal protective equipment for protection and safety

   (b) provide suitable areas for source storage and preparation, personal contamination monitoring, decontamination, and radioactive waste storage and predisposal processing

   (c) provide as appropriate:

      (i) taps and soap dispensers that are operable without direct hand contact, a shower for personal decontamination, and an eyewash in areas where unsealed radioactive material is handled

      (ii) a ventilation system in areas where radioactive aerosols or gases are produced or handled

   (d) shield the facility to ensure that expected doses to any person are as low as reasonably achievable and that rooms housing sensitive instruments maintain a sufficiently low level of background radiation to avoid interference

   (e) verify and document the adequacy of shielding required in subclause 3(d) whenever circumstances change that could increase the risks

   (f) designate and delineate appropriate areas as controlled areas or supervised areas and periodically review those designations and delineations

   (g) restrict access as appropriate to controlled areas and supervised areas

(h) prominently display signs:

(i) specifying the actual or potential presence of ionising radiation using the symbol recommended by the International Organization for Standardization at access points to controlled areas and supervised areas and at appropriate locations within controlled areas

(ii) controlling access by members of the public to controlled areas and supervised areas

(i) ensure that floors, walls and other surfaces are covered with smooth, continuous non-absorbent materials that can be easily cleaned and decontaminated in areas where unsealed radioactive material is used or stored.

Radiation sources and equipment

4. The managing entity must:

(a) ensure that radiation sources are fit for their intended purpose

(b) provide, maintain, test and regularly service protective equipment and ancillary equipment so that it:

(i) is fit for its intended purpose

(ii) fulfils its design requirements for protection and safety

(c) conduct leak tests of sealed sources to confirm that there is no leakage[2] of radioactive material:

(i) on installation if the manufacturer has not supplied a leak test certificate

(ii) every two years if the source is older than 10 years

(iii) immediately if the device has been damaged or there are other reasons to believe that it may be leaking

(iv) using an external service that maintains laboratory accreditation under ISO/IEC 17025 for ionising radiation dosimetry, or internal capability validated by a qualified expert

(d) provide, as appropriate, at entrances to controlled areas:

(i) personal protective equipment

(ii) equipment for individual monitoring and workplace monitoring

(iii) equipment to monitor contamination of skin and clothing

[2] Maximum permitted removable activity is 0.2 kilobecquerels. However, the presence of any measurable activity should be investigated, even if below the permitted activity.

(e) provide, as appropriate, kits for dealing with spills, including items such as:

(i) protective clothing, for example, gowns, disposable overshoes and impermeable gloves

(ii) decontamination materials for the affected areas, including absorbent materials for wiping up spills – for example, buckets, brushes, towels or absorbent pads, forceps or tongs – and decontaminating agents

(iii) decontamination materials for people – for example, mild soap or chelating detergent, sponge and iodide or iodate tablets if appropriate

(iv) warning notices and barrier tape

(v) portable monitoring equipment

(vi) bags for waste, together with tape, labels and pencils

(f) maintain control of radioactive sources to prevent loss or damage and to prevent any person from carrying out unauthorised activities, including by:

(i) maintaining an accurate inventory of all radioactive sources, including their location, description, activity and form

(ii) periodically checking that radioactive sources are under control and in the locations recorded in the inventory maintained under subclause 4(f)(i)

(iii) releasing radioactive sources only to people who are authorised to assume management and control under the Act

(g) take immediate steps to regain control of any radioactive sources that are abandoned, lost, misplaced, stolen or otherwise transferred without proper authorisation

(h) dispose of radioactive waste:

(i) as non-radioactive waste after storing it for a time that is sufficient to meet the criteria for clearance in Schedule 2 of the Act, or

(ii) by returning it to the manufacturer, or

(iii) via landfill and/or discharge to sewer or the atmosphere in accordance with Appendix 4, or

(iv) in accordance with a waste management plan approved by the Director.

Training and authorisation

5. The managing entity must ensure that all people with responsibilities for protection and safety:

   (a) are qualified, educated and trained in protection and safety so that they understand their duties and can perform them competently

   (b) satisfy the training requirements set out in Appendix 2

   (c) are named in a current list with details of their qualifications, education and training

   (d) are notified of their duties in relation to protection and safety

   (e) are authorised to assume their roles and responsibilities.

Restricted activities

6. The managing entity must not, without the prior written approval of the Director, allow:

   (a) practices that result in an increase in activity by deliberately adding radioactive material, or by activation, in food, feed, beverages, cosmetics or any other commodity or product intended for a person to ingest, inhale or take in through the skin, or to be applied to them

   (b) practices involving the frivolous use of radiation or radioactive material in commodities or in consumer products such as toys and personal jewellery or adornments, which result in an increase in activity by deliberately adding radioactive material or by activation

   (c) human imaging using radiation that is:

      (i) performed as a form of art or for publicity purposes

      (ii) performed for occupational, legal or health insurance purposes, and undertaken without referring to clinical indication

      (iii) used to detect concealed objects

   (d) devices or manufactured items into which radionuclides have deliberately been incorporated or produced by activation, or that generate ionising radiation and that can be sold or made available to members of the public without special surveillance or regulatory control after sale, to be made available to the public.

Policies, procedures and local rules

7. The managing entity must establish, implement and maintain policies and procedures to meet the requirements of this code including, without limitation, policies and procedures:

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

   (b) to use constraints to optimise protection and safety

   (c) for the management of radioactive waste and discharges of radioactive material

   (d) for routine radioactive material preparations and dispensing procedures

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

   (f) to report on and learn from accidents and other incidents

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

   (h) for staff who have indicated they may be pregnant, to minimise unnecessary exposure to the embryo or fetus

   (i) to provide protection and safety by applying preventive measures in the following hierarchy:

      (i) engineered controls

      (ii) administrative controls

      (iii) personal protective equipment

   (j) to set an investigation level and establish procedures to follow if such a level is exceeded

   (k) to implement the annual review of the protection and safety management system.

8. The managing entity must maintain, publish and enforce any written local rules that are necessary for protection and safety.

Monitoring and measurement

9. The managing entity must establish and maintain:

   (a) a programme of continuous individual monitoring whenever appropriate, adequate and feasible, which is sufficient to assess occupational exposures for workers who usually work in a controlled area or who may receive a dose exceeding 10 percent of the dose limits

(b) a programme of workplace monitoring that is sufficient to:

(i) evaluate radiological conditions in all workplaces

(ii) assess exposures in controlled areas and supervised areas that are not assessed under subclause 9(a)

(iii) review the classification of controlled areas and supervised areas

(c) 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, if significant, calculate the committed effective doses

(d) programmes of source monitoring or environmental monitoring that are sufficient to assess public exposure arising from radiation equipment under the responsibility of the managing entity

(e) a capability that is sufficient to monitor unexpected increases in radiation levels due to an incident attributed to a source or facility for which the managing entity is responsible

(f) a programme to monitor areas after unsealed radioactive material has been used to ensure that all contaminated articles have been appropriately disposed of and that surface contamination levels are less than 0.4 becquerels per square centimetre for alpha radiation and 3 becquerels per square centimetre for beta and gamma radiation when averaged over an area of 100 square centimetres

(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 managing entity must:

(a) use appropriate monitoring equipment

(b) for continuous individual monitoring under subclause 9(a), use an external service that:

(i) maintains laboratory accreditation under ISO/IEC 17025 for ionising radiation dosimetry

(ii) returns results to the managing entity within 20 working days of receiving all necessary raw information.

11. The managing entity must:

(a) take all reasonable steps to obtain previous dose records

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

(i) records of occupational exposure during and after the 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 ceasing work where the worker was subject to occupational exposure

(ii) records and estimated doses to members of the public

(iii) records of the tests and calibrations of radiation monitoring equipment carried out

(c) provide records of occupational exposure to:

(i) individual workers in respect of their own exposure

(ii) subsequent employers of workers, subject to satisfying confidentiality criteria

(iii) the Director on request or if the managing entity is no longer able to maintain records as required under subclause 11(b)

(d) provide records of source monitoring and environmental monitoring to assess public exposure to:

(i) members of the public on request

(ii) the Director on request

(iii) the Director immediately, if any levels exceed operational limits and conditions relating to public exposure or there is a significant increase in dose rate that could be attributed to the authorised practice.

Incidents, accidents and emergencies

12. The managing entity must:

(a) take all practicable steps to minimise the likelihood of accidents, including 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 that does occur and restore radiation equipment to a safe condition

(c) promptly investigate any incident, including by:

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

(ii) identifying corrective actions required to prevent a recurrence

(d) implement all corrective actions identified in subclause 12(c)(ii)

(e) keep a written record of the incident, including the:

(i) cause or suspected cause

(ii) calculations made under subclause 12(c)(i)

(iii) corrective actions identified under subclause 12(c)(ii)

(iv) details of the implementation of corrective actions under subclause 12(d)

(f) notify any reportable incident to the Director as soon as is practicable but not exceeding 48 hours later.

13. If the safety assessment required by clause 2 indicates a reasonable likelihood of an emergency affecting either workers or members of the public, the managing entity must prepare an emergency plan to protect people and the environment, which includes:

(a) arranging to promptly identify an emergency

(b) determining the correct level of emergency response

(c) providing individual monitoring and area monitoring and arranging for medical treatment

(d) arranging to assess and mitigate any consequences of an emergency

(e) conducting drills and/or emergency exercises at appropriate intervals, which include the involvement of external parties if they are part of the emergency plan.

Records

14. The managing entity must maintain adequate records, retain records for not less than 10 years or as otherwise specified, and make them available as necessary, including:

(a) the delegation of responsibilities of the managing entity

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

(c) annual review of the protection and safety management system

(d) cradle-to-grave documentation for sealed sources including the manufacturer's original documentation for not less than 10 years after sale, export or disposal

(e) reports on investigations of incidents

(f) radioactive waste that is generated, stored, transferred or disposed of

(g) exemptions from this code granted under section 86(3) of the Act.

Other parties

Radiation safety officer

15. The radiation safety officer must oversee the day-to-day implementation of regulatory requirements by the managing entity, including by:

    (a) maintaining source inventory records

    (b) inspecting and maintaining engineering controls, safety features and warning features

    (c) overseeing access control for controlled areas

    (d) establishing and periodically reviewing arrangements for personal dosimetry, including maintaining and reviewing occupational dose records

    (e) performing routine operational checks of monitoring instruments to ensure that they are working properly

    (f) ensuring that everyone with responsibilities for radiation protection and safety is suitably trained in the use of radioactive material and radiation protection, and that they receive regular refresher training

    (g) ensuring that emergency plans are established and practised regularly

    (h) supervising workplace monitoring arrangements

    (i) establishing, issuing and periodically reviewing local rules

    (j) investigating higher-than-usual exposures and overexposures

    (k) investigating and reporting incidents, including accidents.

16. The radiation safety officer must work in close cooperation with qualified experts, if appointed, to ensure that all necessary duties and tasks are performed.

Qualified expert

17. The qualified expert, if appointed, must work in close cooperation with the radiation safety officer to ensure that all necessary duties and tasks are performed.

Manufacturer/supplier

18. The manufacturer/supplier must:

    (a) supply well-designed, well-manufactured and well-constructed ancillary equipment and protective equipment that:

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

        (ii) meets 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) supply radioactive sources that are manufactured in accordance with good manufacturing practice and fit for their intended purpose

    (c) test radiation sources and equipment to demonstrate compliance with relevant specifications

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

    (e) optimise the protection provided by shielding and other protective equipment

    (f) supply all radiation sources and equipment with all appropriate radiation protection tools as a default, rather than as optional extras.

19. The manufacturer/supplier must:

    (a) make suitable arrangements with managing entities to share information on use and operating experience that may be important for protection and safety

    (b) cooperate with the managing entity for the purpose of meeting the requirements in clause 4.

Appendix 1: Cross-reference to Radiation Safety Act 2016

As required by section 87(1) of the Radiation Safety Act 2016, clauses in this code apply to the fundamental requirements in sections 9–12 of the Act as follows.

Section in Act	Clauses in code
9(1)	1–2, 5–8, 15–18
9(2)	1–5, 8–11, 14–18
9(3)	1–5, 8–11, 14–18
10(1)	2, 4–5, 8, 12–14, 16–20
10(2)	2, 4–5, 8, 12–14, 16–20
10(3)	2, 4–5, 8, 12–14, 16–20
11	1, 4
12	2–5, 8, 14, 16–18

Appendix 2: Training requirements

	User	Radiation safety officer	Qualified expert
Atomic structure, X-ray production and interaction of radiation	l	m	h
Nuclear structure and radioactivity	l	m	h
Radiological quantities and units	l	m	h
Fundamentals of radiation detection	m	m	h
Principle and process of justification	l	m	h
Fundamentals of radiobiology, biological effects of radiation	l	m	h
Risks of cancer and hereditary disease	l	m	h
Risks of deterministic effects	l	m	h
General principles of radiation protection, including optimisation	m	m	h
Operational radiation protection	m	h	h
Particular staff radiation protection aspects	m	h	h
Risks from fetal exposure	l	m	h
Quality control and quality assurance	l	m	h
National regulations and international standards	m	h	h

Level of knowledge

l – low level of knowledge (general awareness and understanding of principles)

m – medium level of knowledge (basic understanding of the topic sufficient to influence practices undertaken)

h – high level of knowledge (detailed knowledge and understanding sufficient to be able to educate others)

Equivalence

Qualified expert: The training requirements for a qualified expert in this appendix are deemed to be satisfied by Australasian Radiation Protection Accreditation Board certification in radiation protection.

Appendix 3: Waste disposal

Landfill

Radioactive material may be disposed of without an approved waste management plan by placement into landfill if the material:

20. is in solid form

21. is contained within packaging designed so that:

    (a) the smallest overall external dimension of each package is not less than 10 centimetres

    (b) the package can be easily handled

    (c) there are at least two complete layers of packaging between the radioactive material and the exterior of the package, one layer of which is waterproof

    (d) the outer layer of each package:

        (i) as far as practicable, prevents the collection and retention of water

        (ii) can be easily decontaminated

    (e) as far as practicable, the packaging will retain its contents during transport to the landfill site

    (f) no individual package contains more than the relevant landfill package activity value in column 2 of the table below

    (g) the dose-rate at the surface of any individual package does not exceed 5 microsieverts per hour

    (h) the maximum non-fixed external contamination on any individual package does not exceed:

        (i) 4 becquerels per square centimetre for beta and gamma emitters, or

        (ii) 0.4 becquerels per square centimetre for alpha-emitters having a half-life greater than 10 days

22. is limited to no more than 10 packages containing radioactive material from the person initiating the disposal in any seven-day period at the one landfill site

23. is not placed in the recycling waste stream, and

24. is recorded in a register that is kept by the person initiating the disposal.

Sewerage system

Radioactive material may be discharged into the sewerage system without an approved waste management plan if the material:

25. consists of aqueous materials

26. is released so that:

    (a) the annual activity of a radioactive material from the site to a sewer does not exceed the value in column 3 of the table below

    (b) the concentration at the input to a wastewater treatment plant, calculated as the activity in 21(a) divided by the annual flow[3] through the wastewater treatment plant to which the sewer connects, does not exceed that in column 4 of the table below

27. is recorded in a register that is kept by the person initiating the disposal.

Atmosphere

Radioactive material may be discharged into the atmosphere without an approved waste management plan if the material is:

28. limited so that the annual activity released at the point of discharge does not exceed the air discharge values in column 5 of the table below

29. recorded in a register that is kept by the person initiating the disposal.

[3] The annual flow is calculated as the average dry weather flow applied over a full year.

Table: Landfill package activity, sewerage discharge and air discharge values for periodic disposal of very low-level radioactive material

Column 1	Column 2 Landfill disposal values	Column 3 Sewerage discharge values	Column 4 Sewerage discharge values	Column 5 Air discharge values
Radionuclide	Landfill package activity values[1],[2] (Bq)	Annual activity to sewer from a site[3],[4] (Bq)	Resultant concentration[3] at input to a wastewater treatment plant (Bq/m^3)	Annual activity released to atmosphere from the point of discharge[3] (Bq)
^{3}H	10^{10}	2.0×10^{11}	9.1×10^{6}	1.0×10^{12}
^{14}C	10^{8}	1.8×10^{8}	1.0×10^{3}	1.0×10^{11}
^{18}F	10^{7}	2.3×10^{9}	1.0×10^{5}	2.5×10^{13}
^{22}Na	10^{7}	1.0×10^{6}	1.1×10^{0}	1.0×10^{7}
^{24}Na	10^{6}	1.0×10^{8}	1.1×10^{3}	1.0×10^{10}
^{32}P	10^{6}	1.0×10^{7}	7.1×10^{0}	1.0×10^{9}
^{33}P	10^{9}	3.0×10^{8}	6.3×10^{1}	3.0×10^{10}
^{35}S(inorganic)	10^{9}	3.3×10^{8}	1.1×10^{4}	1.0×10^{9}
^{36}Cl	10^{7}	7.1×10^{6}	3.3×10^{2}	1.0×10^{8}
^{45}Ca	10^{8}	3.0×10^{9}	1.1×10^{5}	1.0×10^{9}
^{51}Cr	10^{8}	1.0×10^{9}	1.1×10^{3}	1.0×10^{10}
^{59}Fe	10^{7}	1.0×10^{7}	1.1×10^{1}	1.0×10^{9}
^{57}Co	10^{7}	6.3×10^{8}	1.6×10^{2}	1.0×10^{10}
^{60}Co	10^{6}	5.6×10^{6}	7.9×10^{0}	8.3×10^{9}
^{63}Ni	10^{9}	6.3×10^{10}	6.6×10^{3}	8.3×10^{12}
^{65}Zn	10^{7}	7.0×10^{6}	3.2×10^{2}	3.0×10^{10}
^{67}Ga	10^{7}	1.0×10^{9}	1.1×10^{3}	1.0×10^{11}
^{85}Kr	10^{5}	–	–	7.7×10^{15}
^{89}Sr	10^{7}	2.0×10^{9}	1.7×10^{3}	1.0×10^{9}
^{90}Sr	10^{5}	1.0×10^{7}	4.6×10^{2}	3.0×10^{10}
^{90}Y	10^{6}	4.2×10^{10}	1.1×10^{5}	1.0×10^{11}
^{99}Mo	10^{7}	1.0×10^{9}	1.1×10^{3}	1.0×10^{10}
^{99}Tc	10^{8}	2.0×10^{6}	8.9×10^{1}	1.0×10^{8}
^{99m}Tc	10^{8}	7.0×10^{8}	1.1×10^{4}	1.0×10^{12}
^{111}In	10^{7}	1.0×10^{9}	1.1×10^{3}	1.0×10^{10}
^{123}I	10^{8}	8.3×10^{9}	1.1×10^{4}	1.0×10^{11}
^{125}I	10^{7}	1.0×10^{9}	1.1×10^{3}	1.0×10^{9}
^{129}I	10^{6}	1.8×10^{7}	8.3×10^{2}	1.3×10^{9}
^{131}I	10^{7}	1.0×10^{8}	1.1×10^{2}	1.0×10^{9}
^{137}Cs	10^{5}	1.7×10^{7}	5.1×10^{1}	1.4×10^{10}
^{147}Pm	10^{8}	1.0×10^{11}	1.1×10^{5}	1.0×10^{11}
^{153}Sm	10^{7}	3.2×10^{10}	1.5×10^{6}	6.3×10^{12}
^{201}Tl	10^{7}	1.0×10^{9}	1.1×10^{3}	1.0×10^{11}
^{223}Ra	10^{6}	1.3×10^{8}	5.7×10^{3}	5.9×10^{8}
^{241}Am	10^{5}	1.3×10^{8}	5.8×10^{3}	1.0×10^{8}

Notes

(1) When there is a mixture of radionuclides in the material to be disposed of to landfill:

$$\sum_i \frac{C_i}{X_i} \leq 10$$

Where C_i is the activity of each isotope *i* to be disposed of
X_i is the activity value given in the table above for each isotope *i*.

(2) For disposal of radioactive material to landfill where the radionuclides are not listed in this table, a package activity value of 10 times the exemption limit for that radionuclide, or mixture of radionuclides calculated in accordance with Note (1) above, applies.

(3) When there is a mixture of radionuclides in the material to be disposed of to a sewer or to air:

$$\sum_i \frac{C_i}{X_i} \leq 1$$

Where C_i is the activity or activity concentration of each isotope *i* to be disposed of
X_i is the activity or activity concentration discharge value, as appropriate, as given in the table above for each isotope i.

(4) A 'site' may be, for example, a university campus or a hospital from which there could be several individual points of disposal to the one sewer. The activities in this column are the total activity discharged from that site to the one sewer.