Australian Government
Australian Radiation Protection and Nuclear Safety Agency

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National Directory for Radiation Protection

Radiation Protection Series No. 6

Incorporating Amendment 7

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Radiation Protection Series

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) publish Fundamentals, Codes and Guides in the Radiation Protection Series (RPS), which promote national policies and practices that protect human health and the environment from harmful effects of radiation. ARPANSA develops these publications jointly with state and territory regulators through the Radiation Health Committee (RHC), which oversees the preparation of draft policies and standards with the view of their uniform implementation in all Australian jurisdictions. Following agreement and, as relevant, approvals at the Ministerial level, the RHC recommends publication to the Radiation Health and Safety Advisory Council, which endorses documents and recommends their publication by the CEO of ARPANSA.

To the extent possible and relevant for Australian circumstances, the RPS publications give effect in Australia to international standards and guidance. The sources of such standards and guidance are varied and include the International Commission on Radiological Protection (ICRP); the International Commission on Non-Ionizing Radiation Protection (ICNIRP); the International Atomic Energy Agency (IAEA); and the World Health Organization (WHO).

Fundamentals set the fundamental principles for radiation protection and describe the fundamental radiation protection, safety and security objectives. They are written in an explanatory and non-regulatory style and describe the basic concepts and objectives of international best practice.

Codes are regulatory in style and may be referenced by regulations or conditions of licence. They contain either general safety or security requirements which may be applicable for all dealings with radiation, or practice-specific requirements. They provide overarching requirements and are expressed as 'must' statements which are to be satisfied to ensure an acceptable level of safety and/or security.

Guides provide recommendations and guidance on how to comply with the Codes or apply the principles of the Fundamentals. They are written in an explanatory and non-regulatory style and indicate the measures recommended to provide good practice. They are generally expressed as 'should' statements.

These three categories of publications are informed by public comment during drafting and are subject to a process of assessment of regulatory impact.

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Radiation Protection Series Publication No. 6

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ARPANSA
619 Lower Plenty Road
YALLAMBIE VIC 3085

Tel: 1800 022 333 (Freecall) or +61 3 9433 2211

Email: info@arpansa.gov.au
Website: www.arpansa.gov.au

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Foreword

The purpose of the *National Directory for Radiation Protection* is to provide an agreed framework for radiation safety, including both ionising and non-ionising radiation, together with clear regulatory statements to be adopted by the Commonwealth, states and territories.

The Australian Health Ministers' Conference (AHMC) endorsed the development of the *National Directory for Radiation Protection* (the Directory) in August 1999 as the means of achieving uniformity in radiation protection practices between jurisdictions. In particular, the Conference agreed that the *National Directory* would be prepared by the Radiation Health Committee for approval by the Conference, via a process for issues resolution which included meeting the Council of Australian Governments' (COAG) requirements for national standard setting. There would be full consultation with stakeholders in the development of the Directory.

AHMC agreed that upon consideration and approval of the provisions of the Directory, **the regulatory elements of the Directory shall be adopted in each jurisdiction as soon as possible, using existing Commonwealth/state/territory regulatory frameworks**.

Ministers recognised that as a variety of agencies have a legislated responsibility for aspects of radiation safety (e.g. mines, occupational health and safety and transport agencies in many jurisdictions), these other agencies were to be involved actively in measures to progress national uniformity, including the development of the Directory.

Subsequently, the development of the Directory was supported by the recommendations of the National Competition Policy (NCP) Review of Radiation Protection Legislation (May 2001). The NCP review was endorsed by all participating jurisdictions. Queensland did not participate in the NCP Review, but endorsed the recommendations relating to uniformity.

The first edition of the *National Directory for Radiation Protection* was developed by a process designed to meet the Council of Australian Governments' *Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-setting Bodies* (Nov 1997). This included the development of a regulatory impact statement and appropriate consultation with stakeholders. Given that AHMC had already made a decision to develop the Directory, the regulatory impact statement analysed the impact of provisions of the Directory. It did not analyse other regulatory options.

The Directory was approved by the Radiation Health Committee out of session on 20 May 2004. It was subsequently endorsed by the Australian Health Ministers' Advisory Council for submission to Ministers, subject to a cost-benefit analysis sufficient to meet the subordinate legislation requirements of each jurisdiction being undertaken. Ministers endorsed the *National Directory for Radiation Protection*, edition 1, as the uniform national framework for radiation protection at AHMC on 29 July 2004. Ministers noted that further cost-benefit analysis was being undertaken sufficient to meet the statutory requirements in each jurisdiction. This was completed during 2005, and ministers agreed that the additional analysis met the requirements of all jurisdictions in January 2006.

Part A of the *National Directory for Radiation Protection* sets out the agreed overall framework for radiation protection in Australia. It is expected that jurisdictions will adopt these principles as reviews of legislation come forward. Part B contains the uniform regulatory elements, which are to be adopted by each jurisdiction within its particular regulatory framework. Part C contains guidance that will assist regulators in adopting consistent approaches, but is not regulatory in nature.

Following publication of edition 1 in August 2004, the Radiation Health Committee agreed that further progression of the Directory would be by individual amendments, that the consolidated version of the Directory would be maintained as an electronic document via the ARPANSA website, that the individual amendments would also be available via ARPANSA's website. This edition includes the seventh amendment since edition 1. Amendment publishing dates are:

- Amendments 1-3 – December 2009
- Amendments 4 – April 2010
- Amendment 5 – July 2011
- Amendment 6 – February 2014
- Amendment 7 – June 2017.

This edition also contains a table of amendments, listing all the changes since edition 1, as a handy reference within the Directory itself.

Edition 1 of the Directory did not apply to mining and mineral processing industries, however with publication of the *Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005), and its adoption into the Directory via Amendment No. 1, the provisions of the Directory will now apply to those industries.

Further amendments to the Directory are in development by the Radiation Health Committee and will be published in due course.

Carl-Magnus Larsson
CEO of ARPANSA

13 June 2017

Contents

1. Introduction

1.1 Citation

This publication should be cited as the *National Directory for Radiation Protection, June 2017*.

1.2 Purpose

To provide an overall agreed framework for radiation safety, including both ionising and non-ionising radiation, together with clear regulatory statements to be adopted by the Commonwealth, states and territories.

1.3 Scope

This Directory provides comprehensive resources to establish and maintain a uniform legislative framework for both ionising and non-ionising radiation protection in Australia. Although the Directory has been developed with the needs of radiation safety and protection agencies and regulators in mind, it is agreed that the Directory will also be used by all sectors involved in implementing radiation controls, including mining, mineral processing and occupational health and safety regulators. While edition 1 of the Directory did not apply to the mining and mineral processing industries, the provisions of the Directory now apply to these industries.

1.4 Interpretation

The presence of the word 'must' in a section indicates that the requirement to which it refers is considered to be mandatory. The presence of the word 'should' in a section indicates a recommendation, that is, a requirement to be applied as far as is practicable to minimise risk.[1] Sections containing the word 'should' summarise agreed best practice in relation to a particular matter at the time of publication.

There are a considerable number of terms that have technical or legal significance, and are central to the national radiation protection framework. The meanings of terms used in this Directory are those defined in the Glossary.

1.5 Structure

This Directory is structured in three Parts. Part A sets out the agreed overall framework for radiation protection in Australia. It is expected that jurisdictions will adopt these principles as reviews of legislation come forward.

Part B of the Directory contains the uniform regulatory elements, which are to be adopted by each jurisdiction, within its particular regulatory framework.

[1] In accordance with Recommendations for Limiting Exposure to Ionizing Radiation and National Standard for Limiting Occupational Exposure to Ionizing Radiation (1995), republished as an ARPANSA/National Occupational Health and Safety Commission publication, Radiation Protection Series (RPS 1), CEO of ARPANSA, March 2002.

Part C of the Directory contains guidance that will assist regulators in adopting consistent approaches, but is not regulatory in nature.

Schedules to the Directory provide additional detailed requirements that form an integral part of the uniform regulatory elements of the Directory.

Annexes to the Directory provide advisory material and background information on the provisions of the Directory.

Notes in italics throughout the Directory are included to assist in understanding the intended inclusions in future versions of the Directory. These notes do not form a part of the Directory.

PART A – General Principles

2. Regulatory frameworks

2.1 Objective of radiation protection legislation

Legislation must include the objective of protecting the health and safety of people and the environment from the harmful effects of ionising and non-ionising radiation.[2]

2.2 Principles for regulatory frameworks

A 'responsible person' is to be primarily responsible for radiation protection and safety. Nevertheless, regulators also need to establish and enforce standards through a system of regulation. Responsible persons are required to make notifications, or gain approvals and authorisations from regulators, before conducting a practice. These authorisations include registrations, licences and accreditations.

The regulatory frameworks in each Australian jurisdiction must follow the principles and requirements below[3], to ensure that the objective of the legislation is met:

(a) **Radiation protection principles** in regard to ionising radiation, include justification of practices to ensure that benefits outweigh the detriment, limitation of radiation doses (see Schedule 1) to individuals from all practices, and optimisation of protection and safety so that individual doses, the number of people exposed and the likelihood of exposure are all kept as low as reasonably achievable, economic and social factors being taken into account.

(b) **Management requirements** to provide for responsible persons to establish a safety culture, establish quality assurance programs, reduce the probability of human error leading to accidents, make appropriate training and information available to staff, allocate sufficient resources to enable safety and security of radiation sources over their lifetime (including disposal), and provide the qualified expertise necessary to observe the requirements.

(c) **Technical requirements**, such as shielding design and interlocks as necessary, to ensure that radiation sources remain within control, and that they are secure from theft or damage. Defence-in-depth measures in facility design and operating procedures, which are intended to prevent accidents, to mitigate the consequences of accidents and to restore safety should an accident occur, must be established as required within this Directory. Further, good engineering practice is to be followed throughout the life (siting, design, construction, operation and decommissioning) of a facility.

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2 In accordance with Recommendation 1 of the National Competition Policy Review of Radiation Protection Legislation, May 2001.

3 The principles for regulatory frameworks will require development of specific guidance on protection of non-human species, which will be included when international guidance on the issue becomes clear.

(d) **Processes for verification of safety and security**[4], which involve safety assessments to identify and determine the magnitudes of radiation exposures during normal operation and accidents, and to assess the provisions for protection, safety and security. Procedures and equipment required for monitoring operations and verifying compliance with safety requirements and standards must be established and available. Appropriate records and reports must be maintained.

(e) **Risk management principles**, which include a broader evaluation of risk assessment and take into account not only scientific data, but also the social and economic considerations.

(f) **Intervention actions** for accidental or abnormal exposure situations requiring protective action to reduce or avert radiation exposures, or their likelihood (see section 6).

2.3 Powers and functions conferred by legislation

Legislation must establish a regulatory authority [the Authority], which is effectively independent[5], and accountable to a Minister of the Crown and through that Minister to the Parliament. Use of the term 'the Authority' throughout this Directory is not intended to preclude that a jurisdiction may choose to have more than one Authority to regulate different aspects of radiation protection. The legislation must prohibit any dealing with a radiation source without the appropriate authorisation. The administration of radiation control legislation in each jurisdiction must be the responsibility of the Authority. Legislation must bind the Crown and provide the following powers and functions to the Authority:

(a) advise the Minister on radiation protection and nuclear safety matters

(b) set standards for radiation protection and the safety and security of radiation sources

(c) assess applications for authorisations against criteria specified in the Act or regulations

(d) grant, refuse, vary, revoke or suspend authorisations, and impose conditions on these

(e) grant exemptions from regulatory requirements and determine conditions for exemptions

(f) ensure a system of periodic inspections, documentation and reporting to verify compliance with regulatory requirements

(g) enforce compliance with regulatory requirements

(h) require safety assessments and environmental assessments where appropriate

(i) accredit persons or classes of persons to assess compliance with the requirements of the legislation, and set the conditions to which they should be subject

(j) control the categories of non-ionising radiation apparatus specifically identified in Schedule 2 of this Directory

(k) maintain a register of radiation sources, including requirements for amendment of the register

(l) plan for, and give directions in the case of, a nuclear or radiological emergency

(m) require notification of radiation incidents to the Authority

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4 Australia has given a commitment to the Director General of the IAEA that it will work towards implementing the IAEA *Code of Conduct for the Safety and Security of Radioactive Sources* (2004).

5 Effectively independent does not mean that the Authority needs to be a separate statutory authority, but that there should be arrangements to ensure that judgements may be made, and enforcement action taken, without undue pressure from interests that may compete with safety.

(n) investigate radiation incidents, and provide reports to ARPANSA for inclusion in the Australian Radiation Incident Register

(o) promote or conduct studies, investigations and research associated with radiation protection and nuclear safety, including public health and safety and environmental considerations, and

(p) prepare an annual report for tabling before the Parliament.[6]

2.4 Advisory body

Legislation should provide for the establishment of an advisory body to provide the Authority and the Minister with policy and technical advice on radiation protection and nuclear safety matters.

2.5 Review of legislation

The legislation must be reviewed at intervals not exceeding ten years.[7]

2.6 Practices to which legislation applies

The practices to which the requirements of the legislation must apply include:

(a) the manufacturing or possession of radiation sources

(b) the use of radiation or radioactive materials for any practice which involves or could involve exposure to radiation or radioactive materials, including medical (both diagnostic and therapeutic), dental, chiropractic, industrial, veterinary and agricultural purposes, in consumer products, education, training, research, or the servicing or maintenance of radiation apparatus or sealed source apparatus

(c) in relation to nuclear installations, and radiation facilities specifically identified in Schedule 3 of this Directory, the preparation of a site, possession or control, construction, operation, decommissioning or disposal of such an installation or facility

(d) practices involving exposure to natural sources specified by the Authority as requiring control

(e) practices dealing with radioactive material arising from exploration, mining, mineral processing or petroleum industries

(f) practices involving radioactive waste management and the disposal of radioactive material

(g) practices involving categories of non-ionising radiation apparatus specifically identified in Schedule 2 of this Directory

(h) sale or transfer of responsibility of ionising radiation sources and categories of non-ionising radiation apparatus specified in this Directory

(i) transport of radioactive material, and

(j) any other radiation-related practice specified by the Authority.

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6 The annual report may form part of a broader departmental annual report.

7 This is in accordance with Recommendation 8 of the National Competition Policy Review of Radiation Protection Legislation, May 2001.

2.7 Categories of authorisation

Legislation must provide for authorisations to regulate various dealings with radiation sources. The holding of the relevant authorisation will be a mandatory condition of engaging in a particular dealing, unless exemptions apply. The authorisation may be effected through a single authorisation covering various dealings or separate authorisations covering particular dealings, for example:

(a) Authorisation to possess

An authorisation to possess must be obtained by a responsible person who wishes to:

- possess a radiation source
- otherwise be in control of a radiation source for a specified purpose, or
- be responsible for a practice.

(b) Authorisation to use

An authorisation to use must be obtained by any natural person who wishes to use a radiation source for a particular purpose, and who is not otherwise authorised to use the source under an authorisation for other dealings.

(c) Authorisation for other dealings

An authorisation must be obtained by a responsible person for dealings such as preparation of a site, construction, possession or control, operation, decommissioning, and disposal of nuclear installations, and radiation facilities specifically identified in Schedule 3 of this Directory.

2.8 Refusal to grant an authorisation

An Authority must be able to refuse to grant an authorisation if:

(a) the applicant is not a fit and proper person

(b) it is necessary to do so in the interests of public health and safety, or

(c) the proposed use of radiation is inappropriate or unjustified.

2.9 Suspension, variation or cancellation of an authorisation

An Authority must be able to suspend, vary or cancel an authorisation if there is evidence to suggest that:

(a) the authorisation was obtained improperly

(b) the holder of an authorisation has contravened a condition of the authorisation

(c) the holder of an authorisation has been convicted of an offence against the legislation, under which the authorisation was granted, or other relevant legislation

(d) unless the authorisation is suspended, varied or cancelled there would be a risk to the health and safety of people or to the environment

(e) unless the authorisation is suspended, varied or cancelled there would be security risk from access to the radioactive source

(f) the holder has ceased to hold a qualification or meet other criteria, which formed the basis on which the authorisation was granted

(g) the holder of an authorisation has consistently made decisions that compromised radiation safety, or

(h) the holder of an accreditation has ceased working in a capacity for which accreditation is required.

Where an Authority makes a decision to suspend, vary or cancel an authorisation, it should advise all other relevant Authorities within and outside of its jurisdiction of that decision.

2.10 Annual reports

The annual report of an Authority is a necessary part of the accountability and transparency of its operations and should address the following key elements:

(a) all activities and operations of the Authority for the year

(b) a summary of authorisations issued

(c) a summary of all radiation incidents investigated, and

(d) a summary of prosecutions undertaken by the Authority.

PART B – Uniform Regulatory Elements

3. Scope of regulation

3.1 Exclusions

The following exposures whose magnitude or likelihood is essentially not amenable to control through legislation are excluded from regulation[8]:

(a) K-40 in the body

(b) cosmic radiation at the surface of the earth and

(c) unmodified concentrations of radionuclides in most raw materials, unless otherwise specifically identified in this Directory.

3.2 Exemptions

3.2.1 The general criteria for granting an exemption are:

(a) the health risks and the risks to the environment associated with the source, practice, or type of person using a source are sufficiently low as to be of no regulatory concern and

(b) radiation protection, including the cost of regulatory control, has been optimised.[9]

3.2.2 The criteria to exempt radioactive material[10] or practices from notification, registration and licensing are:

(a) the radioactive material has an activity concentration[11] less than that prescribed in Schedule 4 or consists of or contains less than the activity prescribed in Schedule 4, or

(b) the radioactive material has an activity concentration greater than that prescribed in Schedule 4[12] and consists of or contains greater than the activity prescribed in Schedule 4, but causes an annual effective dose to an individual member of the public of less than 10 μSv, and a collective effective dose to the critical group committed by one year of performance of the practice, as determined by the Authority, of less than 1 person.Sv[13], or

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8 For normal exposure situations, the concept of exclusion usually applies to exposures from materials containing radionuclides of natural origin, where the concentration of each radionuclide is below 1 Bq/g. Typically, 'most raw materials' would include raw materials, except for uranium, which is mined to recover radionuclides; mineral sands, which have radionuclide content high enough to warrant a regulatory approach; and other materials specifically identified in this Directory.

9 For ionizing radiation optimisation means, in relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received are all kept as low as reasonably achievable, economic and social factors being taken into account. For non-ionizing radiation, optimisation can be equated to cost-effectiveness.

10 The definition of radioactive material and the exemption levels for activity and activity concentration for particular radionuclides in this Directory are based on those of the International Atomic Energy Agency. The rationale for the definition and exemption levels is provided in Annex 2.

11 The 'activity concentration' of a radionuclide means the activity per unit mass of the material in which the radionuclide is essentially uniformly distributed. [A sealed source in a lead surround does not constitute being uniformly distributed].

12 All dealings with all radioactive material below the activity concentration or activity levels in Schedule 4 of the Directory, other than for the control of discharges to the sewer or atmosphere which are dealt with in Schedule 14, are exempt from regulation without approach to the Authority. In relation to the transport of radioactive material, the activity concentration levels for

(c) in the case of a mixture of radioactive materials, where each of the radioactive materials present does not exceed the individual activity or activity concentration, the mixture is defined as exempt if the sum of the fractions obtained by dividing the activity of each material present by the appropriate activity value from Schedule 4, or the sum of the fractions obtained by dividing the activity concentration of each material present by the appropriate activity concentration value from Schedule 4, does not exceed 1

(d) in the special case of exposure to naturally-occurring radon-222 in the workplace, the long-term average concentration of radon-222 is less than 1000 Bq/m^3.

3.2.3 The Authority may exempt material or practices that are not exempt under 3.2.2 above, subject to conditions that may be determined by the Authority[14], where an assessment for the optimisation[9] of protection shows that exemption is the optimum option.[15] When this provision is used, the Authority must notify the Radiation Health Committee (RHC) immediately after granting the exemption.

3.2.4 The Authority may declare material or practices otherwise exempt under 3.2.2 above to be subject to the legislation if an assessment of the magnitude of individual doses, the number of people exposed and the likelihood that potential exposures will actually occur justify the practice being subject to the legislation.[16] When this provision is used, the Authority must notify the RHC immediately after making such a declaration.

3.2.5 Where the Authority has determined that regulatory controls will apply, the stringency of the regulatory measures should be proportionate to the degree of risk associated with the material.[17]

3.2.6 A radiation generator or electronic tube, of a type approved by the Authority, must be exempted from notification, registration or licensing requirements, provided that:

(a) in normal operating conditions it does not cause an ambient dose equivalent rate or a directional dose equivalent rate, as appropriate, exceeding 1 µSv h^{-1} at a distance of 0.1 m from any accessible surface of the apparatus

(b) the maximum energy of the radiation produced is no greater than 5 keV, or

(c) the apparatus is listed in Schedule 5.

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exempt material, the activity limits for exempt consignments, and the modifying factor in clause 107(e) in the Code of Practice for the Safe Transport of Radioactive Material apply.

13 Subject to the agreement of the Authority on the applicable scenarios and method of calculation to be applied, dealings with radioactive materials involving activity concentrations or activities greater than Schedule 4 but which are demonstrated through direct measurement or the calculation of doses from applicable scenarios to result in doses less than those on which Schedule 4 is based are exempt.

14 When an exemption is granted, the Authority should be able to impose appropriate conditions on the exemption, such as requirements for reporting and monitoring.

15 Exemptions will be granted for practices (generally expected to be dealings involving quantities of naturally occurring radioactive materials) resulting in individual doses up to about 1 mSv per year on the basis of an assessment to be agreed between the operator and the Authority that the radiation protection is optimised. Such an exemption may be subject to monitoring and reporting conditions to ensure that the basis for the exemption remains in place.

16 Material or practices otherwise exempted through the operation of Schedule 4 of the Directory will only be subjected to regulation if the Authority can demonstrate that the magnitude of individual doses, the number of people exposed and the likelihood that potential exposure will occur significantly exceed the values upon which the exemptions in Schedule 4 are based.

17 A graded approach will be applied to the regulation of material and practices commensurate with hazard.

3.2.7 A radioactive source listed in Schedule 5 must be exempted from the notification, registration or licensing requirements specified, subject to disposal of that source meeting the requirements of Section 4.2.2.

4. Authorisations

4.1 Authorisations to possess

A responsible person seeking to possess or be in control of a radiation source for a specific purpose must hold an authorisation to possess, issued by the Authority.

Legislation in each jurisdiction places significant responsibilities and obligations on holders of such authorisations. Many of these responsibilities will be dealt with specifically on a practice type by practice type basis in Codes of Practice, however some requirements might be placed in future versions of this Directory if they are generally applicable or if they amend or override instructions in Codes. These will be added as they are developed by the Radiation Health Committee.

Obligations on holders of such authorisations may include:

- *ensuring a radiation protection plan for the practice is developed and implemented*
- *ensuring all radiation sources meet appropriate standards for safe use, that they are registered and that they have been assessed by an accredited person*
- *ensuring all radiation sources are satisfactorily secured*
- *ensuring all facilities in which radiation sources are used meet the appropriate radiation safety standards and that they are checked by an accredited person*
- *ensuring all persons who use radiation sources are properly authorised to do so*
- *ensuring appropriate safe handling and other safety equipment and clothing is provided to users of the sources and other persons as required, and is worn*
- *ensuring they are advised by a competent radiation safety officer*
- *if unsealed radioactive substances are involved in the practice, ensure that unsealed radioactive materials are disposed of in a way that is approved of by the Authority*
- *ensuring that radiation doses arising from the radiation practice are kept below the limits and as low as reasonably achievable*
- *providing personal radiation monitoring devices to relevant persons*
- *keeping personal radiation monitoring records for persons exposed in the practice*
- *ensuring radiation-related equipment is properly maintained*
- *ensuring that the transport of radioactive material under the control of the responsible person is in accordance with the Code of Transport for the Safe Transport of Radioactive Material (2008)*
- *notifying the Authority in the event of an incident.*

4.2 Requirements for authorising practices

4.2.1 Requirements applied to authorisations for practices by the Authority must include the set of requirements specified in Schedule 7 for the relevant categories.

The introduction of nationally uniform minimum set of requirements is an important element of uniformity. A minimum set of nationally agreed requirements is to be developed by the RHC to cover key practices. Once these 'model' requirements have been agreed nationally, the same practice carried out in different jurisdictions will be subject to the same requirements.

Model requirements covering practices including the following, will be developed and incorporated into a future version of this Directory in addition to those specified in Schedule 7:

Use for non-medical purposes

Use for medical purposes (including radiology, radiography, restricted radiography in rural/remote areas, radiation oncology, cardiology, nuclear medicine, chiropractic, dentistry, and veterinary practice)

Use by installers/repairers

Sale or transfer of responsibility of radiation sources

Mining and mineral processing

Disposal of radioactive materials

Management of radioactive waste facilities,

Possession and operation of radiation facilities.

4.2.2 No authorisation is required to dispose of radioactive material if the disposal is in accordance with Schedule 14.

4.3 Competency requirements

The *Mutual Recognition Act 1992* and the *Trans-Tasman Mutual Recognition Act 1997* apply within Australia and have the effect of facilitating the recognition of equivalent occupations.

If a natural person in a jurisdiction meets the requirements as set out in Schedule 6 of this Directory, that person will, unless refused on the grounds specified in section 2.8 of this Directory, be granted authorisation to use the specified radiation source for the specified purposes in that jurisdiction.

The RHC will consider competency and/or prerequisites for obtaining authorisation to use radiation sources for additional specified practices progressively over time and incorporate the agreed requirements in a future version of this Directory in Schedule 6.

The occupations and professions who may use a radiation source and whose members will typically be required to meet competency requirements include:

- *medical practitioners (including specialists)*
- *dental practitioners (including dental therapists and dental hygienists)*
- *veterinary surgeons*
- *diagnostic radiographers*
- *radiation therapists*

- *nuclear medicine technologists*
- *health & medical physicists*
- *chiropractors;*
- *industrial radiographers*
- *borehole loggersq*
- *radiation source testers*
- *persons servicing, installing, commissioning, maintaining, repairing, or manufacturing radiation sources.*

4.4 Security requirements

Any natural person or corporation making application for authorisation to deal with a radiation source must meet the security requirements as set out in Schedule 8 of this Directory.

4.5 Services for rural and remote areas

A natural person may be granted permission to undertake a restricted range of health-related diagnostic X-ray services without meeting the relevant competency requirements contained in Schedule 6 of this Directory only if:

(a) the services are to be provided in an area recognised as an 'area of need' for particular services

(b) reasonable efforts have been made to attract an appropriately trained and accredited professional to the position

(c) the person has undertaken training accredited by the Authority for the purpose, and

(d) appropriate conditions and restrictions are placed on the authorisation in regard to the services permitted to be provided.

4.6 Registrations

4.6.1 Requirement to register

All apparatus, sources and premises in the categories specified in this Directory must be registered. The categories to which registration applies are:

(a) sealed sources of radioactive materials, sealed source apparatus, radiation apparatus, non-ionising radiation apparatus specified in this Directory, and the premises on which these radiation sources and apparatus are secured, stored, used or manufactured

(b) premises at which unsealed radioactive sources are stored or used, and

(c) in the case of radiation sources that are intended for portable or field use, the sources and the principal place of storage.

4.6.2 Criteria for registration allowing the use of radiation sources and premises

Registrations allowing the use of a radiation source or premises must only be issued when those criteria considered necessary for the safe operation and security of the radiation source or the premises and specified in Schedule 9 are met.

Standard criteria for industrial radiography radiation source and premises registrations are included in Schedule 9. Criteria for other radiation sources and premises will be developed and incorporated into future editions of this Directory in Schedule 9.

4.7 Accreditation of third party service providers

A future version of this Directory will specify in Schedule 10 nationally agreed categories of accreditations, standard requirements for accreditation, national accreditation processes and guidelines and functions suitable for outsourcing by an Authority. The Implementation Plan for the National Competition Policy Review of Radiation Protection Legislation includes a project on 3rd party certification. This is intended to provide an agreed set of regulatory functions that could be undertaken by accredited persons. The implementation plan also includes an agreed set of principles and guidelines for the development of accreditation standards and processes.

5. National adoption of codes and standards

5.1 Adoption by direct referencing

Codes and standards referenced in this Directory must be adopted by Authorities within their regulatory frameworks. This should be done preferably by direct reference to a code or standard in the regulations of an Authority, but may be achieved by using a code or standard as conditions of licence and/or registration issued by an Authority. The referenced codes and standards are listed in Schedule 11.

The RHC will, progressively over time, agree on more codes and standards that must be adopted by jurisdictions. These codes and standards will be and referenced in Schedule 11 of future versions of this Directory as these Codes and Standards are promulgated under ARPANSA's Radiation Protection Series.

5.2 Adoption of extracts from codes and standards

Extracts from codes or standards specified in this Directory and detailed in Schedule 12 must be adopted by Authorities within their regulatory frameworks.

The RHC will, progressively over time, agree on extracts to be adopted by an Authority in its legislative framework and describe such agreed extracts in Schedule 12 of future versions of this Directory.

5.3 Adoption of national radiation incident reporting framework

An Authority must report radiation incidents of the types described in Schedule 13 to ARPANSA for inclusion in the Australian Radiation Incident Register.

Required timelines for reporting particular incident types are to be included in Schedule 13.

5.4 Adoption of national regulatory elements for control of specified practices

In a case where no code or standard applies to a practice specified in this Section, the provisions applying to that practice must be adopted by Authorities within their regulatory frameworks.

5.4.1 Solaria

The Responsible Person in relation to the operation of a solarium used for cosmetic purposes must ensure that:

(a) no individual under the age of 18 is permitted to be exposed in a tanning unit that is under the control of the Responsible Person

(b) any operator of a tanning unit has completed approved training in the following:

- (i) safe use and operation of the tanning unit
- (ii) use of exposure schedules
- (iii) the requirements of Australian Standard AS/NZS 2635:2008 and its practical implementation
- (iv) determination of skin photo types (using the Fitzpatrick classification system) and exposure times
- (v) screening for potentially exposure limiting conditions
- (vi) emergency procedures in case of over-exposure to UV light
- (vii) types and wavelength of UV light, and health risks
- (viii) procedures for sanitising protective eyewear and tanning equipment

(c) an assessment of skin photo type is conducted by a trained operator for every client before exposure in a tanning unit, and that individuals with Skin Photo Type 1 are not permitted to be exposed in a tanning unit

(d) only a trained operator determines and controls an exposure session

(e) exposure of any client to ultraviolet radiation in a solarium is subject to supervision by a trained operator at all times

(f) prior to the commencement of a course of tanning of one or more exposure sessions in a tanning unit, a consent form as set out in Table A is handed to the client, and that:

- (i) the client signs and dates the form
- (ii) the client returns the signed and dated form prior to commencement of the first exposure session in the establishment
- (iii) the original signed and dated form is filed in the records of the establishment for a period of not less than 2 years
- (iv) a copy of the signed and dated form is handed to the client

(g) any exposure session does not exceed 0.9 MED, and that any repeat exposure session takes place no sooner than 48 hours after the previous exposure session

(h) protective eyewear is worn by every user of a tanning unit during any period for which the tanning unit is operative

(i) warning notices of an appropriate size are placed within immediate view of every client entering a solarium, and in each tanning unit cubicle. The warning notice must include the following information:

- tanning units emit ultraviolet radiation
- exposure to ultraviolet radiation contributes to skin cancer and skin ageing
- repeated exposure further increases risk
- people with fair skin who burn easily will not be permitted to use a tanning unit
- further intentional exposure to sunlight or a tanning unit must be avoided for the next 48 hours
- protective eyewear must be worn at all times while undergoing tanning unit exposure
- no person under the age of 18 years is permitted to use a tanning unit.

TABLE A

CONSENT FORM FOR CLIENTS OF SOLARIA

CLIENT CONSENT FORM

Please read carefully the following information:

1. Exposure to ultraviolet radiation such as from a tanning unit contributes to skin cancer and the skin ageing process.
2. People with fair skin who are unable to tan must not use a tanning unit.
3. Intentional tanning unit exposure should be avoided for 48 hours before and after sunlight or tanning unit exposure.
4. Protective eyewear must be worn at all times while undergoing tanning unit exposure. You must not read while the tanning unit is in operation.
5. There is additional risk, and sun-tanning unit exposure is not recommended if you -
   (a) have ever been treated for solar keratoses or skin cancer;
   (b) have a large number of moles, freckles and /or naevi;
   (c) have a history of frequent childhood sunburn;
   (d) burn easily; or
   (e) have ever suffered from an abnormal reaction, or allergy, to light.
6. There may be further risk if you are pregnant, taking certain medications by mouth or applying medications or certain cosmetics to the skin.

If there is any doubt in your mind in relation to any of the particulars described in Items 2, 5 and 6 above, consult your doctor before undergoing any ultraviolet exposure.

I, ..., am aged 18 years or over, acknowledge that the trained operator has made an assessment of my photo skin type, and have carefully read and fully understand the above information and choose to undergo ultraviolet exposure in this establishment.

Client Signature: ..... Date: .....

Name of establishment: .....

PART C – Guidance for Best Practice

This section contains guidance to assist regulators. It will also, where appropriate, provide background information and rationale for provisions in other parts of this Directory. This section will be completed in a future version of this Directory.

6. Intervention in radiological emergencies and chronic exposure situations

6.1 Basic obligations

In order to reduce or avert exposures in intervention situations, protective actions or remedial actions must be undertaken whenever they are justified.

The form, scale, and duration of any such protective action or remedial action must be optimised so as to produce the maximum net benefit, understood in a broad sense, under the prevailing social and economic circumstances.

Responsible persons must be accountable for the development, maintenance and implementation of emergency plans and establishing remedial action plans for chronic radiation exposures.[18] Emergency plans should be consistent with the principles and requirements in the IAEA's *Preparedness and Response for a Nuclear or Radiological Emergency*, Safety Standards Series No. GS-R-2, 2002.

6.2 Application

Intervention actions (see section 2.2(f)) apply to emergency exposure situations requiring protective action to reduce or avert temporary radiation exposures, including:

- accidents and emergencies in which an emergency plan or emergency procedures have been activated
- any other temporary exposure situation identified by the Authority as warranting intervention.

Intervention actions also apply to chronic exposure situations requiring remedial action to reduce or avert chronic exposure, including:

- natural exposure, such as exposure to radon in buildings and workplaces
- exposure to radioactive residues from past events, such as the radioactive contamination caused by accidents, after the situation requiring protective action has been terminated, as well as from the conduct of practices and the use of sources not under the system of notification, and authorisation
- any other chronic exposure situation specified by the Authority as warranting intervention.

[Note: it is anticipated that the new ARPANSA intervention recommendations would be referenced in this section in an appropriate way when completed]

[18] In the case of intervention to reduce existing exposures, justification of protective or remedial actions is required, as is optimisation of the levels at which actions are implemented. However, dose limits (see Schedule 1), do not apply. Further, restrictions on the exposure of those taking part in the intervening action may need to be applied.

7. Patient discharge recommendations

The Authority should advise hospitals and clinics treating patients with radioactive substances to establish procedures for the discharge of patients consistent with the provisions of Radiation Protection Series (RPS) No. 4, *Recommendations for the Discharge of Patients Undergoing Treatment with Radioactive Substances* (ARPANSA 2002).

Schedule 1: Dose limits

(Refer section 2.2(a))

Application	Dose limits[1]	
	Occupational	Public
Effective dose	20 mSv per year, averaged over a period of 5 consecutive calendar years[2]	1 mSv in a year[4]
Annual equivalent dose:		
the lens of the eye	150 mSv	15 mSv
the skin[5]	500 mSv	50 mSv
the hands and feet	500 mSv	-

1 The limits shall apply to the sum of the relevant doses from external exposure in the specified period and the 50-year committed dose (to age 70 years for children) from intakes in the same period.

2 With the further provision that the effective dose shall not exceed 50 mSv in any single year. In addition, when a pregnancy is declared by a female employee, the embryo or fetus should be afforded the same level of protection as required for members of the public.

3 (DELETED)

4 In special circumstances, a higher value of effective dose could be allowed in a single year, provided that the average over 5 years does not exceed 1 mSv per year.

5 The equivalent dose limit for the skin applies to the dose averaged over any 1 cm^2 area of skin, regardless of the total area exposed.

NOTE 1: The above dose limits table has been directly extracted from ARPANSA's Recommendations for limiting exposure to ionizing radiation (1995), [republished as RPS 1 in 2002]. However, as the RHC now advises that the exceptional circumstances clause is not recommended for use in Australia, note 3 of the table in RPS 1 has been deleted from this Directory.

NOTE 2: Exposure to radiation from natural sources is generally excluded from occupational or public exposure, except when the exposure is a direct consequence of a practice or is specifically identified by the appropriate authority as requiring control through the implementation of a program of radiation protection. Medical exposure includes doses received by patients undergoing medical diagnosis or therapy, doses received by volunteers in medical research, and doses received knowingly and willingly by persons other than health care workers as a consequence of their proximity to an exposed patient. Dose limits do not apply to exposures from natural sources, except as described above, or to medical exposures.

Schedule 2: Categories of non-ionising radiation

(Refer sections 2.3(k) and 2.6(g))

The following non-ionising radiation apparatus that produce harmful non-ionising radiation when energised are specified as requiring regulatory control.

(1) A tanning unit used for cosmetic purposes within a solarium.

The Radiation Health Committee will progressively add to this schedule the categories of non-ionizing radiation that are agreed to need a regulatory approach.

Schedule 3: Radiation facilities

(Refer sections 2.6(c) and 2.7(c))

The Radiation Health Committee will progressively add to this schedule the radiation facilities that are agreed to require authorisation to prepare a site, construct, possess or control, operate, decommission or dispose of such an installation or facility.

For example, the types of facility that may be considered for inclusion in a future edition of this Directory are:

(a) a particle accelerator that has, or is capable of having, a beam energy greater than 1 MeV; or can produce neutrons

(b) an irradiator that contains more than 10^{15} Bq of a radioactive material

(c) an irradiator that contains more than 10^{13} Bq of a radioactive material and

- *(i) does not include shielding as an integral part of its construction, or*
- *(ii) if it does include shielding as an integral part of its construction – the shielding does not prevent a person from being exposed to the source, or*
- *(iii) if it does include shielding as an integral part of its construction – has a source that is not inside shielding during the operation of the irradiator*

(d) a facility used for the production, processing, use, storage, management or disposal of:

- *(i) sealed sources of radioactive materials of activity greater than 10^9 times the exemption limits*
- *(ii) unsealed sources of radioactive materials of activity greater than 10^6 times the exemption limits*

(e) a facility where:

- *(i) a mixture of radioactive materials is produced, used, stored, managed or disposed of using the facility, and*
- *(ii) the activity of the mixture is greater than the applicable level, when determined as follows:*

  Step 1: Divide the activity of each radionuclide in the mixture by the exempt activity for that radionuclide.
  Step 2: Add the fractions for each radionuclide. The activity of the mixture is greater than the applicable level if the result from step 2 is greater than 10^9 for sealed sources or 10^6 for unsealed sources.

Schedule 4: Exemption levels

(Refer section 3.2.2)

Exempt activity concentrations and exempt activities of radionuclides[19]

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
H-3 (tritiated compounds, including OBT)	1×10^6	1×10^9
H-3 (elemental)	1×10^6	1×10^9
Be-7	1×10^3	1×10^7
C-11	1×10^1	1×10^6
C-14	1×10^4	1×10^7
N-13	1×10^2	1×10^9
0-15	1×10^2	1×10^9
F-18	1×10^1	1×10^6
Na-22	1×10^1	1×10^6
Na-24	1×10^1	1×10^5
Mg-28	1×10^1	1×10^5
Si-31	1×10^3	1×10^6
P-32	1×10^3	1×10^5
P-33	1×10^5	1×10^8
S-35	1×10^5	1×10^8
Cl-36	1×10^4	1×10^6
Cl-38	1×10^1	1×10^5
Ar-37	1×10^6	1×10^8
Ar-41	1×10^2	1×10^9
K-40	1×10^2	1×10^6
K-42	1×10^2	1×10^6
K-43	1×10^1	1×10^6
Ca-45	1×10^4	1×10^7
Ca-47	1×10^1	1×10^6
Sc-46	1×10^1	1×10^6
Sc-47	1×10^2	1×10^6
Sc-48	1×10^1	1×10^5
V-48	1×10^1	1×10^5
Cr-51	1×10^3	1×10^7
Mn-51	1×10^1	1×10^5
Mn-52	1×10^1	1×10^5
Mn-52m	1×10^1	1×10^5
Mn-53	1×10^4	1×10^9
Mn-54	1×10^1	1×10^6
Mn-56	1×10^1	1×10^5

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Fe-52	1×10^1	1×10^6
Fe-55	1×10^4	1×10^6
Fe-59	1×10^1	1×10^6
Co-55	1×10^1	1×10^6
Co-56	1×10^1	1×10^5
Co-57	1×10^2	1×10^6
Co-58	1×10^1	1×10^6
Co-58m	1×10^4	1×10^7
Co-60	1×10^1	1×10^5
Co-60m	1×10^3	1×10^6
Co-61	1×10^2	1×10^6
Co-62m	1×10^1	1×10^5
Ni-59	1×10^4	1×10^8
Ni-63	1×10^5	1×10^8
Ni-65	1×10^1	1×10^6
Cu-64	1×10^2	1×10^6
Cu-67	1×10^2	1×10^6
Zn-65	1×10^1	1×10^6
Zn-69	1×10^4	1×10^6
Zn-69m	1×10^2	1×10^6
Ga-67	1×10^2	1×10^6
Ga-72	1×10^1	1×10^5
Ge-68	1×10^1	1×10^5
Ge-71	1×10^4	1×10^8
As-73	1×10^3	1×10^7
As-74	1×10^1	1×10^6
As-76	1×10^2	1×10^5
As-77	1×10^3	1×10^6
Se-73	1×10^1	1×10^6
Se-75	1×10^2	1×10^6
Br-75	1×10^1	1×10^6
Br-76	1×10^1	1×10^5
Br-82	1×10^1	1×10^6
Kr-74	1×10^2	1×10^9
Kr-76	1×10^2	1×10^9
Kr-77	1×10^2	1×10^9

[19] This table is taken from the IAEA's International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series 115 [IAEA 1996], and is supplemented from NRPB Report R306, Exempt Concentrations and Quantities for Radionuclides not Included in the European Basic Safety Standards Directive [NRPB 1999].

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Kr-79	1×10^{3}	1×10^{5}
Kr-81	1×10^{4}	1×10^{7}
Kr-83m	1×10^{5}	1×10^{12}
Kr-85	1×10^{5}	1×10^{4}
Kr-85m	1×10^{3}	1×10^{10}
Kr-87	1×10^{2}	1×10^{9}
Kr-88	1×10^{2}	1×10^{9}
Rb-81	1×10^{1}	1×10^{6}
Rb-86	1×10^{2}	1×10^{5}
Sr-85	1×10^{2}	1×10^{6}
Sr-85m	1×10^{2}	1×10^{7}
Sr-87m	1×10^{2}	1×10^{6}
Sr-89	1×10^{3}	1×10^{6}
Sr-90[a]	1×10^{2}	1×10^{4}
Sr-91	1×10^{1}	1×10^{5}
Sr-92	1×10^{1}	1×10^{6}
Y-88	1×10^{1}	1×10^{6}
Y-90	1×10^{3}	1×10^{5}
Y-91	1×10^{3}	1×10^{6}
Y-91m	1×10^{2}	1×10^{6}
Y-92	1×10^{2}	1×10^{5}
Y-93	1×10^{2}	1×10^{5}
Zr-93[a]	1×10^{3}	1×10^{7}
Zr-95	1×10^{1}	1×10^{6}
Zr-97[a]	1×10^{1}	1×10^{5}
Nb-93m	1×10^{4}	1×10^{7}
Nb-94	1×10^{1}	1×10^{6}
Nb-95	1×10^{1}	1×10^{6}
Nb-97	1×10^{1}	1×10^{6}
Nb-98	1×10^{1}	1×10^{5}
Mo-90	1×10^{1}	1×10^{6}
Mo-93	1×10^{3}	1×10^{8}
Mo-99	1×10^{2}	1×10^{6}
Mo-101	1×10^{1}	1×10^{6}
Tc-95m	1×10^{1}	1×10^{6}
Tc-96	1×10^{1}	1×10^{6}
Tc-96m	1×10^{3}	1×10^{7}
Tc-97	1×10^{3}	1×10^{8}
Tc-97m	1×10^{3}	1×10^{7}
Tc-99	1×10^{4}	1×10^{7}
Tc-99m	1×10^{2}	1×10^{7}
Ru-97	1×10^{2}	1×10^{7}
Ru-103	1×10^{2}	1×10^{6}
Ru-105	1×10^{1}	1×10^{6}
Ru-106[a]	1×10^{2}	1×10^{5}
Rh-103m	1×10^{4}	1×10^{8}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Rh-105	1×10^{2}	1×10^{7}
Pd-103	1×10^{3}	1×10^{8}
Pd-109	1×10^{3}	1×10^{6}
Ag-105	1×10^{2}	1×10^{6}
Ag-108m	1×10^{1}	1×10^{6}
Ag-110m	1×10^{1}	1×10^{6}
Ag-111	1×10^{3}	1×10^{6}
Cd-109	1×10^{4}	1×10^{6}
Cd-115	1×10^{2}	1×10^{6}
Cd-115m	1×10^{3}	1×10^{6}
In-111	1×10^{2}	1×10^{6}
In-113m	1×10^{2}	1×10^{6}
In-114m	1×10^{2}	1×10^{6}
In-115m	1×10^{2}	1×10^{6}
Sn-113	1×10^{3}	1×10^{7}
Sn-117m	1×10^{2}	1×10^{6}
Sn-121	1×10^{5}	1×10^{7}
Sn-125	1×10^{2}	1×10^{5}
Sb-122	1×10^{2}	1×10^{4}
Sb-124	1×10^{1}	1×10^{6}
Sb-125	1×10^{2}	1×10^{6}
Te-123m	1×10^{2}	1×10^{7}
Te-125m	1×10^{3}	1×10^{7}
Te-127	1×10^{3}	1×10^{6}
Te-127m	1×10^{3}	1×10^{7}
Te-129	1×10^{2}	1×10^{6}
Te-129m	1×10^{3}	1×10^{6}
Te-131	1×10^{2}	1×10^{5}
Te-131m	1×10^{1}	1×10^{6}
Te-132	1×10^{2}	1×10^{7}
Te-133	1×10^{1}	1×10^{5}
Te-133m	1×10^{1}	1×10^{5}
Te-134	1×10^{1}	1×10^{6}
I-123	1×10^{2}	1×10^{7}
I-124	1×10^{1}	1×10^{6}
I-125	1×10^{3}	1×10^{6}
I-126	1×10^{2}	1×10^{6}
I-129	1×10^{2}	1×10^{5}
I-130	1×10^{1}	1×10^{6}
I-131	1×10^{2}	1×10^{6}
I-132	1×10^{1}	1×10^{5}
I-133	1×10^{1}	1×10^{6}
I-134	1×10^{1}	1×10^{5}
I-135	1×10^{1}	1×10^{6}
Xe-131m	1×10^{4}	1×10^{4}
Xe-133	1×10^{3}	1×10^{4}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Xe-135	1×10^{3}	1×10^{10}
Cs-129	1×10^{2}	1×10^{5}
Cs-131	1×10^{3}	1×10^{6}
Cs-132	1×10^{1}	1×10^{5}
Cs-134m	1×10^{3}	1×10^{5}
Cs-134	1×10^{1}	1×10^{4}
Cs-135	1×10^{4}	1×10^{7}
Cs-136	1×10^{1}	1×10^{5}
Cs-137[a]	1×10^{1}	1×10^{4}
Cs-138	1×10^{1}	1×10^{4}
Ba-131	1×10^{2}	1×10^{6}
Ba-133	1×10^{2}	1×10^{6}
Ba-140[a]	1×10^{1}	1×10^{5}
La-140	1×10^{1}	1×10^{5}
Ce-139	1×10^{2}	1×10^{6}
Ce-141	1×10^{2}	1×10^{7}
Ce-143	1×10^{2}	1×10^{6}
Ce-144[a]	1×10^{2}	1×10^{5}
Pr-142	1×10^{2}	1×10^{5}
Pr-143	1×10^{4}	1×10^{6}
Nd-147	1×10^{2}	1×10^{6}
Nd-149	1×10^{2}	1×10^{6}
Pm-147	1×10^{4}	1×10^{7}
Pm-149	1×10^{3}	1×10^{6}
Sm-147	1×10^{1}	1×10^{4}
Sm-151	1×10^{4}	1×10^{8}
Sm-153	1×10^{2}	1×10^{6}
Eu-152	1×10^{1}	1×10^{6}
Eu-152m	1×10^{2}	1×10^{6}
Eu-154	1×10^{1}	1×10^{6}
Eu-155	1×10^{2}	1×10^{7}
Gd-153	1×10^{2}	1×10^{7}
Gd-159	1×10^{3}	1×10^{6}
Tb-160	1×10^{1}	1×10^{6}
Dy-165	1×10^{3}	1×10^{6}
Dy-166	1×10^{3}	1×10^{6}
Ho-166	1×10^{3}	1×10^{5}
Ho-166m	1×10^{1}	1×10^{6}
Er-161	1×10^{1}	1×10^{6}
Er-169	1×10^{4}	1×10^{7}
Er-171	1×10^{2}	1×10^{6}
Tm-170	1×10^{3}	1×10^{6}
Tm-171	1×10^{4}	1×10^{8}
Yb-169	1×10^{2}	1×10^{7}
Yb-175	1×10^{3}	1×10^{7}
Lu-177	1×10^{3}	1×10^{7}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Hf-181	1×10^{1}	1×10^{6}
Ta-182	1×10^{1}	1×10^{4}
W-181	1×10^{3}	1×10^{7}
W-185	1×10^{4}	1×10^{7}
W-187	1×10^{2}	1×10^{6}
W-188	1×10^{2}	1×10^{5}
Re-186	1×10^{3}	1×10^{6}
Re-188	1×10^{2}	1×10^{5}
Os-185	1×10^{1}	1×10^{6}
Os-191	1×10^{2}	1×10^{7}
Os-191m	1×10^{3}	1×10^{7}
Os-193	1×10^{2}	1×10^{6}
Ir-190	1×10^{1}	1×10^{6}
Ir-192	1×10^{1}	1×10^{4}
Ir-194	1×10^{2}	1×10^{5}
Pt-191	1×10^{2}	1×10^{6}
Pt-193m	1×10^{3}	1×10^{7}
Pt-197	1×10^{3}	1×10^{6}
Pt-197m	1×10^{2}	1×10^{6}
Au-198	1×10^{2}	1×10^{6}
Au-199	1×10^{2}	1×10^{6}
Hg-195m	1×10^{2}	1×10^{6}
Hg-197	1×10^{2}	1×10^{7}
Hg-197m	1×10^{2}	1×10^{6}
Hg-203	1×10^{2}	1×10^{5}
Tl-200	1×10^{1}	1×10^{6}
Tl-201	1×10^{2}	1×10^{6}
Tl-202	1×10^{2}	1×10^{6}
Tl-204	1×10^{4}	1×10^{4}
Pb-203	1×10^{2}	1×10^{6}
Pb-210[a]	1×10^{1}	1×10^{4}
Pb-212[a]	1×10^{1}	1×10^{5}
Bi-206	1×10^{1}	1×10^{5}
Bi-207	1×10^{1}	1×10^{6}
Bi-210	1×10^{3}	1×10^{6}
Bi-212[a]	1×10^{1}	1×10^{5}
Bi-213	1×10^{2}	1×10^{6}
Po-203	1×10^{1}	1×10^{6}
Po-205	1×10^{1}	1×10^{6}
Po-207	1×10^{1}	1×10^{6}
Po-210	1×10^{1}	1×10^{4}
At-211	1×10^{3}	1×10^{7}
Rn-220[a]	1×10^{4}	1×10^{7}
Rn-222[a]	1×10^{1}	1×10^{8}
Ra-223[a]	1×10^{2}	1×10^{5}
Ra-224[a]	1×10^{1}	1×10^{5}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Ra-225	1×10^{2}	1×10^{5}
Ra-226[a]	1×10^{1}	1×10^{4}
Ra-227	1×10^{2}	1×10^{6}
Ra-228[a]	1×10^{1}	1×10^{5}
Ac-225	1×10^{1}	1×10^{4}
Ac-227	1×10^{-1}	1×10^{3}
Ac-228	1×10^{1}	1×10^{6}
Th-226[a]	1×10^{3}	1 × 1AR0[7]
Th-227	1×10^{1}	1×10^{4}
Th-228[a]	1×10^{0}	1×10^{4}
Th-229[a]	1×10^{0}	1×10^{3}
Th-230	1×10^{0}	1×10^{4}
Th-231	1×10^{3}	1×10^{7}
Th-nat (incl Th-232)	1×10^{0}	1×10^{3}
Th-234[a]	1×10^{3}	1×10^{5}
Pa-230	1×10^{1}	1×10^{6}
Pa-231	1×10^{0}	1×10^{3}
Pa-233	1×10^{2}	1×10^{7}
U-230[a]	1×10^{1}	1×10^{5}
U-231	1×10^{2}	1×10^{7}
U-232[a]	1×10^{0}	1×10^{3}
U-233	1×10^{1}	1×10^{4}
U-234	1×10^{1}	1×10^{4}
U-235[a]	1×10^{1}	1×10^{4}
U-236	1×10^{1}	1×10^{4}
U-237	1×10^{2}	1×10^{6}
U-238[a]	1×10^{1}	1×10^{4}
U-nat	1×10^{0}	1×10^{3}
U-239	1×10^{2}	1×10^{6}
U-240	1×10^{3}	1×10^{7}
U-240[a]	1×10^{1}	1×10^{6}
Np-237[a]	1×10^{0}	1×10^{3}
Np-239	1×10^{2}	1×10^{7}
Np-240	1×10^{1}	1×10^{6}
Pu-234	1×10^{2}	1×10^{7}
Pu-235	1×10^{2}	1×10^{7}
Pu-236	1×10^{1}	1×10^{4}
Pu-237	1×10^{3}	1×10^{7}

Nuclide	Activity concentration (Bq/g)	Activity (Bq)
Pu-238	1×10^{0}	1×10^{4}
Pu-239	1×10^{0}	1×10^{4}
Pu-240	1×10^{0}	1×10^{3}
Pu-241	1×10^{2}	1×10^{5}
Pu-242	1×10^{0}	1×10^{4}
Pu-243	1×10^{3}	1×10^{7}
Pu-244	1×10^{0}	1×10^{4}
Am -241	1×10^{0}	1×10^{4}
Am-242	1×10^{3}	1×10^{6}
Am-242m[a]	1×10^{0}	1×10^{4}
Am-243[a]	1×10^{0}	1×10^{3}
Cm-242	1×10^{2}	1×10^{5}
Cm-243	1×10^{0}	1×10^{4}
Cm-244	1×10^{1}	1×10^{4}
Cm-245	1×10^{0}	1×10^{3}
Cm-246	1×10^{0}	1×10^{3}
Cm-247	1×10^{0}	1×10^{4}
Cm-248	1×10^{0}	1×10^{3}
Bk-249	1×10^{3}	1×10^{6}
Cf-246	1×10^{3}	1×10^{6}
Cf-248	1×10^{1}	1×10^{4}
Cf-249	1×10^{0}	1×10^{3}
Cf-250	1×10^{1}	1×10^{4}
Cf-251	1×10^{0}	1×10^{3}
Cf-252	1×10^{1}	1×10^{4}
Cf-253	1×10^{2}	1×10^{5}
Cf-254	1×10^{0}	1×10^{3}
Es-253	1×10^{2}	1×10^{5}
Es-254	1×10^{1}	1×10^{4}
Es-254m	1×10^{2}	1×10^{6}
Fm-254	1×10^{4}	1×10^{7}
Fm-255	1×10^{3}	1×10^{6}
Alpha-emitting radionuclide not mentioned in this Table	1×10^{0}	1×10^{3}
Radionuclide that is not alpha-emitting and not mentioned in this Table	1×10^{1}	1×10^{4}

a The exemption levels given in this schedule for the following radionuclides are for the parent nuclides, which are assumed to be in secular equilibrium with the progeny listed below:

Sr-80	Rb-80
Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Ag-108m	Ag-108
Cs-137	Ba-137m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat (incl Th-232)	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

NOTE 1: The limits in relation to U(nat) and Th(nat) are to be applied in terms of the parent radionuclides ie. U-238 and Th-232 respectively.

Schedule 5: Exempt radiation generating apparatus, electron tubes and radioactive sources

(Refer section 3.2.6(c) and 3.2.7)

S 5.1: Exemption of apparatus

The apparatus listed in this schedule are exempt from notification, registration and licensing requirements.

(a) television receivers

(b) visual display units

(c) cold cathode gas discharge tubes

(d) electron microscopes

S 5.2: Exemption of radioactive sources

The radioactive sources listed below are exempt from the provisions specified[20]:

(a) Americium-241 sealed sources of activity up to 40 kBq used in domestic smoke alarms meeting the requirements of AS3786:1993 are exempted from the requirements of registration, and of licensing the end user to possess or use.

(b) Depleted uranium in solid massive form that is used for ballast in aircraft and boats and ships is exempted from the requirements of registration, and of licensing the end user to possess or use.

(c) Depleted uranium that is completely contained within an appropriate metallic sheath, and is used as radiation shielding in a container for radioactive sources that complies with the requirements of the *Code of Practice for the Safe Transport of Radioactive Material (2008)* [RPS 2] is exempted from the requirements of registration, and of licensing the end user to possess or use.

(d) A gaseous tritium light source that is solely used for safety purposes and includes less than 74 GBq of tritium is exempted from the requirements of registration, and of licensing the end user to possess or use.

(e) A sealed radioactive source used for teaching the characteristics and properties of radiation or radiation sources and containing a radionuclide listed in Table S5.1 below, with an activity not greater than listed in the table, is exempted from the requirements of registration, and of licensing the end user to possess or use.

[20] It should be noted that the provisions requiring authorisation prior to disposal of radioactive materials still apply, unless the disposal is in accordance with Schedule 14.

Table S5.1

Radionuclide	Activity (kBq)
Cobalt-60	200
Strontium-90	80
Caesium-137	200
Radium-226	20
Americium-241	40

(f) A geological sample that contains radioactive material is exempted from the requirements of registration, and of licensing the end user to possess or use, if:

a. it emits radiation at a level not more than 5 micrograys an hour, measured at a distance of 10 cm from its surface

b. it is being used as a sample in teaching or for display as a geological specimen.

(g) An electron capture detector or similar device used in gas chromatography containing a nickel-63 sealed source with activity not more than 750 MBq, or tritium source with activity not more than 20 GBq, is exempted from the requirements of registration, and of licensing the end user to possess or use.

(h) Lighting products that include krypton-85 are exempted from the requirements of registration, and of licensing the end user to possess or use.

Schedule 6: Competency requirements for authorisation to use radiation sources for specified practices

(Refer sections 4.3 and 4.5)

This schedule specifies the agreed competencies and/or prerequisites for obtaining authorisations to use radiation sources for specified practices.

S 6.1: Use of X-ray equipment by chiropractors for plain/conventional diagnostic radiography of the spine and pelvis[21]

Must provide evidence of the following:

- current registration as a chiropractor with the Chiropractic Board of Australia; and one of the following:
  - graduates in Chiropractic from RMIT University, Bundoora, Victoria (or forerunner Phillip Institute of Technology)
    - graduates in chiropractic from Macquarie University, NSW (or forerunner Sydney College of Chiropractic, Ashfield, Sydney, NSW since 30 Nov 1983)
  - a pass in the Western Australian Radiation Safety (Chiropractic) restricted X-ray Examination
  - For overseas trained chiropractors, one of the following:
    - satisfactory assessment by RMIT University or Macquarie University
    - individual assessment by the relevant State/Territory Authority against a protocol agreed by the Radiation Health Committee
    - a pass in the Western Australian Radiation Safety (Chiropractic) restricted X ray Examination.

S 6.2 – Use of intra-oral X-ray equipment by dentists for radiography of teeth and facial bones[22]

Must provide evidence of the following:

- current registration by the relevant Dental Board.

S 6.3: Use of intra-oral X-ray equipment by dental hygienists for dental radiography[23]

Must provide evidence of the following:

- current registration as a dental hygienist by the relevant Dental Board; and one of the following:
  - Diploma of Dental Hygiene from Oral Health Centre of WA or Torrens Valley College of TAFE (Gilles Plains SA)
  - for overseas trained dental hygienists, satisfactory assessment from Oral Health Centre of WA or Torrens Valley College of TAFE (Gilles Plains SA).

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21 Nationally agreed requirements for radiography of extremities will be included in a later edition of the Directory.

22 Nationally agreed requirements for OPG, and for radiography of hand & wrist for bone age, will be included in a later edition of the Directory.

23 Nationally agreed requirements for dental assistants will be considered for inclusion in a future edition of the Directory.

S 6.4: Use of intra-oral X-ray equipment by dental therapists for dental radiography

Must provide evidence of the following:

- current registration as a dental therapist by the relevant Dental Board, and satisfactory assessment at course in dental therapy accredited by the Authority.

S 6.5: Use of X-ray equipment by diagnostic radiographers for diagnostic radiography

Must provide evidence of one of the following:

- Australian Institute of Radiography (AIR) Statement of Accreditation (AIR Statement of Accreditation)
- Certificate of Competence issued by the Conjoint Board of the Royal Australasian College of Radiologists (RACR) and the AIR
- Diploma of Qualification issued by the Conjoint Board of the RACR and the AIR
- 1984 Assoc. Diploma in Diagnostic Radiography Graduates from Sydney TAFE.

Persons undertaking the Professional Development Year (PDY) at an accredited institution or practice must provide evidence of the following to obtain a restricted authorisation:

- AIR Provisional Statement of Accreditation.

S 6.6: Use of radiation equipment by radiation therapists for radiation therapy

Must provide evidence of one of the following:

- AIR Statement of Accreditation in therapeutic radiography (AIR Statement of Accreditation)
- Certificate of Competence in therapeutic radiography issued by the Conjoint Board of the RACR and the AIR
- Diploma of Qualification in therapeutic radiography issued by the Conjoint Board of the RACR and the AIR.

Persons undertaking the Professional Development Year (PDY) at an accredited institution or practice must provide evidence of the following to obtain a restricted authorisation:

- AIR Provisional Statement of Accreditation.

S 6.7: Use of radioactive materials by nuclear medicine technologists for nuclear medicine purposes

Must provide evidence of the following:

- Statement of Accreditation by ANZSNM.

Persons undertaking the Professional Development Year (PDY) at an accredited institution or practice must provide evidence of the following to obtain a restricted authorisation:

- Provisional Statement of Accreditation from Australian and New Zealand Society of Nuclear Medicine (ANZSNM).

S 6.8: Use of radiation sources by veterinary surgeons for veterinary purposes

Must provide evidence of the following:

- diagnostic X-ray equipment use for small animal radiography[24]
  - current registration by the relevant Veterinary Board
- sealed radioactive source use:
  - current registration by the relevant Veterinary Board, and satisfactory completion of an accredited examination on the principles and practices of radiation protection in the proposed use of radioactive materials
- unsealed radioactive source use:
  - current registration by the relevant Veterinary Board, and satisfactory completion of an accredited examination on the principles and practices of radiation protection in the proposed use of radioactive materials.

[24] Requirements for large animal radiography and therapy use of X-ray equipment will be considered in a future edition of the Directory.

Schedule 7: Requirements for licensing specific practices

(Refer section 4.2.1)

S 7.1: Requirements for borehole logging or well logging

1. The licence must include a purpose statement that restricts the licensee to the use of radioactive sources or radiation apparatus registered for use in borehole logging or well logging only.
2. The licence must require the licensee to comply with the *ARPANSA/NOHSC Standard for limiting occupational exposure to ionizing radiation RPS 1 (2002)*.
3. The licence must require the licensee to comply with the *Code of practice for the safe use of sealed radioactive sources in borehole logging (1989)* [RHS 28].
4. The licence must require the licensee to ensure the direct supervision of any field site while radioactive sources or radiation apparatus are in use, to ensure that unauthorised persons do not enter the site.

S 7.2: Requirements for industrial radiography

1. The licence must include a purpose statement that restricts the licensee to the use of radioactive sources or radiation apparatus registered for use in industrial radiography only.
2. The licence must require the licensee to comply with the *ARPANSA/NOHSC Standard for limiting occupational exposure to ionizing radiation RPS 1 (2002)*.
3. The licence must require the licensee to ensure that all practices involving industrial radiography ionising radiation sources are conducted in compliance with the *Code of practice for the safe use of industrial radiography equipment (1989)* [RHS 31].
4. The licence must require the licensee to undertake continuous and immediate personal supervision of any assistant using industrial radiography apparatus.
5. The licence must prohibit the licensee from using industrial radiography ionising radiation apparatus or sealed source apparatus if the working conditions are likely to render radiation-warning devices ineffective.
6. The licence must require the licensee to ensure that a beam stop is used when performing warm up operations on industrial radiography X-ray apparatus or when energising the X-ray tube for any purpose other than the production of a radiographic image.
7. The licence must require the licensee to use collimating devices on industrial radiography ionising radiation apparatus or sealed source apparatus where practicable.
8. The licence must require the licensee to ensure that:
   (a) unless otherwise approved in writing by the Authority, the source is disposed of by returning it to the supplier at the end of its useful life
   (b) where a radioactive source is being used for industrial radiography at an area other than the place where it is usually stored, diagrams or photographs with dimensions and identifying features of the source and the steps to be taken by any person finding such a source are immediately available at the area where the source is being used.

Schedule 8: Nationally agreed security requirements for persons applying for authorisation to possess, store or use a radiation source

(Refer section 4.4)

A future version of this Directory will specify in this schedule the agreed security requirements for persons to be authorised to possess, store or use radiation sources of specified categories.

Schedule 9: Criteria for registration allowing the use of radiation sources and premises

(Refer section 4.6.2)

S 9.1: Registration criteria for industrial radiography sealed sources and premises

1. All source capsules used for industrial radiography must:
   (a) be designed and constructed to so that any radioactive material must remain effectively enclosed within the capsule during normal use and accident conditions
   (b) for the purposes of section (a), a capsule complies if it meets the requirements of ISO 2919:1999 (E), as expressed in table 4 of that Standard
   (c) have current special form certification.
2. All source containers used for industrial radiography, other than those for X-ray crawler control sources, must:
   (a) comply with the *Code of Practice for the Safe Use of Industrial Radiography Equipment (1989)* [RHS 31]
   (b) have current Type B(U) certification, the requirements for which are specified in the *Code of Practice for the Safe Transport of Radioactive Material (2008)* [RPS 2], or be transported in the relevant approved overpack.
3. The premises constituting the principal place of storage of sources used for industrial radiography must comply with the *Code of Practice for the Safe Use of Industrial Radiography Equipment (1989)* [RHS 31].

Schedule 10: Minimum set of nationally agreed accreditation requirements for third-party service providers

(Refer section 4.7)

A future version of this Directory will specify in this Schedule categories of accreditations, standard requirements for accreditation and personnel security checks, national accreditation processes and guidelines and functions suitable for outsourcing by an Authority to a third-party service provider.

Schedule 11: National adoption of referenced codes and standards

(Refer section 5.1)

The following codes and standards are referenced and must be adopted by all jurisdictions within their respective regulatory frameworks:

RPS 1 Recommendations and National Standard	*Recommendations for Limiting Exposure to Ionizing Radiation* (1995) and *National Standard for Limiting Occupational Exposure to Ionizing Radiation* (1995), NOHSC/ARPANSA, republished in March 2002.
RPS 2 Code of Practice	Safe Transport of Radioactive Material, ARPANSA, January 2008.
RPS 3 Radiation Protection Standard	Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz, ARPANSA, May 2002.
RPS 5 Code of Practice	Portable Density/Moisture Gauges containing Radioactive Sources, ARPANSA, May 2004.
RPS 8 Code of Practice	Exposure of Humans to Ionizing Radiation for Research Purposes, ARPANSA, May 2005.
RPS 9 Code of Practice	Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing, ARPANSA, August 2005.
RPS 10 Code of Practice	Radiation Protection in Dentistry, ARPANSA, December 2005.
RPS 11 Code of Practice	Security of Radioactive Sources, ARPANSA, January 2007.
RPS 12 Radiation Protection Standard	Occupational Exposure to Ultraviolet Radiation, ARPANSA, December 2006.
RPS 13 Code of Practice	Safe Use of Fixed Radiation Gauges, ARPANSA, January 2007.
RPS 14 Code of Practice	Radiation Protection in the Medical Applications of Ionizing Radiation, ARPANSA, May 2008.
RPS 17 Code of Practice	Radiation Protection in Veterinary Medicine, ARPANSA, July 2009.
RPS 19 Code of Practice	Radiation Protection in Application of Ionizing Radiation by Chiropractors, ARPANSA, November 2009.

NOTES:

Codes of practice and standards previously published by the National Health and Medical Research Council in its Radiation Health Series (RHS) publications have been handed over to ARPANSA for review and republication in ARPANSA's Radiation Protection Series (RPS). The RHC will progressively review RHS publications and promulgate the new publications in the RPS series.

Many codes and standards in the RHS series have been adopted by one or more Australian jurisdictions either in their regulations or as conditions of licence. The status of the RHS documents and other standards in the various jurisdictions is tabulated in Annex 3.

Schedule 12: National adoption of extracts from codes and standards

(Refer section 5.2)

The RHC will, progressively over time, agree on extracts that must be adopted by an Authority in its legislative framework and include such agreed extracts in future versions of this Directory.

Schedule 13: National incident reporting framework

(Refer section 5.3)

This schedule specifies the types of incidents that must be reported to ARPANSA for compilation in the Australian Radiation Incident Register (ARIR).

A radiation incident is any unintended or ill-advised event when using ionising radiation apparatus, specified types of non-ionising radiation apparatus or radioactive substances, which results in, or has the potential to result in, an exposure to radiation to any person or the environment, outside the range of that normally expected for a particular practice, including events resulting from operator error, equipment failure, or the failure of management systems that warranted investigation.

As expected by section 2.3(m), legislation in each jurisdiction must require notification of radiation incidents to the Authority. The Authority must provide information on radiation incidents of the following types to ARPANSA for inclusion in the ARIR. In some cases judgements will need to be made by the Authority in regard to whether an incident is too minor for reporting to the register.

1. Medical exposure of patients

(a) any diagnostic procedure other than as prescribed by the medical practitioner

(b) any diagnostic procedure resulting in an observable acute radiation effect

(c) any therapeutic treatment delivered to either the wrong patient or the wrong tissue, or using the wrong radiopharmaceutical

(d) when during the administration of a radioactive substance for diagnostic purposes, the activity of the substance administered exceeds the activity prescribed in the hospital/practice standard protocol for that test by 50% or more

(e) when during the administration of a radioactive substance for therapeutic purposes, the activity administered differs from that prescribed by 15% or more

(f) when during administration of a therapeutic dose of radiation from a radiation apparatus or a sealed radioactive source, the dose delivered differs from the total prescribed treatment dose by more than 10%.

2. Incidents that cause or may lead to radiation injuries or radiation doses exceeding the annual dose limits to workers or members of the public[25]

3. Lost or stolen radioactive sources or radiation apparatus

4. Transport of radioactive material

(a) where a package is damaged during freight handling or transport

(b) where a package is transported without the required documentation, placarding or labelling.

[25] Note that situations where radiation injuries or high doses [exceeding 0.25 Sv whole body, 0.75 Gy organ dose, 6 Gy skin dose] occur must be reported to the ARIR as soon as possible, and within 24 hours. ARPANSA will report incidents exceeding these doses to the IAEA for inclusion on their severe incidents database.

5. Unintentional or unauthorised discharges of radioactive materials into the environment[26]

Where unintentional or unauthorised activity discharges exceeding 100 times the exempt activity for the radionuclide specified in Schedule 4 of this Directory have occurred.

6. Damage to, or malfunctioning of, a radiation apparatus or sealed source apparatus

Where the damage or malfunction could in any way affect the radiation safety of the apparatus, including issues such as shielding integrity or causing increased radiation levels.

7. Contamination with, or dispersal of, a radioactive material[26]

Where a surface, substance or material is contaminated by a radioactive substance resulting from the spillage of more than 100 times the exempt activity of that substance specified in Schedule 4 of this Directory.

8. Out of control source of radiation

Where a radiation source is out of control, for example, where a source is not safely secured or shielded, or contamination is not confined.

9. Non-ionising radiation

Where there is actual injury, or the potential for injury, as a result of operator error, damage or malfunction of equipment, or failure of management systems, for the types of non-ionising radiation equipment specified below:

(i) lasers

(ii) radiofrequency generating equipment

(iii) man-made sources of ultraviolet radiation

(iv) magnetic resonance imaging machines.

10. Nuclear Incidents

Where events such as criticality incidents or those relating to the safety of a nuclear reactor occur.

11. Other incidents

Such incidents that the Authority must report include near-miss situations that may serve as a warning to other users, such as situations where radiation monitors at the entrance of scrap metal processing factories and landfill sites are triggered.

[26] This provision does not apply to mining. Reporting levels for mining incidents will be considered in a future edition of the Directory.

Schedule 14: Requirements and limits for the disposal of radioactive waste by the user

(Refer section 4.2.2)

For the purpose of Section 4.2.2, the radioactive material must meet the following criteria:

S14.1: Disposal of radioactive material via landfill

No authorisation is required from the Authority to dispose of radioactive material for final placement into landfill if the material:

1. is in solid form
2. is contained within packaging designed so that:
   (a) the smallest overall external dimension of each package is not less than 10 cm
   (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, and
      (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 Table S14.1 of this Schedule
   (g) the dose-rate at the surface of any individual package does not exceed 5 µSv/h
   (h) the maximum non-fixed external contamination on any individual package does not exceed:
      (i) 4 Bq/cm^2 for beta and gamma emitters, or
      (ii) 0.4 Bq/cm^2 for alpha-emitters having a half-life greater than 10 days
3. is limited to no more than 10 packages containing radioactive material from the person initiating the disposal in any 7 day period at the one landfill site
4. is not placed in the recycling waste stream, and
5. is recorded in a register that is kept by the person initiating the disposal.

S14.2: Disposal of radioactive material via sewer

No authorisation from the Authority is required to dispose of radioactive material into the sewerage system if the material:

1. consists of aqueous materials
2. is released so that:
   (i) the annual activity of a radioactive material from the site to a sewer does not exceed the value in column 3 of Table S14.1 of this Schedule, and

(ii) the concentration at the input to a waste water treatment plant, calculated as the activity in (i) divided by the annual flow[27] through the waste water treatment plant to which the sewer connects, does not exceed that in column 4 of Table S14.1 of this Schedule, and

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

S14.3: Disposal of radioactive material to the atmosphere

No authorisation is required from the Authority to dispose of radioactive material into the atmosphere if the material is:

1. limited so that the annual activity released at the point of discharge does not exceed the air discharge values in column 5 of Table S14.1 of this schedule, and

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

Table S14.1 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 waste water 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}

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

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 waste water treatment plant (Bq/m^3)	Annual activity released to atmosphere from the point of discharge[3] (Bq)
^{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:

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

Where C_i is the activity of each isotope *i* to be disposed of, and

X_i is the activity value given in Table S14.1 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, and

X_i is the activity or activity concentration discharge value, as appropriate, as given in Table S14.1 for each isotope i.

(4) A 'site' may be, for example, a university 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.

Annex 1: Process for resolving a national approach to various radiation protection issues[28]

Introduction

This paper describes a process for resolving the various issues which will arise as national uniformity of radiation protection frameworks is progressed. The shorthand reference to this process will be the 'process for issue resolution'.

Over time, a broad range of issues will be resolved through use of the process for issue resolution. In some cases, the outcome will be new national standards or codes of practice. As such, the process for issue resolution will need to mirror, as closely as possible, the existing processes for national standards setting which were prescribed by the Council of Australian Governments in the publication *Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies* (the COAG Principles and Guidelines). That document effectively sets out the requirements for impact assessment where new regulation is proposed, including the steps to preparing a regulatory impact statement (RIS).

The approach to progressing national uniformity which has been agreed at officer level centres on the Radiation Health Committee (RHC), established under the Commonwealth's *Australian Radiation Protection and Nuclear Safety Act 1998* and serviced by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), developing a National Directory for Radiation Protection. The process for issue resolution, comprising research, consultation, and implementation, will need to be followed for each matter which will appear in the National Directory. Once the RHC has completed its deliberations on a particular issue, the proposed provisions will be submitted direct to Health Ministers (through AHMAC) for approval.

It is also expected that, where the process for issue resolution has been followed in resolving a particular issue, there will be a reduced need for individual jurisdictions to complete their own comprehensive regulation impact assessment prior to implementing agreed provisions of the National Directory. For example, comprehensive consultations will occur at the national level as provisions are being developed, perhaps requiring only a limited supplementary process in states and territories. To achieve this aim, however, the process will need to meet not only the requirements laid down by the Council of Australian Governments' *Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Councils and Standard-Setting Bodies*, but also regulation review requirements of all states and territories. The process will be developed further until this objective has been achieved.

Once the contents of the initial draft National Directory are resolved through use of the process for issue resolution, the draft National Directory will be used as a resource guiding all states, territories and the Commonwealth to undertake nationally uniform legislative changes.

The National Directory will also change over time as further agreements are reached by the members of the RHC, and as additional scientific and other research becomes available about the health effects of radiation.

[28] This Annex is a copy of the paper submitted to the 4 August 1999 Australian Health Ministers' Conference, and formed part of the Ministerial agreement to develop the National Directory for Radiation Protection.

General description of the process for issue resolution

The various elements of the process for issue resolution are discussed below. Naturally, the process is intended to be flexible and it is expected that some of these steps may be dispensed with, or combined, in any particular case. Likewise, timeframes for completion of the process will depend on the complexity of the particular issue at hand.

The key objectives of the process for issue resolution are to ensure that:

- a range of options is considered
- comprehensive consultation is undertaken, and the results are recorded and considered
- there are visible 'signposts' which indicate how a particular decision was reached.

It is worth noting that the COAG Principles and Guidelines outline various techniques which may be used as part of an RIS framework. Some of the available techniques include cost effectiveness analysis and risk assessment. The particular issue at hand will largely determine which of these techniques is most appropriate.

Issue identification

The process for issue resolution is initiated when an issue is brought to the attention of the RHC of ARPANSA. Some understanding will need to be developed between jurisdictions to ensure that the RHC is given an opportunity to discuss issues which have a national dimension. If possible, unilateral action by any jurisdiction where that action will detract from uniformity should be avoided.

An issue may be raised by a range of interested parties, including:

- the CEO of ARPANSA
- a member of the RHC
- a member of the Radiation Health and Safety Advisory Council (RHSAC) of ARPANSA, or
- an outside stakeholder such as another state or Commonwealth agency (e.g. WorkCover) or a professional peak organisation, for example the Australian Institute of Non-Destructive Testing [in this case the approach would be made in writing to the CEO].

Regulations under the ARPANS Act will prescribe in general terms the roles and functions of the RHSAC and various Committees. However, it is anticipated that these arrangements will give the RHC some discretion to decide how a particular issue should be dealt with. The options here may include:

- direct resolution of an issue by the RHC
- a recommendation to the RHSAC that it address a particular issue
- the cooperative resolution of an issue through discussions and correspondence with outside agencies and other stakeholders [coordinated by the CEO]
- combining the 'new' issue with other issues already being discussed, or
- a decision that an issue raised does not require further investigation.

Several broad types of issues for resolution may be identified at this point. Many issues will be primarily 'scientific' in nature, such as the definition of a radioactive substance or the content of a Code of Practice. Other issues will be primarily 'regulatory' in nature, such as reaching an agreed position on how a particular

occupation or professional group should be regulated across all jurisdictions, or creating a policy for the use of accredited private sector inspectors/auditors (and the criteria for their accreditation). Both types of issues are likely to require impact assessment.

As a matter of policy, the issue to be resolved should be identified in a broad sense. This will allow a range of perspectives to be considered as part of the process for issue resolution. This in turn will help to ensure that the best decision is made. An example would be 'Ensure radiographic services in remote areas are operated to a high radiation safety standard.'

Working group

Once the RHC has resolved to take action, a working group will be formed to oversee the process for issue resolution.

Composition of the working group will depend on the issue at hand. It will always comprise one or more members of the RHC, and will include other members as required. These other members may be representatives of stakeholders such as industry, professional groups or academic institutions. They may also be nominees of other Commonwealth or state/territory agencies such as WorkSafe Australia.

While the formation of each Working Group will be issue-specific, it is anticipated that the resolution of each issue will generally require both scientific and legal/policy expertise. The members of each working group will be selected with this in mind. Other sources of available expertise will include members of the ARPANSA Secretariat and ARPANSA scientific, technical, policy and legal staff, as well as contractors.

At the outset, the Working Group will agree a work plan for completing a response to the particular issue. In deciding a work plan, it may be most appropriate for the Working Group to refer to the various techniques for impact assessment set out in the COAG Principles and Guidelines. In all cases, the work plan will include a deadline.

Development of a preferred position

The working group will undertake research on the issue for resolution, including examining work done previously in Australia and overseas. The secretariat will provide assistance in this area. Working group members will also discuss the issue with other RHC members.

As the process for issue resolution progresses, the working group will develop a 'preferred position'. That position should, where possible, be the outcome of consideration of a range of options. The process of looking at the relative impacts of different options to achieve the objective will allow the working group to identify the one with the greatest net benefit.

The development of a preferred position should take account of the 'features of good regulation' as identified in the COAG Principles and Guidelines. These include:

- provisions should entail the minimum necessary regulation to achieve the objectives
- provisions should minimise, as much as possible, the financial impact of administration and enforcement on government and the affected sectors of the community
- provisions should be performance based, that is they should focus on outcomes rather than inputs
- provisions should be drafted in 'plain language' so that their intent is clear.

The preferred position should be reached by consensus within the group.

Once developed and agreed, a 'preferred option' may be compared with the status quo, and other possible options, to provide some assessment of the impact of the proposed changes, including costs and benefits. This will ensure that the preferred position is the one with the greatest net benefit.

Consideration should also be given to what final form the provision should take. The majority of processes for issue resolution will conclude with an entry into the National Directory. However, beyond that point, a new Code of Practice may be required, or an amendment to an existing Code or Standard.

The development of a preferred position will also include consultation with the full RHC to ensure that the committee is comfortable with the direction being taken by the working group.

Consultation

The consultation process undertaken by the working group will conform to the COAG Principles and Guidelines. Interested parties should be given a firm proposal to consider. This means that the preferred position should be developed to a point where the impacts are clear before consultation begins.

The level of consultation will correspond to the particular issue being discussed and, at the least, will include those most likely to be affected by regulations (e.g. business organisations and professional bodies). In most cases, however, it will comprise full consultation with relevant stakeholders, including radiological advisory councils in most states and territories.

Effective consultation at the national level will indicate the level of support for the proposal. In most cases, it will also provide valuable feedback on the costs and benefits of a proposed regulation.

The outcome of all consultations will be recorded by the working group and members of the secretariat. At the conclusion of the process for issue resolution, details of the stakeholders consulted and their views on the preferred option (and other options) will be included in the final report.

Nationally agreed position

A nationally agreed position will be created when, following the consultation phase, the working group reports back to the whole RHC. This will take the form of a final written report.

Another important element in developing the nationally agreed position will be the technical advice provided by all members of the RHC in relation to implementation issues.

Once the working group's written report has been received, the RHC will provide that report to the CEO of ARPANSA and request that the Standards Development and Committee Support Section of ARPANSA prepare the necessary papers for consideration by Health Ministers (through AHMAC).

At this stage, the RHC may also recommend to the CEO that consideration be given to further action on the matter. For example, the RHC may recommend that work begin on a new code or that an existing code be revised.

Approval

Once the report has been provided to ARPANSA, the nationally agreed position will be considered to be a draft entry in the National Directory. It will remain a draft pending formal approval by Health Ministers.

Since AHMAC and Health Ministers meet only twice a year, they will be advised on several issues at each meeting. Those briefings will comprise detailed information on 'complex' issues, for example those connected with the professions, and shorter summaries of agreements on more 'routine' matters such as new definitions. Other business related to the Directory may be completed on an out-of-session basis.

Once approved by Health Ministers, the provision will become a 'final' entry in the National Directory and will be used by jurisdictions undertaking legislative changes. It may also be further developed to become a new code, or a standard, or a guidance note.

Implementation

After Health Ministers have approved the agreed position, the provision will be available to guide legislative amendments in each jurisdiction.

Other details of the implementation process, including the degree of flexibility available to jurisdictions in implementing provisions of the National Directory, may be a matter for negotiations between the Commonwealth and the states and territories.

Annex 2: Derivation of exemption levels for regulatory purposes

Introduction

The definition of radioactive material and the levels used to define exemption from regulatory control in legislation and regulations throughout Australia vary considerably between jurisdictions. These differences have been historical in origin as regulations have changed at different times and local issues such as mining in some jurisdictions have also influenced the definitions used. In some cases legislation has defined what is radioactive and in other jurisdictions the definition has been in terms of what is exempt from legislation. The differences between definitions can cause difficulties where a material defined as radioactive in one jurisdiction is unregulated in another. There have also been changes in radiation protection philosophy and practice introduced following the publishing of International Commission on Radiological Protection publication 60. These have included the adoption of Australian ARPANSA/NOHSC recommendations and national standard, revised ICRP kinetic and dosimetric model of the respiratory tract, new dose coefficients for workers using this model (ICRP 68), and revised IAEA Basic Safety Standards which include a new system for exempting radioactive materials from regulatory control. The IAEA has also recently revised its transport regulations and adopted the dose criteria used in the Basic Safety Standards.

Consequently a need for a uniform definition of radioactive material and exemption limits for regulatory purposes has been identified and this guideline has been developed for this purpose.

Principles and methods

In order to develop a uniform Australian approach to the definition of radioactive material a review was undertaken of existing approaches both in Australia and overseas. As a result a generalised definition of radioactive material has been adopted in conjunction with exemption levels based on IAEA Safety Series No. 115. IAEA adopts a system of activity and activity concentration levels for each radionuclide rather than a single overall figure. The IAEA approach has also been adopted by the European Communities.

IAEA established general principles for exemption from regulatory control in Safety Series No. 89 (1988). Broadly, they are:

(a) the radiation risks to individuals should be sufficiently low as to be of no regulatory concern

(b) radiation protection, including the cost of regulatory control, must be optimised.

The individual risk is addressed by defining a level of dose that can be regarded as ‘trivial’. Two approaches were adopted in Safety Series No. 89. A level of risk (and the corresponding dose) was chosen that could be considered to be of no significance to individuals. Exposure to natural background radiation was used as a reference level, as it is both normal and unavoidable.

Safety Series No. 89 concluded that for the purposes of exemption from regulations, a level of dose of some tens of μSv in a year could reasonably be regarded as trivial. Since an individual may be exposed to radiation from several exempt sources, it is necessary to ensure that the total dose from exempt sources does not exceed the trivial dose level. Accordingly, it was recommended that the critical group dose from any one exempt source should be of the order of 10 μSv per year. This level was used in the IAEA International Basic Safety Standards and has been adopted in this guideline.

The IAEA International Basic Safety Standards calculated individual exemption levels for 299 radionuclides, of which 103 were found to have current or conceivable uses. Six physical forms were considered to cover the existing range of use: gas/vapour, liquid/solution, dispersible solid (e.g. powder), non-dispersible solid, thin film/foil, and sealed source/capsule. The exemption level given for each radionuclide was that for the most restrictive form. Short-lived radionuclide daughters were included with the parent where they would be expected to be in equilibrium over the period of use and/or disposal. Two extra cases were considered: naturally occurring materials where all radionuclides in (i) ^{238}U and (ii) ^{232}Th decay chains would be in equilibrium.

The IAEA exemption levels were derived using a methodology given in the EC report Radiological Protection 65 and resulted from taking the most limiting case for potential exposure from workplace and public exposure scenarios. Three basic scenarios were considered: normal use, accidental exposure and disposal. Each results in doses from one or more of three exposure pathways: ingestion, inhalation and external exposure. A total dose for each scenario was calculated by summing across the pathways. Since it is unlikely that an individual will be significantly exposed via more than one pathway at any time, this is clearly a conservative assumption. The scenarios and pathways used are listed in Table I.

There were no scenarios covering accidents in the workplace used in calculating exempt concentrations; it was considered that the scenarios developed for normal use and the associated dose criterion, 10 μSv y^{-1}, ensured an adequate level of protection in the case of possible accidents. The methodology is further outlined in the block diagrams, Figures 1, 2 & 3.

There is one other issue with the application of the exemption values: the quantity of material involved. The radionuclide-specific concentration levels for exemption were calculated on the basis of small to moderate amounts of materials. This is mainly an issue in the external exposure scenario that assumes a source size of 1 m^3. Clearly, if a larger volume of radioactive material was assumed, doses higher than 10 μSv y^{-1} would be estimated. However, it is difficult to envisage circumstances where doses could be higher than 1 mSv y^{-1} from material containing radionuclides at the exempt concentration level.

Thus, the radionuclide-specific levels are such that:

(i) the maximum effective dose to an individual using radionuclides, or to an individual subsequently exposed as a result of, or as a consequence of, disposal following use, will be 10 μSv y^{-1} or less under plausible normal circumstances

(ii) effective doses from accidents, misuse, or unexpected situations should not be higher than the dose limit for members of the public, and

(iii) skin doses should not exceed 50 mSv y^{-1}.

Nevertheless, the International Basic Safety Standards do note that exemption of bulk amounts of materials with activity concentrations lower than the exemption levels may require further consideration by the appropriate authority.

References

Harvey MP, Mobbs SF, Cooper J, Chapius AM, Sugier A, Schneider T, Lochard J, Janssens A., *Principles and Methods for Establishing Concentration and Quantities (Exemption values) below which reporting is not Required in the European Directive*, Commission of the European Communities 1993. Radiological Protection No 65, EC Doc XI-028/93, Luxembourg.

International Atomic Energy Agency, 1996. *International Basic Safety Standards for Protection against Ionizing radiation and for the Safety of Radiation Sources*, IAEA Safety Series No. 115.

International Commission on Radiation Protection 1991, 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, Annals of the ICRP, **21:** 1-3.

International Commission on Radiological Protection 1994, *Dose Coefficients for Intakes of Radionuclides by Workers*: Replacement of ICRP Publication 61, ICRP Publication 68, Annals of the ICRP, **24; 4:**

International Atomic Energy Agency, 1988. *Principles for the Exemption of Radiation Sources and Practices from Radiation Control*, IAEA Safety Series No. 89.

Official Journal of the European Communities, L159, Volume 39, 29 June 1996, Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation.

Recommendations for Limiting Exposure to Ionizing Radiation (1995) and *National Standard for Limiting Occupational Exposure to Ionizing Radiation* (1995), NOHSC/ARPANSA, republished in March 2002 as Radiation Protection Series (RPS) 1.

Table I: List of exposure scenarios and pathways considered in calculations of doses for exemption in the basic safety standards.

A	**ACTIVITY CONCENTRATION**
A1	**Normal use (workplace) scenario**
	External exposure from a 1 m^3 source
	External exposure from a gas bottle
	External exposure from handling a source
	Ingestion from contaminated hands
	Inhalation of Dusts
A2	**Accidental (workplace) scenario:**
	This is covered by Normal use (workplace) scenario
A3	**Disposal (public) scenario**
	External exposure from a landfill site
	Inhalation of dust from a landfill site
	Ingestion of object from a landfill site
B	**ACTIVITIES/QUANTITIES**
B1	**Normal use (workplace) scenario:**
	External exposure from a point source
	External exposure from handling a source
B2	**Accidental (workplace) scenario:**
	Spillage: External exposure from contaminated surface
	Spillage: External exposure from contaminated hands
	Spillage: External exposure from contaminated face
	Spillage: Ingestion from hands
	Spillage: Inhalation of resuspended activity
	Spillage: External dose from aerosol or dust cloud
	Fire: Contamination of skin
	Fire: External from combustion products
	Fire: Inhalation of dust or volatiles
B3	**Disposal (public) scenario**
	External exposure from a landfill site
	Inhalation from a landfill site
	External exposure to skin from handling an object from a landfill site
	Ingestion of an object from a landfill site

Figure 1: Block diagram illustrating method for calculating exempt activities and activity concentrations

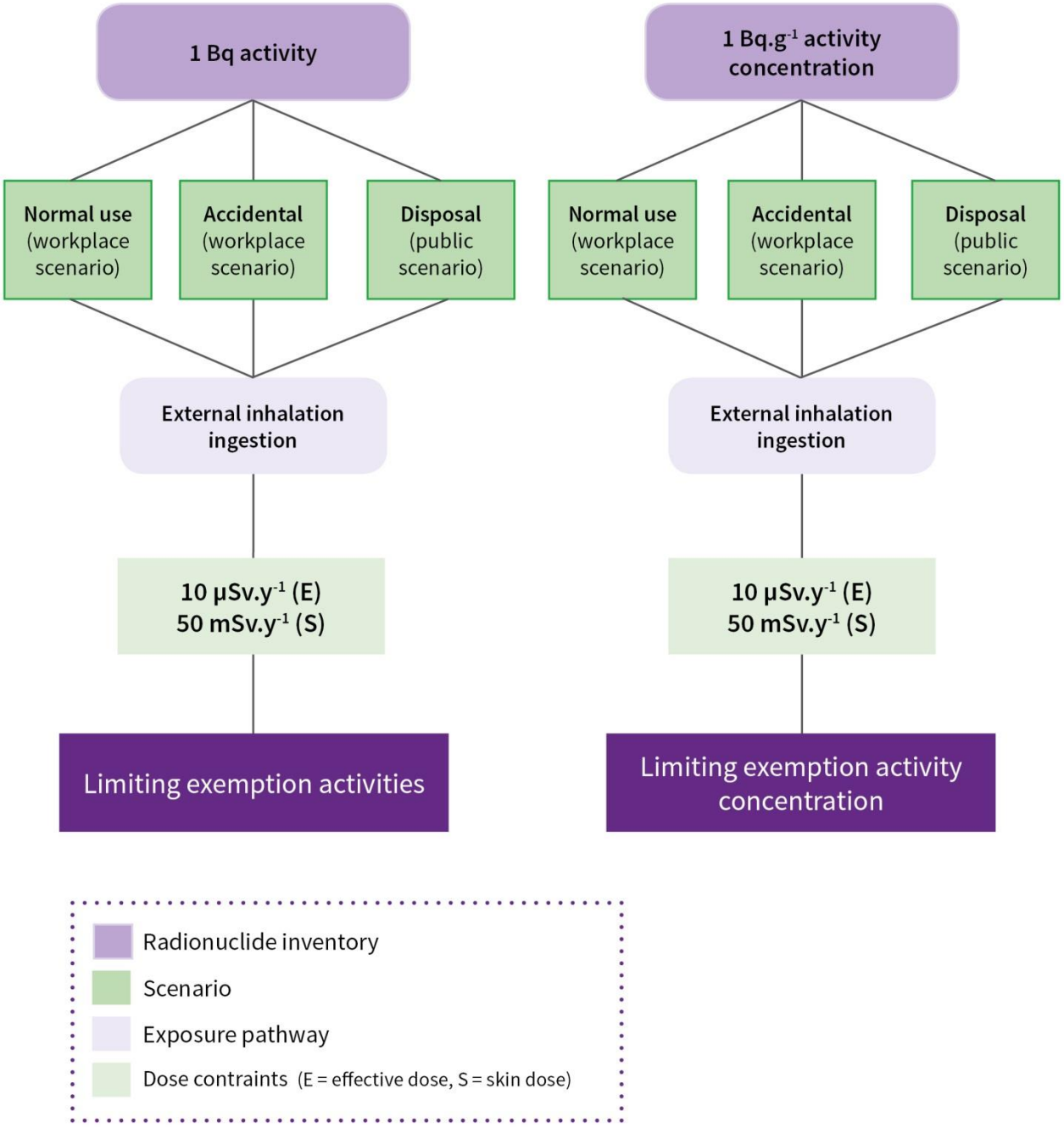


Figure 2: Block diagram showing workplace and public scenarios used to calculate doses for unit activity of 1 Bq

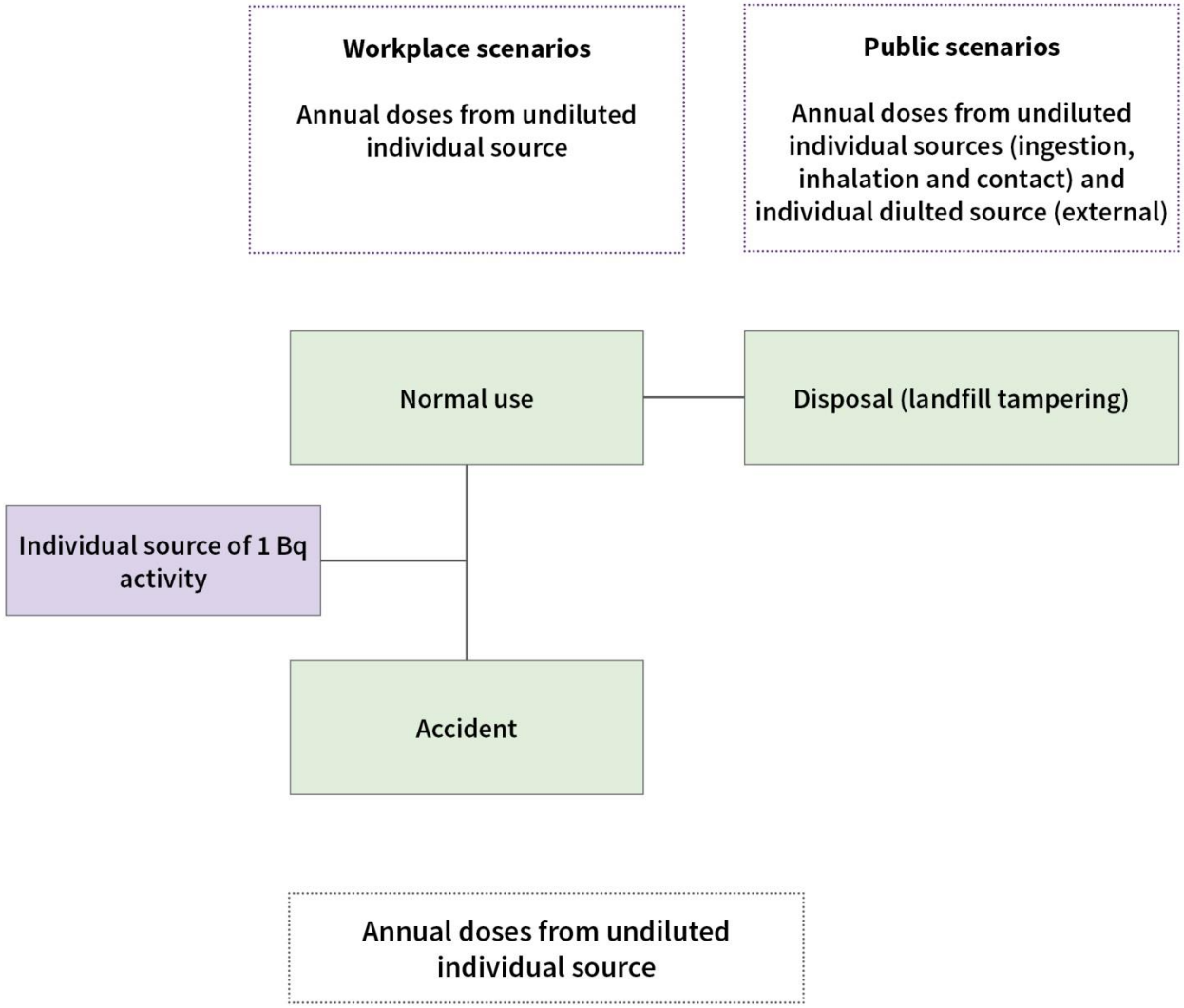
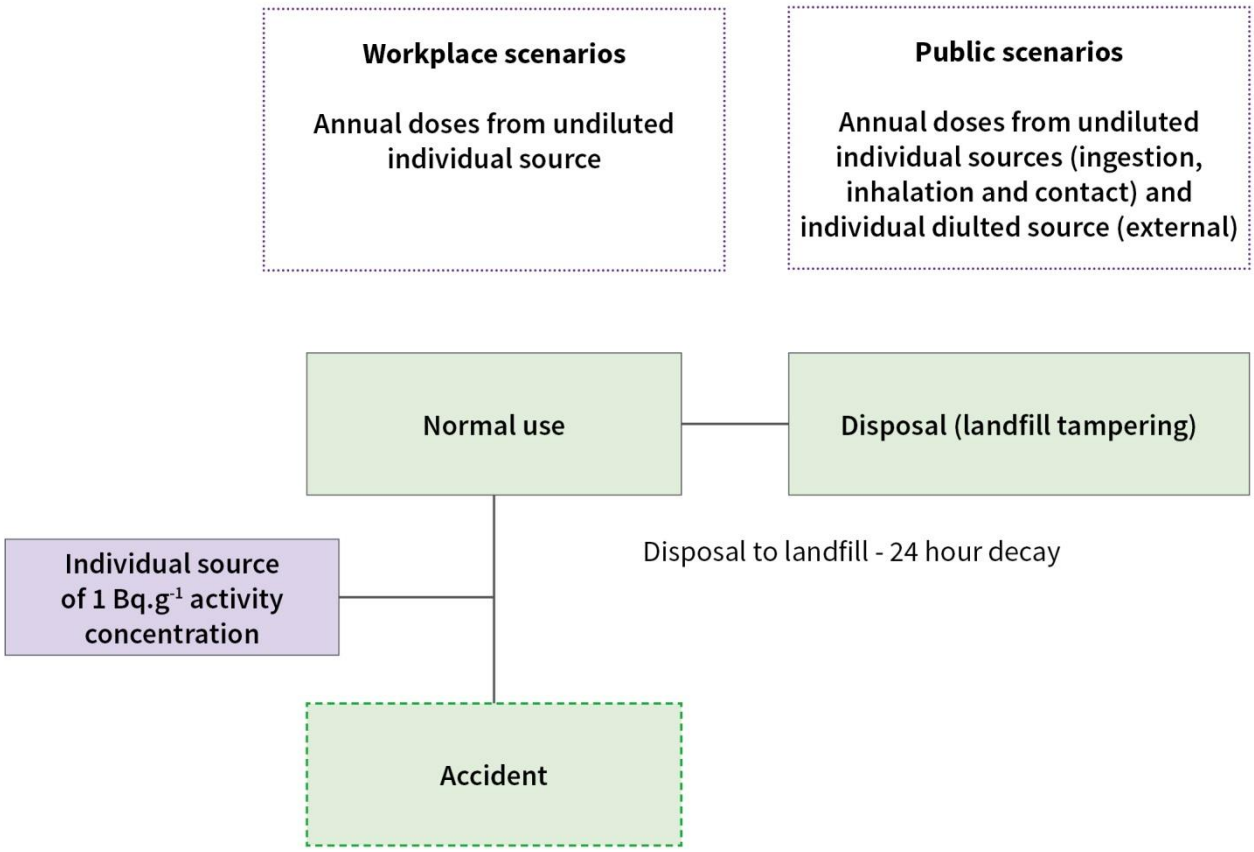


Figure 3: Block diagram showing workplace and public scenarios used to calculate doses for unit activity concentration of 1 Bq.g^{-1}.



Annex 3: Current status of Radiation Health Series documents and other standards in jurisdictions

	Adopted in regulations	Adopted as requirements, licence or registration conditions
RHS 2 - Code of Practice for the Design of Laboratories using Radioactive Substances for Medical Purposes (1980)		Vic
RHS 3 - Code of Practice for the Safe Use of Ionizing Radiation in Veterinary Radiology		NSW, Vic, Tas, NT, SA, Qld, WA, ARPANSA
RHS 4 - Code of Practice for the Safe Use of Radiation Gauges (1982)	SA, WA	NSW, Vic, Tas, Qld NT, ARPANSA
RHS 5 - Recommendations Relating to the Discharge of Patients Undergoing Treatment with Radioactive Substances		Vic, Tas, NT
RHS 8 - Code of Nursing Practice for Staff Exposed to Ionizing Radiation (1984)		Tas, NT
RHS 9 - Code of Practice for Protection Against Ionizing Radiation Emitted from X-ray Analysis Equipment (1984)	WA	NSW, Vic, Tas, Qld, NT, ARPANSA
RHS 10 - Code of Practice for Safe Use of Ionizing Radiation in Veterinary Radiology: part 3 - Radiotherapy		NSW, Vic, ARPANSA
RHS 11 - Code of Practice for the Safe Use of Soil Density and Moisture Gauges Containing Radioactive Sources (1984)		NSW, Vic, Tas, NT, Qld, WA, ARPANSA
RHS 12 - Administration of Ionizing Radiation to Human Subjects in Medical Research (1984)	NSW	Vic, Tas, NT, Qld, SA(exemptions adopted through Govt. Gazette)
RHS 14 - Recommendations for Minimising Radiological Hazards to Patients (1985)		Tas, Qld
RHS 15 - Code of Practice for the Safe Use of Microwave Diathermy Units (1985)		ARPANSA
RHS 16 - Code of Practice for the Safe Use of Shortwave (Radiofrequency) Diathermy Units (1985)		ARPANSA
RHS 18 - Code of Practice for the Safe Handling of Corpses Containing Radioactive Materials (1986)		Tas
RHS 19 - Code of Practice for the Safe Use of Ionizing Radiation in Secondary Schools (1986)	SA, Tas	NSW, NT, WA
RHS 20 - Code of Practice for Radiation Protection in Dentistry (1987)		NSW, Vic, SA, Qld, Tas, ARPANSA
RHS 21 - Revised Statement on Cabinet X-ray Equipment for Examination of Letters, Packages, Baggage, Freight and Other Articles for Security, Quality Control and Other Purposes (1987)	SA, WA	Vic, NT, Qld, Tas, ARPANSA
RHS 22 - Statement on Enclosed X-ray Equipment for Special Applications (1987)	WA	Vic, NT, Qld, ARPANSA

	Adopted in regulations	Adopted as requirements, licence or registration conditions
RHS 23 - Code of Practice for the Control and Safe Handling of Radioactive Sources Used for Therapeutic Purposes (1988)		Vic, NT, Tas
RHS 24 - Code of Practice for the Design of and Safe Operation of Non-medical Irradiation Facilities (1988)		Vic, Qld, ARPANSA
RHS 25 - Recommendations for Ionization Chamber Smoke Detectors for Commercial and Industrial Fire Protection Systems (1988)		Vic
RHS 28 - Code of Practice for the Safe Use of Sealed Radioactive Sources in Borehole Logging		NSW, Vic, NT, WA, Tas, Qld ARPANSA
RHS 29 - Occupational Standard for Exposure to Ultraviolet Radiation (1989)	WA, ARPANSA	
RHS 30 - Interim Guidelines on Limits of Exposure to 50/60 Hz Electric and Magnetic Fields (1989)	WA, ARPANSA	
RHS 31 - Code of Practice for the Safe Use of Industrial Radiography Equipment (1989)	WA, SA	NSW, Vic, NT, Qld Tas, ARPANSA
RHS 34 - Safety guidelines for magnetic resonance diagnostic facilities (1991)		Tas
RHS 35 - Code of Practice for the Near-Surface Disposal of Radioactive Waste in Australia (1992)	WA, ARPANSA	
RHS 37 - Code of Practice for the Safe Use of Lasers in the Entertainment Industry (1995)		Tas, WA
RHS 39 - Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (1995) (see Note 2 below)	ARPANSA, Comcare, Qld (Act is based on RHS 39), SA (defns refer to RHS 39 defns)	Tas, SA (in Mining licences)
Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1987)	WA	Vic, NT, SA
Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores (1982)		Vic, NT, SA
AS 2772.1 (1990) Radiofrequency Maximum Exposure Levels - 100kHz to 300 GHz	Comcare, WA	
AS 2772.2 Radiofrequency Radiation Principles and methods of measurement - 100kHz to 300 GHz		Comcare
RPS 3 - Radiation protection Standard for Maximum Exposure Levels to Radiofrequency Fields 3 kHz – 300 GHz (2002)	ARPANSA	
AS 2211 (1991) Laser Safety	Comcare, WA	Tas
AS/NZS 2211 Pts 1-2 (1997) Code of Practice for Laser Safety	Qld (use classification system for regulating Class 4 medical lasers), ARPANSA	Comcare

	Adopted in regulations	Adopted as requirements, licence or registration conditions
AS/NZS 2243 Pts 1-10 Safety in Laboratories		Comcare
AS/NZS 2243 Pt 4 Safety in Laboratories		NSW
AS 1188 (1990) Radio Transmitters and Similar Equipment - Safe Practices	Comcare	
AS 2397 Guide to the Safe Use of Lasers in the Construction industry	Comcare	
Guidance Note for the Protection of Workers from the Ultraviolet Radiation in Sunlight [NOHSC:3012(1991)]		Comcare

NOTE 1: All RHS documents will be reviewed and progressively republished under ARPANSA's Radiation Protection Series but not all of them will be republished as codes or standards, with some of them being rewritten as guidance notes in this Directory.

NOTE 2: This has been republished as RPS 1 and has been adopted in Schedule 11 of this Directory.

Annex 4: Disposal of radioactive material by the user

Introduction

Radioactive material is used extensively in medical, research and industrial applications. While the use of radioactive material has significant medical, research and industrial benefits, there is often a need to dispose of waste material generated during the particular process. As ionising radiation can be detrimental to human health and the broader environment, it is important to dispose of unwanted radioactive material with minimum effect on the health and safety of people and the environment.

Previously, requirements on the disposal of unwanted radioactive material by the user was contained in the NHMRC in its Radiation Health Series publication number 13, the *Code of Practice for the Disposal of Radioactive Wastes by the User* (1985) (RHS13) (NHMRC 1985). RHS13 provided a means of determining activities of radioactive material that could be approved for disposal to sewer or to landfill. Disposal of higher activities of radioactive material required additional consultation with and approval of the regulatory authority. The activity values calculated using RHS13 were based on 'reasonable' assumptions but not on any specific exposure scenarios.

Review of disposal requirements

Following a review of RHS13, the Radiation Health Committee (RHC) concluded that an agreed set of activities and activity concentrations for each commonly used isotope be prepared to promote a uniform approach to disposal of radioactive material in Australia. The RHC specified that the revised requirements should include disposal to landfill, sewer and atmosphere.

Further, RHC agreed that the values be such that no approval of the relevant regulatory authority would be required if the person were to dispose of the material with an activity or activity concentration below the value specified for the particular isotope. Where, however, this were not the case, regulatory approval would be required.

The revised approach

The NDRP entry and schedule to replace RHS13 was developed to:

- be as simple as possible but as complex as necessary
- have regard to current national and international guidance on disposal and discharge of radioactive material including the requirements for disposal and discharges of radioactive material in the IAEA Basic Safety Standards (IAEA 2012)
- have regard to currently available methodologies and international experience in dealing with disposal and discharge of radioactive material by users in hospitals, universities, etc.
- take account of likely exposure of people and of the environment
- be based on conservative but realistic, documented scenarios and modelling considered applicable to Australian conditions
- consider the direction of the *Fundamentals for Protection Against Ionising Radiation* and *Code of Practice for Planned Exposure Situations* (ARPANSA 2014)
- consider current practice in all Australian jurisdictions.

In applying these criteria, values expressed as an annual activity to account for exposure of people and an activity concentration for exposure of the environment were considered to be the simplest parameters.

Thus, NDRP entry 4.2.1 and the corresponding set of values in Schedule 14 represent activities and concentrations below which *no* approval for disposal and discharge would be required. This addresses an omission from RHS13, where approval was required for all disposal and discharge of radioactive material to sewer and to landfill. RHS13 did not address disposal to atmosphere (NHMRC 1985).

Thus, any person would be able to dispose of radioactive material below the activity specified in Schedule 14 to landfill. Further, any person could discharge radioactive material to a waterway or to the atmosphere below the specified activities and concentrations.

The specifications of the activities and concentrations were based on model sites such as universities or hospitals from which the discharges were made and from which there could be several individual points of disposal to the one sewer. The specified activities were therefore the total activity discharged from each site or facility to the one sewer.

The values of activity and concentration in Schedule 14 are *not* limits and it is not intended to suggest that higher values would be unacceptable. The values are merely estimates above which approval for disposal is required. Disposal or discharge above these values can be acceptable but would require approval. The values in Table S14.1 are therefore screening values below which *no* approval is required.

The derivation of values for Schedule 14

The dose criterion for disposal by the user

Although each isotope has an exemption activity and exemption activity concentration as set by the International Atomic Energy Agency (IAEA), and adopted into this Directory, the IAEA makes clear that these exemption levels are not intended to apply to the control of discharges (IAEA 2012).

It was therefore considered necessary to derive values for disposal to landfill, sewerage and the atmosphere that could be justified in accordance with international doctrine.

As discussed in Annex 2, exemption levels were derived based on scenarios where the maximum effective dose to an exposed individual would not be greater than 10 µSv a year under plausible normal circumstances.

Given the restricted opportunity for the likely exposure of people to radiation from the disposal of radioactive material by the means specified in Schedule 14, the threshold value for exposure of any person above which approval would be required was set at 100 µSv a year. Disposal of radioactive material with activity (and activity concentration where relevant) below the values in Schedule 14 would result in the exposure of a person of less than 100 µSv a year and would not harm the environment. Disposal of radioactive material below these values does not require approval.

It should be noted that where regulatory approval is required, i.e. when the values in Schedule 14 are exceeded, the radiation regulator is likely to have some restrictions on exposure, such as 300 µSv a year from any one source of radiation exposure or a limit of 1 000 µSv a year to any person from all sources of radiation exposure. The person initiating the disposal might then need to carry out an assessment to show that these exposures will not be exceeded and that there will be no harm to the environment.

The models used to estimate exposure of people and the environment

Many of the models available for estimating exposures of people and the environment from disposal and discharges use an approach in line with that presented in IAEA Safety Report Series No. 19 (IAEA 2001). This approach uses simple transfer parameters that take account of several environmental processes, and implicitly assumes a state of equilibrium between the concentration in water or air and other environmental materials.

Once the concentration of discharged radionuclides in environmental materials is estimated, the routes by which 'receptors', such as representative members of the public, might come into contact with the discharged material are identified and a critical group determined.

This approach was considered appropriate for facilities where the application of annual averages is suitable.

In the models selected to generate the values for Schedule 14, two main categories of exposure were considered:

- external exposure from radionuclides present in the air or in material incorporated in, for example, soils or sediment
- internal exposure from the inhalation or ingestion of radionuclides present in air or incorporated in water or foods respectively.

The relative importance of different exposure pathways were dependent on the:

- magnitude of the discharge
- route of discharge
- physical and chemical characteristics of the radionuclides discharged
- characteristics of the radioactive decay.

Values obtained using this methodology tend to be highly conservative and therefore are suitable for use for screening.

It was considered that regulators would benefit from adopting such generic models for assessing radiation dose to exposed persons.

Disposal to landfill

Scenarios adopted in the Commission of the European Communities were used to obtain the activities for disposal to landfill (EC 1993). Disposal to landfill is one of the scenarios considered in this European document and is not the most restrictive scenario for all radioisotopes. The landfill scenarios include exposure of the public from accidental tampering with the radioactive source and from inhalation, ingestion and skin exposure pathways. The landfill site is assumed to be a generic small site with a capacity of domestic waste of 1.5×10^4 tonnes over an area of 1×10^{-2} km^2.

The use of the values from that document therefore provides some conservatism in the estimation of radiation exposures.

Based on the rationale described in the dose criterion above, the landfill package activity values were calculated as ten times the exemption activity level listed in Schedule 4 of this Directory.

Disposal to sewer

The derived levels of radioactive waste for disposal to the sewer by the user were based on calculation of the annual activity of radioactive material that could result in a dose of 100 µSv in a year to the most exposed individual and a concentration that would result in an exposure rate of less than 10 µGy h^{-1} to the most exposed organism.

Exposure of people

Three methodologies were considered to determine exposure to people. Two methodologies were from the UK – that for calculation of Generalised Derived Constraints (GDCs) (NRPB 2000, NRPB 2010) and that for the 'Initial radiological assessment methodology' (Environment Agency 2006), which is based on dose per unit release (DPUR) data. The third methodology is that used by the IAEA to calculate clearance values in its Tecdoc-1000 (IAEA 1998). It was noted that these models and data were developed for application in temperate European and North American conditions but were deemed applicable for the Australian situation, particularly in the urban areas where such disposal is likely to occur.

Estimates of the annual activities of radioactive materials that would not result in an annual dose above 100 µSv were derived using each methodology. Table S14.1 contains the minimum of the available values.

All three approaches base their modelling on principles similar to those described in IAEA Safety Series 19 (IAEA 2001) but make different assumptions. The three data sources combined included all the isotopes in the NDRP Schedule. None of the three approaches considered exposure of the environment.

The methodologies considered three main exposure groups and relevant age groups (infants, adults, etc.) within each group and base their recommendations on the most restrictive scenario.

The three exposure groups considered were:

1. Sewage plant workers who were considered to spend a working year at the waste water treatment plant and who were exposed to radionuclides in sludge and effluent. Exposure from external radiation, inhalation and ingestion were considered.

2. Members of the public who were exposed to radionuclides in river water that has received treated effluent. Exposures occurred due to:
    - external exposure from sediments
    - drinking water and eating fish from the river
    - producing and consuming green vegetables and potatoes on land irrigated by the river water.

3. Members of the public assumed to live adjacent to farmland treated repeatedly with sewage sludge and to consume animal products produced from the treated land – foods consumed were assumed to have been produced on treated farmland, intakes were assumed to be at critical group levels.

(The IAEA methodology did not consider the transfer of radionuclides to the terrestrial food chains due to irrigation or treatment with sewage sludge.)

Each methodology made conservative, but slightly different assumptions.

Both UK methodologies assumed that the dry weather flow through the waste water treatment plant was ~60 m^3 day^{-1}, serving a population of 400 people. The IAEA assumed a plant that was 40 times larger.

The GDC calculation assumed that workers were exposed to sludge for 1000 hours a year; the DPUR calculation assumed exposure for 500 hours a year and the IAEA methodology assumed exposure for 2000 hours a year.

The GDC and IAEA calculations assumed that all the radionuclide remained in effluent and that all the radionuclide remained in sludge. The DPUR calculations partitioned the radionuclide between effluent and sludge.

The DPUR calculations were modified to allow exposure of workers to sludge for 1000 hours a year and to remove the partitioning between effluent and sludge, thus making the assumptions closer to those used for the GDC calculations.

The GDCs are the discharge rates to a sewer given in Bq y^{-1} and are based on a dose criterion of 300 µSv y^{-1}. The IAEA also specified clearance values (IAEA 1998) although these were based on 10 µSv y^{-1} exposure scenarios. The DPUR methodology resulted in values for the dose, in µSv y^{-1}, resulting from a discharge of 1 Bq y^{-1} for various exposure pathways and age groups.

Therefore in order to determine values for this Directory, GDC values were divided by three to equate to 100 µSv y^{-1}. Conversely, the IAEA clearance values were multiplied by a factor of 10. The (worst case, modified) DPUR values were scaled to yield the activity that corresponded to a dose of 100 µSv y^{-1}.

The most restrictive annual activity is listed in Table S14.1.

Although the three data sources gave different values, the agreement was reasonable for common radionuclides and the use of values from documented sources was considered to be the best approach. A person wishing to discharge radioactive material can use this information as a basis for calculations of potential exposures from higher activities of radioactive material.

Protection of the environment

A screening dose rate value of 10 µGy h^{-1} to biota was used as the no-effect level, below which environmental risks would be negligible.

Corresponding concentrations in freshwater and the marine environment were then calculated using the Erica assessment tool.

The Erica assessment tool (Brown et al 2008) (free download available) provides values of Environmental Media Concentration Limits (EMCLs) for water and sediment in freshwater and marine environments in its parameters database – risk characterisation. These EMCLs represent the lowest concentration derived from water or sediment for freshwater or marine environments below which all biota would receive an exposure of less than 10 µGy h^{-1}. The concentration in water (freshwater or marine) corresponding to the EMCL in sediment was obtained by dividing the sediment concentration by the distribution coefficient (Kd).

The minimum concentration obtained by these calculations for each isotope in the Erica database was used in the derivation of values for Table S14.1.

The exit point from a waste water (sewage) treatment plant was chosen as the calculation point for the concentrations derived from the Erica assessment tool. The activity concentration at the exit point was taken as equal to that at the input to the plant.

Concentrations at the input to the waste water treatment plant corresponding to the annual activity obtained for the three methodologies for protection of people, discussed above, were calculated. The concentration at the input to a waste water treatment plant listed in Table S14.1 is the minimum of the available concentrations (for protection of people and of the environment) for each isotope.

The environment considerations are very conservative and the most limiting organism may not even be present in many disposal situations. However, as the Schedule is intended for screening purposes, the use of the most conservative value for each radionuclide was necessary hence the requirement in Schedule 14 for both the activity and the activity concentration to be met for disposal to sewer.

Not all the isotopes in Table S14.1 are contained in the Erica assessment tool and concentration values will be reviewed as more Erica data become available.

Disposal to atmosphere

The same three methodologies discussed above were used to generate annual activities that could be dispersed to atmosphere with no approval. The calculations included those of doses arising from inhalation, external exposure and ingestion. Several assumptions were made regarding:

- discharge point height above ground
- wind patterns
- distance to closest human habitation
- distance to farmland
- consumption of food (crops and animal products) from this farmland
- build-up of radionuclides in the environment.

Again, radiation doses were calculated for methodologies available for each radionuclide cases and the most restrictive level was used as the value in Table S14.1.

Applicability of the values in Schedule 14 to short-term releases

Radioactive material discharged to the aquatic environment generally occurs over a short period each day and discharges are unlikely to be continuous.

The three methodologies used to generate annual activities in Table S14.1 assumed that the activity is discharged continuously and uniformly throughout the year. Given the other uncertainties in the assessment process, the results based on continuous release were considered appropriate for these normal operational daily variations in discharges.

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Other documents consulted

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- *Code of Practice for the Safe Transport of Radioactive Material* (2008 Edition), Radiation Protection Series No. 2 (RPS 2), ARPANSA.
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Glossary

Accessible surface means that surface of the apparatus to which human access is possible without the use of tools or without penetration of any radiation shield.

Accreditation means an authorisation by the Authority for a person to provide any of the specified radiation protection services identified in this Directory.

Authorisation means a written permission granted by the Authority for an operating organisation to perform specified practices. The form of an authorisation can include a licence, registration, or accreditation.

CIE means Commission Internationale de l'Eclairage

Dealing includes to use, manufacture, store, transport, sell, possess, install, operate, maintain, repair, or dispose of, a radiation source.

Defence-in-Depth means the application of more than a single protective measure for a given safety objective such that the objective is achieved even if one or more of the protective measures fails.

Erythemally effective dose means the dose obtained by weighting the spectral distribution of UV radiation incident on the subject with the erythemal effectiveness set by the CIE across the UV radiation wavelength range (280 to 400 nm) and then integrating to obtain the total dose in $J.m^{-2}$.

Exposure session means a session of exposure to UV radiation in a solarium, and where the total exposure does not exceed 0.9 MED.

Intervention means an action intended to reduce or avert exposure or the likelihood of exposure to sources which are not part of a controlled practice or which are out of control as a consequence of an accident or other event.

Ionising radiation is defined as meaning electromagnetic or particulate radiation capable of producing ions directly or indirectly, but does not include electromagnetic radiation of a wavelength greater than 100 nanometres.

Ionising radiation apparatus is defined as an apparatus that produces ionising radiation when energised, or when assembled or repaired is capable of doing so when energised (e.g. a diagnostic x-ray machine or an industrial radiography x-ray machine).

Legislation refers to Acts and Regulations covering radiation protection, which are in place in Australian jurisdictions.

Licence means an authorisation granted by the Authority allowing a person to carry out a practice involving radiation.

MED – Minimum Erythemal Dose means the minimum dose of UV radiation required to produce erythema (sunburn) in the skin. For skin photo type 1, MED is 2 SED (200 $J.m^{-2}$). For skin photo type 2, MED is 2.5 SED (250 $J.m^{-2}$). For skin photo type 3, MED is 3 SED (300 $J.m^{-2}$). For skin photo type 4, MED is 4.5 SED (450 $J.m^{-2}$). For skin photo type 5, MED is 6 SED (600 $J.m^{-2}$). For skin photo type 6, MED is 10 SED (1000 $J.m^{-2}$).

Non-ionising radiation is defined as meaning electromagnetic radiation of a wavelength greater than 100 nanometres.

Non-ionising radiation apparatus is defined as an apparatus of a prescribed type that when energised produces non-ionising radiation, or when assembled or repaired is capable of doing so (e.g. laser surgery equipment).

Notification means a document submitted to the Authority to notify an intention to carry out a practice or any other dealing described in this Directory.

Nuclear installation[29] means a nuclear fuel fabrication plant, nuclear reactor (including critical and sub-critical assemblies), research reactor, nuclear power plant, spent fuel storage facility, enrichment plant or reprocessing facility.

Person in this Directory includes a natural person and corporation.

Practice means any human activity that introduces additional sources or exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed to radiation.

Radiation is defined as meaning electromagnetic waves or quanta and/or sub-atomic particles, propagated through space or through a material medium.

Radiation apparatus means an ionising radiation apparatus or a non-ionising radiation apparatus.

Radiation incident is defined as any unintended or ill-advised event when using ionising radiation apparatus, specified types of non-ionising radiation apparatus or radioactive substances, which results in, or has the potential to result in, an exposure to radiation to any person or the environment, outside the range of that normally expected for a particular practice, including events resulting from operator error, equipment failure, or the failure of management systems that warranted investigation.

Radiation source[30] means anything that may emit ionising radiation, or an apparatus specified in Schedule 2 that emits non-ionising radiation.

Radioactive material[28] means any material that emits ionising radiation spontaneously.

Registration means an authorisation by the Authority for a radiation apparatus or sealed source apparatus, or for a premises in which radiation sources are used.

Responsible person in relation to any radioactive source, ionising or non-ionising radiation apparatus, nuclear installation, prescribed radiation facility or premises on which unsealed radioactive sources are stored or used means the person:

(a) having overall management responsibility including responsibility for the security and maintenance of the source, apparatus, installation or facility

(b) having overall control over who may use the source or apparatus, installation or facility

(c) in whose name the source, apparatus, installation or facility, would be registered if this is required.

Sealed source is defined as radioactive material that is permanently sealed in a capsule or closely bound and in solid form.

Sealed source apparatus is defined as an apparatus that produces ionising radiation by virtue of the fact that it contains radioactive material in the form of a sealed source.

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[29] Certain types of nuclear installation may be prohibited in Australian jurisdictions by government policy or other legislation.

[30] For regulatory purposes, subject to the exemption and exclusion provisions of this Directory

SED – Standard Erythemal Dose means 100 $J.m^{-2}$ of erythemally effective dose. For example, an erythemally effective dose of 200 $J.m^{-2}$ is 2.0 SEDs which is sufficient to cause mild reddening or erythema in people with skin photo type 1 (fair skin).

Skin Photo Type 1 means skin which always burns and never tans (pale white skin).

Skin Photo Type 2 means skin which always burns easily and tans minimally (white skin).

Skin Photo Type 3 means skin which burns moderately and tans uniformly (light brown skin).

Skin Photo Type 4 means skin which burns minimally and always tans well (moderate brown skin).

Skin Photo Type 5 means skin which rarely burns and tans profusely (dark brown skin).

Skin Photo Type 6 means skin which never burns (deeply pigmented dark brown to black skin).

Solarium means any commercial establishment containing one or more tanning units.

Supervision means being on the premises to ensure that all pre-exposure requirements are fulfilled and to ensure that the exposure session is terminated at the appropriate time.

Tanning unit means an electrically powered appliance or installation intended to produce tanning of the human skin by utilising ultraviolet radiation.

[NOTE: Many additional terms require definition and a more detailed glossary will be published in a later version of the Directory.]

Drafting and review

The National Directory for Radiation Protection was developed by the Radiation Health Committee in accordance with the Ministerial agreement of August 1999, and following a consultation process meeting the COAG *Principles and Guidelines for National Standard Setting and Regulatory Actions by Ministerial Councils and Standard-setting Bodies*. Membership of the Radiation Health Committee in February 2014, when this edition of the Directory was published, was as follows:

Dr Roslyn Drummond	Deputy Director of Radiation Oncology, Peter MacCallum Cancer Centre
Dr Carl-Magnus Larsson (Commonwealth)	CEO of ARPANSA
Mr Keith Baldry (SA)	Director, Regulation and Compliance, Environment Protection Authority
Ms Penny Hill (ACT)	Senior Radiation Safety Officer, Department of Health
Mr Noel Cleaves (VIC)	Manager, Environmental Health Regulation & Compliance, Department of Health
Mr Simon Critchley (Qld)	Director, Radiation Health, Department of Health
Ms Hazel Upton (WA)	Managing Health Physicist, Environmental Health Directorate
Mr Len Potapof (NSW)	Manager Radiation Regulation Unit, Environment Protection Authority
Mr Bradley Feldtman (NT)	A/Manager Radiation Protection, Department of Health
Dr Stephen Newbery (TAS)	Acting Principal Health Physicist
Mr Robert Lyon	Nuclear safety expert, formerly with AECL & IAEA
Dr Peter Karamoskos	Radiologist & nuclear medicine specialist
Dr Bruce Hocking	Consulting specialist in occupational medicine

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Table of amendments

Amendment	Detail	Date Published
Amendment No. 1		
Section 1.3	Updated to provide for application of the Directory to mining and mineral processing.	3 December 2009
Schedule 11	Amended to include the following publications to the referenced Codes and Standards: RPS 2, RPS 5, RPS 8, RPS 9, RPS 10, RPS 11, RPS 12 an RPS 13	3 December 2009
Amendment No. 2		
Section 3.1	Amended to include footnote 8	3 December 2009
Section 3.2	3.2.1(a) amended to add the words “and the risks to the environment”	3 December 2009
	3.2.2(a) amended to include footnote 12	3 December 2009
	3.2.2(b) amended to include footnote 13 and to replace “or” with “and” in line 2.	3 December 2009
	3.2.3 amended to include footnote 15	3 December 2009
	3.2.4 amended to include footnote 16	3 December 2009
	3.2.5 amended to include footnote 17	3 December 2009
	Insert new clause 3.2.7	3 December 2009
Schedule 5	Amended to include a new section on radioactive sources	3 December 2009
Amendment No. 3		
Schedule 11	Amended to include RPS 14 to the referenced Codes and Standards.	3 December 2009
Amendment No. 4		
Section 5	Amended to include Section 5.4	29 April 2010
Schedule 2	Amended to include reference to tanning units used for cosmetic purposes within a solarium.	29 April 2010
Glossary	Additional definitions added to the Glossary.	29 April 2010
Amendment No. 5		
Section 2.2	2.2(a) amended to include the words “in regard to ionising radiation,”	July 2011
Schedule 11	Amended to include the following publications to the referenced Codes and Standards: RPS 17, RPS 19	July 2011
Schedule 13	Amended to correct typographical and editorial matters.	July 2011

Amendment	Detail	Date Published
Amendment No. 6		
Schedule 5	Inserted: • New heading: S 5.1 Exemption of apparatus • New heading: S 5.2 Exemption of radioactive sources • New paragraph (h) Amended footnote 20	February 2014
Schedule 6	Replaced S 6.1 Use of X-ray equipment by chiropractors…	February 2014
Schedule 9	Replaced paragraph 2(b)	February 2014
Schedule 13	Entire schedule replaced and updated.	February 2014
Glossary	Inserted: Definition of Radiation incident	February 2014
Amendment No. 7		
Section 3.2	Footnote 12 amended	June 2017
	3.2.7 – amended to include reference to Section 4.2.2	June 2017
Section 4.2	Leading paragraph deleted	June 2017
	Inserted new clause 4.2.1	June 2017
	Inserted new clause 4.2.2	June 2017
Schedule 5	Amended footnote 20	June 2017
Schedule 7	Updated reference statement to section 4.2.1	June 2017
Schedule 14	New schedule added	June 2017
Annex 4	New annex added	June 2017