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Radiation Protection Service

Department of Wellbeing, Safety and Health

# Radiation Risk Assessment 20:

# Exempt Sealed Sources

### Scope and purpose

This radiation risk assessment relates to the use of sealed sources within the university at an exempt level (i.e. below the activity for exemption in Part 6 of Schedule 23 of the Environmental Permitting Regulations 2016).

The purpose of this risk assessment is to assess the risks from exposure to ionising radiation in order to identify the measures needed to restrict the radiation exposure of employees or other persons and it has been prepared in accordance with the guidance given in ACoP 8 to the Ionising Radiations Regulations 2017.

These types of sealed sources are used for a variety of practices including use in teaching or for instrument checking, calibration or part of an instrument’s detection system and may be installed in instrumentation or used as discrete sources.

### Document control

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| Version  2.0 | Author  ARC | Date of issue/review  9 February 2018 | Comments  Major update for IRR17 |

### Nature of sources of ionising radiation

A variety of radionuclides of exempt activity are used in the university.

These are defined as sources that are covered by one of the following conditions:

Small sealed source exemption: The activity of each source is less than 4MBq.

Tritium sealed source exemption: The activity of each H-3 source is less than 20GBq.

Electrodeposited source exemption: The activity of each Ni-63 source is less than 600MBq.

### Dose assessmentS

**External exposure:**

Various beta and gamma emitters are used.

The highest dose rates for a 4MBq source would be:

137Cs, 0.86mSv/h beta@30cm (=7.7mSv/h @ 10cm)

60Co, 66µSv/h beta+gamma@30cm (=600µSv/h @ 10cm)

90Sr, 7.8Sv/h Contamination skin dose rate

**Internal exposure:**

The highest internal exposure from the radionuclides in use for the ingestion of 40kBq (1% of 4MBq) is:

241Am, 8mSv Committed Effective Dose

### *EXTERNAL DOSES*

**Estimated radiation dose rates to which anyone can be exposed:**

Sources are shielded within their source containers or when installed in instrumentation and external doses are negligible whilst handled correctly unopened.

**Handling of sources**

When sources are handled correctly using forceps or tongs the minimum distances from the source are: hands = 10cm and body = 30 cm.

If sources are handled for 5 minutes then maximum external doses for a 4MBq source are:

Extremity dose to hands: 640 µSv = 6.4 µSv effective dose

Whole body dose: 1.4 µSv

All sources are below this activity and most are very much lower than this, so doses from normal handling of exempt sources are negligible.

**Sources handled incorrectly:**

If handled without forceps or tongs doses to extremities could be:

7.8 Sv/h = 78 mSv/h effective dose

…and the extremity dose constraint of 10mSv will be exceeded in 7 minutes.

### *Internal Doses*

**Likelihood of contamination arising and being spread**

The sources are sealed sources and the likelihood of the sources leaking contamination is low on account of storage conditions and periodic checks:

The sources are stored in the source containers under dry ventilated conditions.

Statutory wipe tests and conditional checks are carried out annually and would give prior indication of deterioration in the sources.

**Estimated levels of airborne and surface contamination**

Airborne or surface contamination is highly unlikely in normal use.

**Estimated internal doses:**

Ingestion of 1% of 4MBq Am-241 would result in an internal dose of 8mSv.

### Dosimetry

The use of dosimetry is not appropriate for these activities as radiation levels would not be detected by dose meters.

### Manufacturer’s advice

Manufacturer’s instructions for installed instrument sources.

### Engineering control measures and design features

Sources are stored in appropriate storage containers that have suitable shielding where necessary.

Sources installed in instruments are correctly and securely fitted in line with manufacturer’s instructions.

### Planned systems of work

Work will be carried out under the RPS local rules and the Standard Operating Procedures ‘SOP Handling exempt sealed sources’.

The Local Rules and SOP includes:

Requirements for supervision, competency and training.

Requirements for source management, security and containment.

Instructions for handling the sources.

Instructions for controlling exposures.

Accident procedures.

### PPE

No additional PPE is required for this work as the radioactivity is contained in sealed sources and no direct handling of the sources is involved.

### access to areas where there are significant dose rates or contamination levels

Access to source storage locations is restricted to authorised staff only.

Sources are used and handled in accordance with SOPs.

### Risk evaluation and controls

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|  | Risk evaluation | Control measures | Residual risk after controls | | |
| Likelihood | Severity | Risk |
| Radiation exposure during normal use | Sources are shielded within the containers and external doses are negligible whilst the sources are handled correctly. | Instructions contained in local rules and SOP. | Low | Low | Low |
| Exposure to airborne or surface contamination | Likelihood of contamination arising and being spread is very low and in normal use airborne or surface contamination is highly unlikely. | Instructions contained in local rules and SOP.  Sources are inspected before and after use by the responsible person, and checked for damage.  Sources are leak tested and checked annually by the Radiation Protection Service to ensure there is no leakage. | Low | Medium | Low |
| Possible accident situations and steps to prevent or limit their consequences | Loss or theft  Loss of source through negligence.  Theft of source through poor security.  Fire damage  Sources may become damaged when in storage through the effects of fire in the room.  Although fire damaged sources may not be intact, radioactivity will most likely be retained in the damaged or molten container or store. | When not in use sources should be returned to their source containers.  After use sources should be returned promptly to their authorised storage location.  Sources must not be left unattended when not in storage.  Loss or theft should be reported immediately to the RPM and immediate steps taken to recover the source.  Sources are inherently low risk and appropriate precautions have been taken within the university regarding fire prevention.  The fire brigade should fight fires in areas where sealed sources are held.  Remediation may only be carried out under the direct supervision of the Radiation Protection Service. | Low | Medium | Low |
| Failure of control measures | Leakage of source  Source leakage could result in contamination and internal doses. Leakage is unlikely.  Failure of source containment  Failure of the source container or source holder could result in the source being dropped or lost. Failure would be noticed on the checks before and after use.  **Failure of systems of work**  If the source user handled the sources incorrectly then they may receive an external radiation dose (see estimated doses above).  *Estimated doses from incorrect handling:*  Source handled incorrectly for 5 minutes:  Extremity = 6.5 mSv effective dose  Whole body = 1.4 µSv | Source leakage would be detected at the annual leak test and the source should be immediately taken out of use for further evaluation and disposal if necessary.  Failure of the source would be found either during the inspection before or after use or the annual leakage test and the source be taken out of use.  Estimated dose from incorrect use is low.  Instructions contained in local rules and SOP. | Low | Medium | Low |