SOP RSC 6.1 Radiation Safety with Sealed Sources

Version and Date of Issue: V5 November 2022
Written by: William Bartolo, Bartolo Safety Management Service
The Radiation Safety Committee
Review due date: October 2025

BACKGROUND

The University utilises sealed sources and sealed sources devices for a number of field research, scientific and teaching purposes. There are requirements contained in the legislation as well as in the Australian Standard and ARPANSA Codes of Practice. In particular, some sealed sources need a licence and registration, some sealed sources require registration, and some are exempt. It is essential that sealed sources in each of these categories are identified so that proper steps can be taken to ensure maintenance of our legal requirements.

RESPONSIBILITIES

The University/Radiation Management Licence Holder

The University via the Radiation Management Licence (RML) holder alone is responsible for the purchase, possession and disposal of radiation apparatus and for ensuring that all relevant records are maintained.

The University via the RML holder will be responsible for ensuring that:

(a) the maintenance, disposal or sale of sealed sources comply with the NSW Government (2013) Protection from Harmful Radiation Regulation.

(b) copies of all maintenance and inspection reports undertaken on sealed sources (and sealed source devices), together with a copy of the registration certificate if relevant are kept in the area where the sealed source is used and copies are sent to the Radiation Safety Committee (RSC) and Faculty of Science Technical Support Unit.

(c) annual and random inspections in regard to the management of these sealed sources are conducted by the RSC and WHS Unit.

Note: The records may be in hardcopy or electronic form.

Note: The records must be kept for at least 5 years and made available on request to an authorised officer of the EPA. They can only be disposed of after permission is granted from the State Director General.

The Radiation Management Licence Holder and the Principal Investigator

Both the RML Holder responsible for the sealed source and principal investigators using these sources must ensure compliance with the following procedures relating to the storage, maintenance, disposal or sale of these sources. Normally, the process would occur jointly between these parties.

The Principal Investigator and the RML Holder will ensure that the information that is to be contained in local and university inventory are the following details (NOTE: for many older sources and orphan sources the details may not be known, there was never a serial number or it has been worn off):

- Source serial number
- Isotope

- Date of calibration by supplier (or date of acceptance)
- Activity (in KBq or MBq)
- Storage location

SEALED SOURCES

A sealed source refers to radioactive material that is firmly bonded within metals or sealed in a capsule or similar container of adequate mechanical strength so that the active material cannot be dispersed into the environment under foreseeable conditions of use and wear. Typically, sealed sources are double encapsulated.

For more information in Neutron Gauges, (soil moisture gauges, etc.) see RMP Section 17.

Part of the legislative requirements for the registration of premises that store or use radioactive substances is the registration of sealed sources. The following is an extract of the current legislative requirements:

Act 2010

6 Restrictions on possession, use and sale etc of radioactive substances and certain radiation apparatus

(1) This section applies to the following:

(a) all radioactive substances,

(b) all ionising radiation apparatus,

(c) non-ionising radiation apparatus prescribed as apparatus to which this section applies.

(2) A person must not possess, use, sell or give away anything to which this section applies unless the person is the holder of a licence under this section and does so in compliance with any conditions to which the licence is subject.

7 Responsibilities of owners of sealed source devices and certain radiation apparatus

(1) This section applies to the following things:

(a) all sealed source devices,

(b) radiation apparatus that is prescribed as apparatus to which this section applies.

(2) The owner of anything to which this section applies is guilty of an offence unless it is registered under this section in the owner's name and any conditions to which that registration is subject are complied with.

8 Responsibilities of occupier of premises on which certain radioactive substances are kept or used

(1) The occupier of any premises on which a radioactive substance that is not contained in a sealed source device is kept or used is guilty of an offence unless the premises are registered under this section and any conditions to which that registration is subject are complied with.

(2) The occupier of premises registered under this section must not allow a person to use any radioactive substance that is not contained in a sealed source device and is kept on the premises unless the person is authorised to do so by a licence.

Regulations 2013

Part 2 Licensing and accreditation

8 Exemptions from radiation management licensing requirements for certain radioactive substances, ionising radiation apparatus and sealed source devices

A person is exempt from the requirement to hold a radiation management licence in relation to the following types of regulated material:

(a) radioactive substances specified in Part 2 of Schedule 3,

(b) ionising radiation apparatus specified in Part 4 of Schedule 3,

(c) (Repealed)

9 Exemptions from radiation user licensing requirements for certain radioactive substances and ionising radiation apparatus

A person is exempt from the requirement to hold a radiation user licence in relation to the following types of regulated material:

(a) radioactive substances specified in Part 1 or 2 of Schedule 3,

(b) ionising radiation apparatus specified in Part 3 or 4 of Schedule 3.

Schedule 3 Exemptions from licensing

Part 1 Exemptions from radiation user licensing requirements for certain radioactive substances

1 Sealed source devices used for radiation gauging installed in fixed positions

2 Self-shielded irradiators (that is, gamma irradiators in which the radioactive substance is completely enclosed in a dry container constructed of solid material that shields the radioactive substance)

Part 2 Exemptions from radiation management and radiation user licensing requirements for certain radioactive substances

1 Radioactive substances in luminous dials on any devices, including on clocks and watches

2 Gaseous tritium in luminous devices, including in self-luminous “EXIT” signs

3 Radioactive substances used in nuclear medicine for checking gamma cameras and dose calibrators and having a level of activity of less than 40 megabecquerels

4 Radioactive substances used as laboratory reference sources and having a level of activity of less than 40 megabecquerels

5 Radioactive substances for demonstration, teaching or training having a level of activity of less than 40 megabecquerels

6 Uranium metal of natural isotopic composition, or depleted in uranium 235, which is used as radiation shielding in transport packages for radioactive substances or is used in any other manner

7 Radioactive substances used in electron capture detectors or similar devices used in gas chromatography

8 Radioactive substances used as static eliminators and having a level of activity of less than 40 megabecquerels

9 Radioactive ores that are at any place to which the Work Health and Safety (Mines and Petroleum Sites) Act 2013 applies

10 (Repealed)

11 Radioactive ores that are at any place where activities that are regulated under the Petroleum (Offshore) Act 1982 are carried out

12 Radioactive ores that are at any place where activities that are regulated under the Petroleum (Onshore) Act 1991 are carried out

13 Americium 241 in industrial smoke detectors that do not contain any other radioactive substance

Part 3 Exemptions from radiation user licensing requirements for certain ionising radiation apparatus

1 X-ray baggage inspection apparatus

2 Cabinet x-ray inspection apparatus

3 Enclosed x-ray diffraction, absorption and fluorescence analysers that comply with the requirements for enclosed units as defined in the document published by the National Health and Medical Research Council entitled Code of practice for protection against ionizing radiation emitted from X-ray analysis equipment (or as defined in any document replacing that document that is published by the Australian Radiation Protection and Nuclear Safety Agency)

4 X-ray apparatus used for radiation gauging and installed in a fixed position

Part 4 Exemptions from radiation management and radiation user licensing requirements for certain ionising radiation apparatus

1 Television receivers

2 Visual display units

3 Cold cathode gas discharge tubes

4 Electron microscopes

Part 5

(Repealed)

Since sealed sources not contained in a sealed source device are not excluded from registration, except as reference, teaching and training sources below 40 MBq, then all sealed sources not contained in a registered device must be inventoried and listed under the Radiation Management Licence.

The information that is to be contained in this inventory are the following details (NOTE: for many older sources and orphan sources the details may not be known, there was never a serial number or it has been worn off):

- Source Serial Number
- Isotope
- Date of calibration by supplier (or date of acceptance)
- Activity (in KBq or MBq)
- Storage location

In addition, any sealed sources that are deemed to be classed as a Security Enhanced Source must comply with the security requirements of the Legislation and the ARPANSA RPS11 Code in terms of security, storage and management. It is the responsibility of the principal investigator to determine the cost of any additional security required before purchase.

The following table gives the threshold levels for some of the sealed sources of concern, above which Security as per the legislation and necessitating a Security Plan is required:

Threshold activities for sealed radioactive sources

Radionuclide	Activity (GBq)	Element
Am-241	60	Americium
Am-241/Be	60	Americium/Berylliu m
Au-198	200	Gold
Cd-109	20,000	Cadmium
Cf-252	20	Californium
Cm-244	50	Curium
Co-57	700	Cobalt
Co-60	30	Cobalt
Cs-137	100	Caesium
Fe-55	800,000	Iron
Gd-153	1,000	Gadolinium
Ge-68	700	Germanium
Ir-192	80	Iridium
Ni-63	60,000	Nickel
Pd-103	90,000	Palladium
Pm-147	40,000	Promethium
Po-210	60	Polonium
Pu-238	60	Plutonium
Pu-239/Be	60	Plutonium/Berylliu m
Ra-226	40	Radium
Ru-106 (Rh-106)	300	Ruthenium (Rhodium)
Se-75	200	Selenium
Sr-90 (Y-90)	1,000	Strontium (Yttrium)
Tl-204	20,000	Thallium
Tm-170	20,000	Thulium
Yb-169	300	Ytterbium

For Security Assessment and requirements please contact the RSC by emailing: radiationsafety@csu.edu.au

Requirements of Australian Standard 2243.4

AS2243.4 details safety considerations when working with sealed sources. These include:

(a) handling sealed sources by remote means such as tongs or forceps and for the minimum possible time.

(b) locating shielding as close as practicable to the source of radiation. Precautions should be taken to protect laboratory workers and persons in adjacent areas from direct and scattered radiation.

(c) Every sealed source should be labelled with, and a record kept of the following:

i) the serial number or identification code;

ii) the nature of the source, its date of receipt, and its activity upon receipt;

iii) details of any relocations both within and out of the laboratory; and

iv) the date and details of disposal.

(d) When not in use, store sealed sources in secure and adequately shielded containment, which is labelled with the international radiation symbol and other relevant information.

(e) Where a source could potentially release a radioactive gas, the storage area must be adequately Exhaust ventilation should be run for an adequate time before entering the area.

Sealed sources may be used in either an enclosed or open installation.

Safety Guidelines for Enclosed Installations

Permanent enclosures for any source of radiation and the materials being irradiated should be designed so that:

- no person can be within the enclosure during an irradiation.
- Interlocks prevent persons from entering the enclosure during an irradiation.
- any person accidentally shut in an enclosure be able to leave by a suitable exit or be able to immediately enter an adequately shielded refuge.
- an irradiation is capable of being prevented or quickly interrupted from within a large enclosure. It should not be capable of being reset from outside the enclosure.
- persons outside the enclosure are adequately protected.
- during operation, the dose rate at any accessible outside surface of any large enclosure should not, in any one hour, exceed 10uSv. If non radiation workers have access to the outside area, the dose should not exceed 0.5uSv.
- when not in use, sealed sources should be housed, by remote control, within adequate shielding inside the enclosure.
- fail-safe interlocks and control systems should be provided on all enclosed installations. If electrically operated, the system should be rendered inoperative or non-hazardous in the event of loss of electrical power.

Safety Guidelines for Open Installations

Open installations, because of the nature of their operation, such as the use of portable apparatus, cannot be provided with the same safeguards as for enclosed installations. In an open installation, the source of ionizing radiation and the materials being irradiated should be confined as far as possible within a specific area. The area should be outlined by suitable barriers, appropriate warning signs displayed, and follow the requirements of an enclosed installation as detailed above, so that:

- only authorised persons have access to the area.
- persons outside the area are not exposed to the source of radiation.
- authorised persons enter the area for the minimum time needed to make essential adjustments to the equipment.
- if possible, the apparatus be capable of adjustment by remote handling methods.

There are several NHMRC documents that deal with sealed sources for medical applications that would be of use for developing safety procedures. Please note that some of these have been revised and are now listed as ARPANSA RPS documents and some are still in the process of being revised and replaced by the ARPANSA Radiation Protection Series.

Purchase of Sealed Sources

Purchase is the sole responsibility of the RML Holder, however if sealed source purchase is being contemplated please ensure the following:

(a) The purchase has as part of the contract return to the supplier when unwanted or decayed.

(b) If not possible or economic to return to supplier that there is a disposal pathway.

(c) That funds are allocated for any disposal of sealed sources (this can be a very expensive exercise).

(d) Please refer to RMP Section 18 for further guidance.

Sealed Sources Lacking Proper Identification or Disposal Pathway

Any person who detects or has a sealed source lacking proper identification or lacking disposal pathway at the time of purchase (e.g. purchases or acquisitions pre-2010) that needs to be disposed of should contact the RSC.

In some cases the sealed source may still be highly radioactive. If this is the case, the following alternatives should be considered:

(a) return to the supplier;

(b) transfer to another user; or

(c) store in a suitable facility.

In all cases, WHS, the RSC, and the Statutory Authority (EPA) should be notified of the decision to be taken.

Storage of Sealed Sources

When in not in use the sealed source must be replaced into its container (if it has one) and returned to the radioactive materials storage facility that is kept under lock and key. There must be an inventory of all sources for this location and must be maintained on a regular basis.

As far as practicable and taking into account the ALARA principle, sealed sources should not be stored near regularly occupied or frequented areas. The dose rate at the surface of the storage facility is to be less than 5 µSv/hr if only occupationally exposed persons have access, or less than 0.5µSv/hr if accessible by the general public. Furthermore, sealed sources should not be stored in the same storage area as dangerous goods of the following Dangerous Goods Classes:

1. Explosives
2.1 Flammable gas
3. Flammable liquid
4.1 Flammable solid
4.2 Spontaneously combustible
4.3 Dangerous when wet
5.1 Oxidising agent
5.2 Organic peroxide
8. Corrosive

As radioactive materials are to be stored (in general) in a storage facility solely dedicated to radioactive storage, and designed for such storage, consideration needs to be given to ARPANSA and relevant Australian Standards documents, as well as legislative requirements (that is registration).

The name and contact details of the CSU RSC, or other relevant person, should be placed on the store in a conspicuous location.

Sealed Source Maintenance

It is expected that each sealed source is checked on a regular basis, either quarterly, six monthly or yearly to ensure that the sealing material maintains its integrity and that it is not degrading. The check involves examining for faults such as cracks or chips and conducting a surface ‘Wipe Test’ to ensure that the radioactive isotope is not “leaking”, by separating from the sealing compound and becoming a free agent. The ‘Wipe Test’ should be left to an expert familiar with sealed sources or equipment containing these sources.

Comprehensive records must be kept for each sealed source, including results of wipe tests (Contamination Survey), visual inspections etc.

DOCUMENTATION

Records of use of source.

Records of storage of source.

Records of Inspection, Wipe tests and maintenance

AUDIT

Every 2 years

REFERENCES

None

REVISION & APPROVAL HISTORY

Date	Revision No.	Author and Approval
Dec 2014	Version 1	William Bartolo, Bartolo Safety Management Service
May 2016	Version 2	William Bartolo, Bartolo Safety Management Service
Dec 2016	Version 3	Radiation Safety Committee, Charles Sturt University
Jan 2017	Version 4	William Bartolo, Bartolo Safety Management Service and Radiation Safety Committee, Charles Sturt University
Nov 2022	Version 5	Radiation Safety Committee, Charles Sturt University