COC−2
Code of Compliance for facility design and shielding 2022

Issued February 2023

This code was approved for publication by the Chief Executive of the South Australian Environment Protection Authority on 7 February 2023.

This code provides the mandatory requirements for the design of premises and performance of shielding in a radiation facility and premises where radiation sources are handled, operated or installed.

It should be read in conjunction with the *Radiation Protection and Control Act 2021* and the *Radiation Protection and Control Regulations 2022*.

Citation

This code may be cited as the *Code of Compliance for Facility Design and Shielding 2022.*

Part 1 − Preliminary

1 Interpretation

In this code, unless the contrary intention appears—

any terms used have the meanings given to them in the *Radiation Protection and Control Act 2021* (the Act) and in the *Radiation Protection and Control Regulations 2022* (the Regulations).

if a word or phrase is defined in this code, other parts of speech and grammatical forms of the word or phrase have corresponding meanings:

ARPANSA means Australian Radiation Protection and Nuclear Safety Agency

aperture means a gap in the protective material of a tube housing through which ionising radiation from an X-ray tube within the tube housing may pass with little or no attenuation

apparatus means *ionising radiation apparatus* to which this code applies

AS/NZS standard means a standard prepared by Standards Australia Limited

Department means the administrative unit of the Public Service that is responsible for assisting a Minister in the administration of the Act

dose constraint, in relation to an individual dose of ionising radiation from a radiation source, means a prospective and source-related restriction on the individual dose which provides a basic level of protection for the most highly exposed individuals from that source, and serves as an upper bound on the dose in optimisation of protection for that source

fixed has the meaning given to *fixed apparatus* in the Regulations

low probability scenarios are those where the probability of occurrence does not exceed 10^{-2} per year

mobile has the meaning given to *mobile apparatus* in the regulations

NORM has the meaning given to *naturally occurring radioactive material* in the regulations

Nuclear medicine means the use of unsealed radioactive sources for diagnostic imaging, physiological testing and therapy

person means a natural person

portable has the meaning given to *portable apparatus* in the Regulations

primary beam means that part of the X-radiation that passes through an aperture of a tube housing by a direct path from an X-ray tube

security category means the category determined in accordance with the *Code of Practice for the Security of Radioactive Sources*

Type A, Type B or Type C premises are as defined in Schedule 1 of this code

2 Application of code

(1) This code applies to premises where—

(a) radiation apparatus (including diagnostic imaging apparatus used for medical, chiropractic or veterinary purposes, dental cone beam CT, radiotherapy apparatus and non-medical apparatus) are to be installed or operated;

(b) sealed sources are to be used or handled;

(c) unsealed radioactive materials are to be used or handled (including for medical and veterinary diagnostic or radiotherapy purposes) in a *registered premises*; and

(d) a *radiation facility* prescribed by regulation 7 exist.

(2) For the purposes of this code, premises are categorised as follows—

(a) Category 1 premises are those containing the following radiation sources or where the radiation practice occurs—

(i) Particle accelerators (other than those used for industrial gauging or borehole logging).

(ii) Irradiators prescribed as a radiation facility.

(iii) Nuclear medicine.

(iv) Radiation therapy apparatus (Co-60, linear accelerators, kilovoltage X-ray therapy, brachytherapy).

(v) Security enhanced sealed radioactive sources (security category 1, 2 or 3).

(vi) Unsealed radioactive material in a Type A registered premises.

(vii) Sealed radioactive sources used in veterinary radiation therapy.

(viii) Industrial radiography involving a radiation apparatus that does not use an X-ray tube as the source of ionising radiation.

(ix) As otherwise published by the Department.

(b) Category 2 premises are those containing the following radiation sources or where the *radiation practice* occurs—

(i) Medical and veterinary fluoroscopy excluding mini C-arm (*).

(ii) Medical, veterinary and chiropractic plain radiography (*).

(iii) Medical and veterinary computed tomography (*).

(iv) Dental panoramic, cephalometric or cone beam computed tomography apparatus (*).

(v) Calibration apparatus involving X-rays.

(vi) Fixed radiation gauges involving sealed radioactive sources.

(vii) Industrial radiography using an X-ray tube or sealed radiation source as the source of ionising radiation.

(viii) Borehole logging tool involving a radiation apparatus.

(ix) Moisture gauge containing a sealed radioactive source.

(x) Irradiators involving X-ray tubes.

(xi) Image guided radiation therapy apparatus (plain radiography or cone beam computed tomography).

(xii) Sealed radioactive sources (security category 4).

(xiii) Unsealed radioactive material in a Type B registered premises.

(xiv) Mammography X-Ray apparatus (*).

(xv) X-ray analysis apparatus that does not use an X-ray tube as the source of ionising radiation.

(xvi) As otherwise published by the Department.

(c) Category 3 premises are those containing the following radiation sources or where the *radiation practice* occurs—

(i) Cabinet X-ray apparatus.

(ii) Calibration check sources.

(iii) Dental X-ray apparatus used for plain radiography (*).

(iv) Fluoroscopy mini C-arm.

(v) Fluorescence apparatus involving sealed radioactive sources or X-ray tubes.

(vi) X-ray analysis apparatus that uses an X-ray tube as the source of ionising radiation.

(vii) Medical X-ray absorptiometry.

(viii) Sealed radioactive sources (security category 5).

(ix) Unsealed radioactive material in a Type C registered premises.

(x) Unsealed radioactive material that is NORM in a registered premises or radiation facility.

(xi) As otherwise published by the Department.

(*) Radiation sources that require mandatory assessment and verification of shielding by clause 6(4).

3 Interaction between the regulations and relevant codes

(1) If a provision of this code is inconsistent with the regulations, the regulations prevail to the extent of the inconsistency.

(2) If a provision of a code or other document, published by the ARPANSA, is inconsistent with this code, the provisions of this code prevail to the extent of the inconsistency.

(3) This code does not apply to radiation sources which fully comply with and used or installed in accordance with the requirements of codes or regulations listed below:

(a) Radiation sources in storage in accordance with regulation 62.

(b) *Code of Practice and safety guide for safe use of fixed radiation gauges* (2007) published by ARPANSA.

(c) *Code of radiation protection requirements for industrial radiography* (2018) published by ARPANSA.

(d) *Code of practice for the safe use of sealed radioactive sources in borehole logging* (1989) published by ARPANSA.

(e) *Code of Compliance for apparatus used for borehole logging 2022* published by the Department.

(f) *Code of Compliance for dental X-ray apparatus used for plain, panoramic & cephalometric radiography and cone-beam computed tomography 2022* published by the Department.

(g) *Code of Practice and safety guide for portable density/moisture gauges containing radioactive sources* (2004) published by ARPANSA.

(h) *Code of practice for protection against ionizing radiation emitted from X-ray analysis equipment* (1984) published by ARPANSA.

Part 2 – General requirements for premises with installations of radiation sources

4 Optimisation of protection

(1) Design and shielding are to be commensurate with the complexity and magnitude of radiation risks associated with the radiation source in a graded manner.

(2) The premises must be designed and constructed such that the protection of any person, located inside or outside of the premises or room, is optimised.

(3) Design constraints are to be used to design and assess optimisation of protection.

(4) Design constraints under planned exposure situations are—

(a) For occupational exposure of a worker—

(i) not greater than an effective dose of 5 mSv in a year; or

(ii) not greater than an effective dose approved by the Department and documented in an approved radiation management plan; and

(b) For exposure of any other person, not greater than an effective dose of 1 mSv in a year1.

(5) Design constraints must ensure that for low probability scenarios, radiation doses for any person do not exceed a dose limit.

5 Design and shielding

(1) The following factors must be taken into account in determining design and shielding—

(a) nature of radiation and exposure pathways

(b) layout of the premises

(c) location of radiation sources and radioactive material

(d) occupancy of all areas

(e) access controls

(f) allowance for reasonable growth and technology change

(g) work processes and workload under planned and expected scenarios

(h) impact of foreseeable low probability and highly significant incident scenarios.

(1) Guidelines for design and shielding issued by recognised national and international bodies that may assist licence holders with compliance with this code are provided in Appendix 1.

(2) The radiation shielding design report must clearly state the guideline adopted for calculations and assumptions for radiation sources. Mixture of use of available guidelines is not permitted.

[1] For practical purposes it may be more appropriate in some circumstances to demonstrate that exposure of any other person is not greater than an effective dose of 20 microsieverts in a week

6 Assessment and verification of design and shielding

(1) Verification of design and shielding is to be commensurate with the complexity of and radiation risks associated with the radiation source in a graded manner.

(2) Where directed by the department verification of compliance with requirements is to be undertaken by—

(a) a person authorised under section 31 of the Act to assess compliance with relevant aspects; or

(b) a person approved for this purpose by the Department; and

(3) Where verification of compliance is required, a report on the verification of design and shielding is to certify compliance with requirements, and—

(a) for Category 1 and 2 premises submitted to the Department;

(b) for Category 3 premises, recorded and made available to the Department on request.

(4) All apparatus indicated with an asterisk (*) in clause 2 (2) shall be verified for design and shielding by persons indicated in subclause (2) above.

Part 3 − Additional requirements for premises with diagnostic or radiation therapy apparatus

7 Patient safety

(1) Patient safety and clinical management are key aspects of the design of the premises. These generally include requirements for apparatus to be installed or used so that the operator is able to clearly observe the movement of the patient during the procedure and is able to communicate with the patient and any other person involved in the procedure.

(2) Radiation protection requirements need to be addressed in conjunction with patient safety requirements.

8 Premises with diagnostic imaging and radiation therapy apparatus

(1) In the case of premises with diagnostic imaging or radiation therapy apparatus, the following factors must be taken into account in determining design and shielding in addition to general requirements—

(a) clinical settings of apparatus

(b) type and nature of radiation

(c) throughput and apparatus use.

(2) In the case of premises with diagnostic imaging apparatus (excluding DEXA apparatus), the control panel or equivalent device must be isolated—

(a) in a room, space or enclosure adjacent to but separate from the room, space or enclosure in which the apparatus is installed; or

(b) behind a fixed protective screen, situated within the room, space or enclosure in which the apparatus is installed. Such screen should include radiation shielding material and, where reasonably practicable, arranged so that the radiation emitted by the apparatus is scattered at least twice before it can enter the area behind the screen from which the apparatus is operated, whenever the X-ray tube is energised.

(2) In the case of premises with mobile and portable apparatus, the apparatus and the operator and all other persons must be arranged, so the operator and all other persons remains—

(a) outside the primary beam and wherever possible at least 2 metres from the X-ray tube and from the patient; or

(b) in a room, space or enclosure adjacent to but separate from the room, space or enclosure in which the apparatus is installed; or

(c) behind a fixed protective screen, situated within the room, space or enclosure in which the apparatus is installed. Such screen should include radiation shielding material and, where reasonably practicable, arranged so that the radiation emitted by the apparatus is scattered at least twice before it can enter the area behind the screen from which the apparatus is operated, whenever the X-ray tube is energised.

(3) In the case of premises with radiation therapy apparatus, the control panel for the apparatus must be located outside the treatment room and in a shielded position. In addition, the following additional factors must be taken into account:

(a) size and location of conduits, pipes, ventilating ducts and high voltage ducts in the protective barriers

(b) presence of maze and doors

(c) skyshine, groundshine and scatter radiations through ceiling.

9 Premises where sealed radioactive sources are used for high dose rate (HDR) brachytherapy

(1) A sealed radioactive source used for high dose rate brachytherapy must be enclosed in a housing so that when the beam control mechanism is in the "off" position—

(a) the equivalent dose rate from leakage radiation at a distance of 1 metre from the source does not exceed 10 µSv per hour; and

(b) the equivalent dose rate from leakage radiation at any accessible point 50 millimetres from the surface of the housing does not exceed 200 µSv per hour.

(2) For the purposes of clause (1), leakage radiation must be measured over an area not greater than—

(a) 10,000 square millimetres at a distance of 1 metre from the source; or

(b) 1,000 square millimetres at a distance of 50 millimetres from the source housing.

(3) The control panel used for high dose rate brachytherapy must be designed and constructed so that—

(a) the beam control mechanism returns to “off” position—

(i) at the end of an exposure; and

(ii) after a preset time period has elapsed; and

(iii) when there is a breakdown or interruption of the force that holds it in the ‘on’ position; and

(b) the ‘off’ position is maintained except when beam control mechanism is activated from the control panel; and

(c) in the event of failure of the automatic beam control mechanism referred to in clause (3) (a) the source can be returned by some alternative means; and

(d) there is a reliable indicator at the control panel and near to or at the source that indicates when the source is in the ‘on’ and ‘off’ positions; and

(e) the beam control mechanism returns to the ‘off’ position after a preset time period has elapsed.

(4) The source housing of a sealed radioactive source must be fire resistant so that in the event of it being involved in a fire the radiation shielding provided by the source housing is preserved.

(5) A sealed radioactive source used for high dose rate brachytherapy must be installed in a room or other enclosed area—

(a) that has a reliable indicator near the entrance that indicates when the source is in the ‘on’ and ‘off’ positions; and

(b) that has interlocks that return the source to the off position when the door to the room is opened AND does not return it to the ‘on’ position when the door is closed but requires activation from the control panel; and

(c) that the door can be opened from the inside; and

(d) that the control panel is located in a shielded position outside the treatment room or area.

Part 4 − Requirements for Premises in which unsealed radioactive materials are handled or kept

10 General requirements

(1) In the case of premises where unsealed radioactive material is kept or handled, the following factors must be taken into account in the premise design—

(a) nature of radioactive material including state and physical and chemical properties

(b) pathways for exposure (direct radiation, aerosol, gaseous, contamination, absorption)

(c) design measures to control exposure pathways including as relevant—

(i) shielding

(ii) ventilation

(iii) containment

(iv) bunding

(v) materials and construction to facilitate hygiene controls

(vi) monitoring.

(d) accident and incident response

(e) safety equipment including PPE.

(2) Volatile radioactive material must not be handled in a recirculating fume cabinet without approval from the department.

11 Additional requirements

(1) Premises where fume cupboards are used must comply with relevant requirements set out in the applicable AS/NZS standards listed in Appendix 1.

(2) Premises with laboratories where unsealed radioactive material is kept or handled must comply with relevant requirements set out in Table 3.4 (Summary of Laboratory Requirements) in part 4 of AS/NZS standards.

Appendix 1

(1) International Atomic Energy Agency, *Radiation protection and safety in medical uses of ionizing radiation* SSG-46, 2018.

(2) International Atomic Energy Agency, *Radiation protection in the design of radiotherapy facilities*, Safety Report Series No. 47, 2006.

(3) National Council on Radiation Protection and Measurements, *Structural shielding design and evaluation for megavoltage X- and gamma-ray radiotherapy facilities*, Report No.151, 2005.

(4) National Council on Radiation Protection and Measurements, *Structural shielding design for medical X-ray imaging facilities*, Report No.147, 2004.

(5) *Radiation shielding for diagnostic radiology*, 2nd edition: report of a BIR working party, October 2010–April 2012.

(6) *ARPANSA Safety guide – Radiation protection in Radiotherapy – Radiation Protection Series 14.3*.

(7) *AS/NZS 2243.8:2006 Safety in laboratories, Part 8: Fume cupboards*.

(8) *AS/NZS 2243.9:2009 Safety in laboratories, Part 9: Recirculating fume cabinets*.

(9) *AS/NZS 2243.4:2018 Safety in Laboratories, Part 4: Ionizing radiations*.

Schedule 1 – Classification of registered premises

(1) Where a premises is used for more than one use then it will be classified as the highest applicable category. (Type A = highest classification, Type C = lowest classification).

(2) Where a premises has multiple parts of the land, building or structure used for storage or handling of radioactive materials, the radiation management plan shall specify the classification of each part of the premises.

Premises use	**Type C**	**Type B**	**Type A**
Laboratories			
Grading against section 3.5 of *AS/NZS 2243.4:2018 Safety in Laboratories Part 4: Ionizing radiations*	Low-level laboratory	Medium-level laboratory	High-level laboratory
Non-laboratory premises			
Storage of unsealed radioactive materials	Storage only		
Premises where radioactive materials are administered to animals, flora or humans	Premises where radioactive materials are applied to soil or flora or to animals which are incapable of escaping their enclosure	Premises where radioactive materials are administered to humans for diagnosis or animals for veterinary purposes.	Premises where radioactive materials are administered to humans for radionuclide therapy.
Non-laboratory premises (eg engineering workshops)	Non laboratory premises handling or keeping: surface contaminated objects	All other non-laboratory premises	

Premises use	Type C	Type B	Type A
	NORM with a total activity concentration below 10 kBq/g artificial radioactive materials classified by the transport code as LSA-I		

Note: Some Type B and C premises may have maximum activity thresholds above the activity threshold prescribed for Radiation Facilities. Most Type A premises may be a prescribed Radiation Facility.

Document history

Publications

Title	Release	Commencement
Code of Compliance for facility design and shielding 2022	Second release	11 February 2023

Amendments

Provision	How changed	Commencement
Introductory text	Included link to regulations	11 February 2023
4(4)	Removed ‘must’	11 February 2023
9	Replace ‘microsievert’ with µSv	11 February 2023
General information	Updated email address	11 February 2023

Further information

Legislation

Online legislation is freely available. Copies of legislation are available for purchase from:

General information

Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Freecall: 1800 623 445 (country)
Website: https://www.epa.sa.gov.au
Email: EPAradiationprotectionbranch@sa.gov.au