# IONISING RADIATION SAFETY STANDARDS

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1 INTRODUCTION

Ionising radiation is used to enable some of our important teaching and research activities, but exposure to ionising radiation can be harmful to your health and the environment. Work with ionising radiation must be planned and managed to eliminate or limit exposure as far as reasonably achievable, prevent environmental contamination and avoid the generation of radioactive waste.

2 PURPOSE

This document outlines the framework for the management of University activities involving the use of ionising radiation.

The minimum performance standards outlined in this document give effect to the Work Health & Safety Policy 2016. Compliance with these performance standards assists the University to meet the specific requirements of NSW Work Health & Safety Act 2011, the Radiation Control Act 1990 and the Radiation Control Regulation 2013.

3 SCOPE

These performance standards apply to all staff, students, affiliates and contractors, and all activities conducted by or on behalf of the University.

These performance standards do not apply to work with non-ionising radiation.

4 PERFORMANCE STANDARDS

The University has established minimum performance standards to manage health & safety risks associated with hazardous operational activities. Compliance with performance standards is compulsory. Below are the performance standards for working with ionising radiation.

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5 DEFINITIONS

**Dangerous goods**  
Substances and mixtures that present an immediate risk due to their physical or chemical properties. For example, radioactive substances, explosives, flammable liquids and gases, corrosives, chemically reactive or highly toxic substances. Dangerous goods are classified in accordance with the criteria in the Australian Code for the Transport of Dangerous Goods by Road and Rail.

**EPA**  
The NSW Environment Protection Authority (EPA). As the State’s primary environmental regulator, the EPA administer the use of ionising radiation in NSW, according to the Radiation Control Act 1990 (the Act) and the Radiation Control Regulation 2013 (the Regulation).

**Exempt person**  
A currently enrolled student, short-term visitor or volunteer working under the supervision of an employee who holds a valid radiation user license.

**Historion**  
Radiation Safety software used by the University to manage personal dose data.

**Radiation apparatus**  
Apparatus that is capable of producing ionising radiation, or of accelerating atomic particles, for which a registration/licence is required from the Environment Protection Authority.

**Radiation material**  
In this document ‘radiation material’ means ‘radiation apparatus’, ‘sealed source’ or ‘radioactive substance’.

**Radioactive substance**  
A substance which spontaneously emits ionising radiation with a concentration greater than 100 Becquerels per gram and a specific activity greater than the prescribed activity outlined in Schedule 1 of the Radiation Control Regulation 2013. A copy of Schedule 1 can be found in Appendix A.

**Regulated material**  
In NSW, the use of ionising radiation is regulated by the EPA. Most radiation materials are regulated. Regulated materials require a radiation management licence and/or a user licence, unless they meet the exemption criteria described in the Radiation Control Regulation 2013.

**Ionising radiation**  
Electromagnetic or particulate radiation capable of producing ions directly or indirectly in passage through matter, but does not include electromagnetic radiation of a wavelength greater than 100 nanometers.

**Licence**  
A radiation management licence or a radiation user licence.

**Principal Investigator**  
The research group leader, usually responsible for the conduct and administration of a research grant.

**Sealed source**  
Any radioactive substance that is firmly bonded within metals or sealed in a capsule or similar container of adequate mechanical strength to prevent dispersion of the active substance into the surroundings under foreseeable conditions of use and wear.

**Security enhanced source**  
A sealed radioactive source prescribed by the regulations as a security enhanced source.

**Supervisor**  
A person who provides direction and/or supervision of other staff, students, contractors or volunteers.

**Unsealed source**  
A radioactive source which is not a sealed source and which under normal conditions of use can produce contamination.
In the University context, a worker is anyone who performs any work for or on behalf of the University. Workers include employees, contractors, higher degree research students, students undertaking research work during their honours year, students participating in work-integrated learning, and volunteers.
6 RESPONSIBILITIES

6.1 UNIVERSITY RADIATION SAFETY COMMITTEE

The Radiation Safety Committee (RSC):

- Reviews all proposed teaching and research activities involving the use of ionising radiation
- Validates that the facilities used for work with ionising radiation are appropriate
- Approves and/or advises on work involving the use of ionising radiation

Work with ionising radiation must not be carried out unless approved by the RSC.

View the RSC terms of reference in Appendix B.

6.2 UNIVERSITY RADIATION SAFETY OFFICER

The University RSO assists the University Executive to fulfil their responsibilities under the Radiation Control Act 1990 and the Radiation Control Regulation 2013, and provides specialist advice to the University Radiation Safety Committee.

The RSO role description can be found in Appendix C.

6.3 DEANS, DIRECTORS, HEADS OF SCHOOL

Deans, Directors and Heads of School (or equivalent) must ensure that the performance standards for working with ionising radiation are implemented within their area of control.

6.4 PRINCIPAL INVESTIGATORS

Principal Investigators are required to implement local procedures for the management of ionising radiation within their workgroup. This includes, but is not limited to:

- Liaising with the Radiation Safety Committee regarding proposed research activities
- Controlling the introduction of new radioactive substances and radiation apparatus into the workplace
- Restricting access to radioactive substances and radiation apparatus
- Complying with regulatory requirements for work with radioactive substances and apparatus
- Ensuring that risk assessments are carried out, and safe work procedures are developed, for all activities involving ionising radiation that have been classified as ‘high’ or ‘very high’ risk, based on the University’s Work Health & Safety risk matrix, available in Appendix D.
- Approval of safe work procedures
- Ensuring that staff and students are provided with workplace induction, task specific training, instruction and supervision
- Ensuring that radiation materials are appropriately labelled and stored
- Preparing for common and plausible emergency situations including radioactive spills, contamination, and other dangerous incidents including fire and explosion
- Managing the short-term storage and disposal of radioactive waste via the University’s Hazardous Waste Program.

The Principal Investigator remains responsible for the safety of their staff and students irrespective of whether or not they have delegated actions to other staff, e.g. a post-doctoral staff member or a laboratory manager.
6.5 WORKERS

All workers that use ionising radiation are required to:

- Complete relevant radiation safety training
- Be familiar with the specific hazards and procedures required to safely handle, store and transport the radiation material used
- Hold an EPA license to use radiation material, or be exempted and work under the supervision of a license holder
- Participate in the risk assessment process and the development of safe work procedures
- Follow established safe work procedures
- Label all radioactive materials
- Dispose of radioactive waste in accordance with the University Hazardous Waste Guidelines.

6.6 LOCAL RADIATION SAFETY OFFICER

Local radiation safety officers (LRSO) are appointed by the Head of School or Director of a research institute, to act on their behalf by ensuring that projects involving the use of radiation are carried out in accordance with University requirements and processes. The LRSO should serve as the first point of contact for staff and students who are planning to conduct work with ionising radiation or have general questions about radiation safety.

The LRSO role description can be found in Appendix E.

7 HAZARDS FROM IONISING RADIATION

Ionising radiation can be harmful to our health and the environment.

7.1 ALARA PRINCIPLE

The ultimate aim when working with any source of radiation is to eliminate exposure. When this is not possible, we need to minimise the radiation dose received as much as possible. This is what is known as the ALARA principle: keeping doses ‘AS LOW AS REASONABLY ACHIEVABLE’.

7.2 HEALTH HAZARDS

Exposure to ionising radiation can have detrimental health effects. The amount and duration of the exposure affects the severity and type of health effects. The short-term effects of exposure to large doses can be systemic (e.g. nausea) or localized (e.g. skin burns). The principal long-term effect of exposure is cancer, and in severe cases death.

Health hazards from ionising radiation are divided in two classes: external and internal. Both types of exposure must be considered when assessing overall risk.

7.2.1 EXTERNAL HAZARDS

External hazards arise from sources of ionising radiation outside the body that can irradiate all or part of the body with sufficient energy to affect the skin and underlying tissues. Working with X-ray and Gamma radiation can pose a risk of external exposure.

Practical control measures include:
- Time – limiting the period of exposure to the external radioactive source
- Distance – maximizing the distance between the person and the external radioactive source
- Shielding – positing suitable shielding in the path between the person and the external radioactive source.
### 7.2.2 INTERNAL HAZARDS

Internal hazards arise when radioactive substance enter the body through inhalation, injection, ingestion or absorption through the skin (or a wound). Working with unsealed sources can pose a risk of internal exposure.

Practical control measures include:

- Good hygiene - eliminate hand to mouth contact
- Wearing standard personal protective equipment (PPE)
- Using a fume cupboard or hot cell for protection from inhalation when working with volatile substances.

### 7.3 ENVIRONMENTAL HAZARDS

All living organisms are affected by ionising radiation. This may lead to effects in the environment impacting individuals, populations, species and whole ecosystems. Environmental effects may include increased morbidity of individuals within populations and reduced reproductive success.

Radiation users have a responsibility to avoid the release of radioactive substances into the environment. This can be achieved by only acquiring the quantity of radioactive material required for immediate use and disposing of radioactive waste in accordance with the University Hazardous Waste Guidelines.

### 8 PROJECT PLANNING

To effectively manage the risks associated with ionising radiation in the workplace, it is essential to consider the entire life cycle from purchase through to storage, usage and disposal. In all cases, use of non-radioactive alternatives must be considered.

The physical form, energy, type of radiation and the activity of the source required for the project or activity must be established in order to develop protocols for storage, handling and disposal.

### 8.1 PROCUREMENT CONSIDERATIONS

Regardless of whether a radioactive substance or radiation apparatus is purchased commercially or procured by other means (e.g. donation or transfer from another area) the hazards and associated risk controls must be considered prior to introducing the radioactive material to the workplace.

Projects involving the use of regulated material, based on accumulated total activity over the lifespan of the project, must be approved by the Head of School (or equivalent) and the University Radiation Safety Committee prior to procurement.

Below is a list of general factors to be considered prior to procurement:

- Safer alternatives, e.g. alternate technique or source
- Access to adequate storage facilities, considering security and shielding requirements
- Access to adequate facilities for use, e.g. fume cupboard for work with volatile substances
- Competency of workers to safely handle ionising radiation
- Quantities to match immediate demand for short-term use
- Radioactive waste disposal
- Regulatory approvals and requirements, e.g. user license, personal dose monitoring
- Emergency response materials and equipment specific to the type of ionising radioactive substance or apparatus.
8.2 PROJECT APPROVAL

The Radiation Safety Committee (RSC) reviews all proposed teaching and research activities involving the use of ionising radiation. Course coordinators and principle investigators who plan to use ionising radiation are required to submit a Request to use Ionising Radiation to the RSC.

The RSC meets once every second month to review projects.

Approved Requests to use Ionising Radiation must be reviewed annually by the relevant course coordinator or principal investigator. If significant changes have been made to the work, an updated request must be submitted to the RSC for review.

8.2.1 EXTERNALLY FUNDED PROJECTS

The Research Proposal Clearance Form (RPCF) asks researchers to identify if a project will involve the use of ionising radiation. The Research Office will not release funds until the Radiation Safety Committee has approved the project.

8.3 WASTE DISPOSAL

Waste products derived from radioactive substances often have similar hazards to the substances from which they derived. Consideration must be given to the packaging, labelling, storage and available disposal pathways.

Radioactive waste must be separated from general waste, packaged in suitable containers and stored securely prior to disposal. Labelling must meet the requirements described in section 9.2.

8.3.1 LOW ACTIVITY RADIOACTIVE WASTE

Only low activity radioactive material can be disposed of through the University’s routine hazardous waste disposal program. To meet the ‘low level’ requirement the specific activity of the material must be below 100 Becquerel per gram (Bq/g).

Radioactive waste with a specific activity greater than 100 Bq/g must be stored pending radioactive decay. Isotopes including Phosphorus-32, Sulfur-35 and Iodine-125 may require storage for up to a year to allow decay to an acceptable level prior to disposal.

Long half-life isotopes including tritium (H-3) and Carbon-14 will not effectively decay in reasonable time frames. These radioactive substances must only be procured and used in quantities and concentrations that generate low activity radioactive waste.

8.3.2 UNKNOWN MATERIAL

Any unknown material located within a facility used for work with radioactive substances must be treated as a potentially radioactive substance pending further investigation.

8.3.3 EMPTY CONTAINERS

Once it has been established that the outer shielding or containers labelled with the radioactive trefoil are not contaminated, the radioactive trefoil label must be removed (so as not to cause alarm if identified) and disposed of as non-radioactive waste.
8.4 RADIATION PREMISES

There are specific requirements for the design, construction and signage of facilities used for work with ionising radiation.

8.4.1 LABORATORY CLASSIFICATION

Laboratories are classified as low, medium or high level dependent on the type radioactive substances and/or apparatus used, total activity stored or used and the specific activities carried out. Information about laboratory grading for work with unsealed radioactive substances can be found in Appendix F.

8.4.2 DESIGN AND CONSTRUCTION REQUIREMENTS

The design and construction of laboratories where ionising radiation is used must comply with the requirement of AS/NZS 2982:2010 and AS/NZS 2243.4.2018. The specific design will depend on the classification of the laboratory (low, medium or high level). Example design requirements for low and medium level laboratories are shown in Appendix G.

Laboratories used for work with unsealed radioactive substances require design features to minimize the possibility of contamination and allow for decontamination where necessary. Facilities where high energy radioactive substances and/or radiation apparatus (e.g. X-ray equipment) are used, may require radiation shielding, warning provisions and limitations on access.

Laboratory design must consider specific engineering risk controls that minimise the likelihood of exposure including shielded storage for high energy radioactive substances and the provision of fume cupboards for protection against volatile sources.

8.4.3 SIGNAGE

Restricted access signage must be displayed at the entrances to all areas containing regulated material.

The sign must display:

- The words 'Ionising Radiation Risk'
- The international sign for radioactivity: black trefoil on yellow background
- The University Radiation Management Licence number: 5061026
- The name and contact details of the Principal Investigator
- The name and contact details of the local radiation safety officer (LRSO)
- The name and contact details of the University radiation safety officer (RSO).

These signage requirements can be incorporated within the University’s Authorized Entry Only Signage. Refer to the example in Appendix H.
9 SAFE WORK PRACTICES

9.1 ACCESS TO RADIATION MATERIAL

Only authorised staff, students and affiliates with a legitimate need should have access to radioactive substances or radiation apparatus.

9.1.1 GENERAL SECURITY REQUIREMENTS

Below is a summary of the general security requirements:

- Ensure that the perimeter entrances to all areas where radioactive substances or radiation apparatus are used or stored are secured whenever unattended
- Keep the entrance to laboratories, workshops and studios closed
- Supervise visitors and contractors when they are required to enter areas where radioactive substances or radiation apparatus are used or stored
- Politely challenge strangers in the workplace, i.e. “Can I help you?”
- Store radioactive substances or radiation apparatus in locked storage areas, e.g. a locked cabinet within a storage area
- Closely monitor the inventory of all radioactive substances or radiation apparatus
- Report any unexplained loss of a radioactive substance or radiation apparatus to the Radiation Safety Officer and Security Services (T. 9351 3487)
- Investigate and report suspicious behavior to Security Services (T. 9351 3487) and the Radiation Safety Officer.

9.1.2 SECURITY ENHANCED RADIOACTIVE SOURCES

In the current global security environment, governments have identified a need to ensure that radioactive sources are secured to prevent their malicious misuse. Some sealed sources are categorised as ‘security-enhanced sources’ and are subject to stringent security requirements. Schedule B of ARPANSA’s ‘Code of Practice for the Security of Radioactive Sources’ describes the categorisation of a radioactive source or an aggregation of radioactive sources. As an example, some sources used in Gamma-irradiators and industrial gauges are classified as security-enhanced sources.

Security-enhanced radioactive sources must be protected by physical security measures during use, transport and storage. The physical security provided must be capable of preventing unauthorised access to the source by human force.

9.2 LABELLING

All containers of radioactive substances (including waste) shall be labelled with the following details:

- ‘RADIOACTIVE SUBSTANCE’
- Department/Laboratory
- Radionuclides
- Activity and corresponding date
- Description of contents
- Name
9.3 STORAGE

Radioactive substances must be segregated from non-radioactive substances and kept in a locked store that:

- Minimise the risk of flooding
- Is made of fire resistant material
- Has interior surfaces easily decontaminated
- Provides adequate shielding to ensure radiation levels outside the store are in accordance with the suitable dose limits (occupational or public).

Refer to section 5.1 of AS/NZS 2243.4.2018 for further information.

9.4 INVENTORY

An accurate inventory of radioactive substances and/or apparatus stored or used must be maintained at all times. This inventory can be kept by using Historion or one of the templates shown in Appendix I. These records must be accessible to workers and validated annually via a stock-take process.

Knowing what you have, how it is classified and where it is stored is a legislative requirement, but it also helps you to understand your risk profile, plan for emergencies and identify unexplained losses.

Any unexplained losses must be immediately reported to the University Radiation Safety Officer and Campus Security.

9.5 RISK ASSESSMENT

A documented risk assessment must be developed prior to commencing any work involving regulated material, and must be completed in accordance with the University’s WHS Risk Management Steps. A risk assessment considers both the hazards of the radioactive material and the nature of the work for which it will be used. A basic risk assessment for tasks involving radioactive material must include the following steps:

- Consider the type of radiation (e.g. alpha, beta, X-ray) and physical form (e.g. solid, liquid, gas) to identify associated hazards
- Consider the proposed work processes, including the energies and activities of the radioactive material used, the equipment, work environment and the people involved
- Identify the possible routes of exposure and the likelihood of exposure
- Identify the likelihood of an incident occurring during the work process, and the associated risk factors
- As necessary, identify additional risk controls (e.g. shielding, use of fume cupboard) to reduce the risk of exposure or incident.

The University’s WHS risk matrix (Appendix D) must be used to identify high or very high-risk activities. A detailed risk assessment must be completed for those activities. The risk assessment must be documented, accessible within the workplace and reviewed at least annually.

9.6 SAFE WORK PROCEDURE

Safe work procedures (SWP) must be established for all activities involving regulated material. A SWP documents the agreed method for completing a particular activity safely. The content of the SWP must be based on the outcome of a completed risk assessment that has been carried out in consultation with the workers involved in the activity.

The SWP should be used as the primary reference document for the training of new staff or students, and must be readily available to all workers who are undertaking the task. The SWP must be reviewed at least annually, or whenever the activity changes or when an incident relating to the task occurs.
### 9.7 APPROPRIATE RADIATION SAFETY TRAINING, WORKPLACE INDUCTION AND SUPERVISION

Before using ionising radiation, workers shall receive training, instruction and supervision appropriate to the nature of the tasks to be undertaken.

#### 9.7.1 TRAINING AND SUPERVISION

The principal investigator must develop and implement safe work procedures. These become the basis of the task specific training provided to staff. Workers who provide training for new workers must have previously been deemed competent in the specific task or activity and have considerable practical experience.

Individual training requirements should be determined via training needs analysis. As a minimum, staff, affiliates and research students who work with radioactive material must be instructed in:

- The radiation hazards and risk management processes associated with their work
- Practical task specific training, e.g. demonstration of Safe Work Procedures for the work to be performed with face-to-face supervision until deemed competent
- Emergency response.

The level of supervision is dependent upon the level of competency of the worker. If a worker is new to a task, direct supervision is recommended until the supervisor is satisfied that the level of competence allows for less frequent direct monitoring.

#### 9.7.2 EPA ACCREDITED TRAINING

Workers who handle unsealed radioactive substances are required to complete the University’s Radiation Safety training for laboratory workers. This training is accredited with the NSW EPA and can be used to apply for a radiation user licence. Equivalent training from other institutions is acceptable, provided that the course is accredited by the NSW EPA.

Information about other accredited radiation training is available via the NSW EPA website.

#### 9.7.3 COMPETENCY RECORDS

The University Radiation Safety Training records are kept in Career Path. Staff who have completed externally provided EPA accredited training must manually record the details of the training within their CareerPath training record by using the 'add external training' function.

Records of local induction and task specific training must be kept by the principal investigator and/or supervisor.
9.8 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The required personal protective equipment (PPE) will depend on the type of ionising radiation being handled, the activities being performed and the facilities within the work environment.

Example PPE and clothing might include:

- Fully enclosed shoes made of non-absorbent material with a non-slip sole
- Safety glasses or goggles which fit well around the eyes
- Laboratory coat or gown
- Disposable gloves
- Disposable overshoe covers
- Leaded apron and leaded eyewear.

PPE must be:

- Properly selected for the activity (appropriate protection) and individual (proper fit)
- Readily available, clean, functional and in good condition
- Australian Standards approved, where possible.

9.9 EMERGENCY PROCEDURES

9.9.1 EMERGENCY PROCEDURES

Local emergency response plans must be developed prior to an incident occurring. Relevant workers must be trained to respond to an emergency according to these plans. Safe work procedures should include emergency response and shutdown procedures. It is recommended that key laboratory and workshop staff attend First Aid and First Attack Fire Fighting Training.

Emergency equipment must be maintained and easily accessible. For example, eye wash facilities should be flushed weekly by laboratory workers and the surrounding area kept clear of obstruction. Annual maintenance is done by Campus Infrastructure Services (CIS).

9.9.2 RADIOACTIVE SPILL RESPONSE

Each laboratory should have a spill kit for responding to radioactive spills and personal contamination. The spill kit must be designed to match the work activities carried out.

An example spill kit might contain:

- Spill procedures
- Absorbent materials
- Gloves and other personal protective clothing and equipment
- Items necessary for personal and area decontamination, e.g. cotton wool, Decon90
- Plastic hazardous waste bags.

A minor spill is defined as a spill where the potential risk of inhalation is less than 20 times the annual limit of intake (ALI). A major spill is defined as a spill where the potential risk of inhalation is more than 20 ALI. The ALI value of each isotope is different and can be found on the Safety Data Sheet (where available).

Spill procedures must be developed, and relevant staff trained to respond. Workers should be trained to determine if the incident requires a minor or major spill response. A minor spill can usually be managed locally. A major spill must immediately be reported to the University RSO, who will advise on appropriate response procedures.

The location of radiation monitors should be known by all workers and visibly displayed on signage within the work area.
9.9.3 RADIATION INCIDENTS AND ACCIDENTS

The EPA describes a radiation accident as a situation where there is an unplanned or unexpected emission of radiation where:

- One or more persons have, or could have, received an effective dose of radiation equal to, or in excess of 5 millisieverts (mSv) in the case of an occupationally exposed person, or 1 mSv in any other case
- The premises or the environment have been contaminated by radioactive material.

In situations where ionising radiation is used on a human subject for medical purposes, the description of an accident can be found in the Radiation Control Regulation, 2013, division 5.

9.9.4 RESPONSE TO EXPOSURE

Exposure can be internal or external.

Internal exposure
If a person has, or is suspected to have had an accidental intake of radioactive material (internal exposure), the University RSO must be contacted immediately to estimate the potential dose and determine if further medical attention is required.

External exposure
If a person has, or is suspected to have been accidently exposed to external radiation, the person should be removed from the area and action taken to isolate the source. The University RSO must be contacted immediately to estimate the potential dose and determine if further medical attention is required.

9.9.5 REPORTING INCIDENT AND ACCIDENT

All incidents involving ionising radiation must be reported immediately to the supervisor, and the University RSO. It should be recorded in RiskWare within 24 hours.

The University RSO will report the event to the regulatory authorities if necessary.

9.10 RADIATION DOSE MONITORING

Monitoring shall be performed to assess the effectiveness of the radiation protection program. Where appropriate, the monitoring program should include:

- Ambient dose rates within and around the work areas
- Contamination of surfaces and equipment in the laboratory
- Contamination in the air and effluents
- Measurement of doses received by individual laboratory workers.

The radiation monitoring program shall be reviewed annually and amended when necessary.

9.10.1 AMBIENT DOSE MONITORING

The principal investigator must organise the periodic measurement of ambient dose rates and surface contamination, and keep records of the results. In some cases, assessment of adjacent work areas might also be required.

Radiation monitors
No single instrument is suitable for all monitoring. The type of monitors must match the type of ionising radiation being used. Information on the various types of instruments and their use can be found in Appendix J. Radiation monitors must be calibrated annually.
9.10.2 SURFACE CONTAMINATION

Surface monitoring should be carried out periodically, dependent on the type of work. The frequency and type of surface monitoring should be documented in the relevant safe work procedures.

Surfaces are considered to be contaminated if the count rate reaches more than twice the background rate. For low-energy beta emitters (e.g. C-14, S-35, H-3), direct monitoring is inappropriate. Wipe testing with liquid scintillation counting should be used.

9.10.3 PERSONAL DOSE MONITORING

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) recommends an annual effective dose limit of 20 mSv for radiation workers and 1 mSv for members of the public and pregnant radiation workers. Personal dose monitoring is recommended in situations where the annual effective dose is estimated to be more than 30% of the annual dose limit.

At the University we generally apply an annual dose limit of 1 mSv for our radiation workers (equivalent to the public dose limit). Therefore, personal dose monitoring must be provided to University workers whenever the annual dose is expected to exceed 300 µSv. However, personal dosimetry is not available for workers using Tritium and Carbon-14 because the energies emitted by those isotopes are below detection limits.

It is the responsibility of the principal investigator to calculate expected annual exposure and ascertain if personal dosimetry is required. As a guideline, the following activities usually require workers to wear personal dosimetry:

- Scientific research in a laboratory classified as a medium or high-level
- Work with neutron-gamma gauges, usually used in agriculture or construction
- Radiotherapy and nuclear medicine
- Large animal veterinary radiography (for example equine)
- Diagnostic or interventional radiology (other than dentistry, veterinary and chiropractic applications)

Record keeping
At the termination of employment, radiation workers must be supplied with a copy of their dose records. These records must be kept safely and permanently and given to any future employer when employed as a radiation worker.

To help meet the legislative requirements for record keeping the University uses a software product called Historion as a centralised database for personal dosimetry records. To enable the management of these records centrally, each School and/or Faculty is required to periodically upload personal dose reports to the Historion database.

Pregnant radiation workers
Radiation workers who are potentially pregnant should inform their supervisor and the University RSO as soon as possible. The potential radiation exposure will be assessed for the period of the pregnancy, and arrangement will be made to eliminate or reduce the exposure to an acceptable level.
9.11 TRANSPORT

Transporting radioactive substances outside of the workplace poses the risk of spill and uncontrolled release.

9.11.1 UNIVERSITY REQUIREMENTS FOR TRANSPORT AND PACKAGING OF RADIOACTIVE SUBSTANCE ON CAMPUS

When transporting radioactive substances outside of the immediate work area, the primary package must be sealed (e.g. with a cap, stopper or lid) and secondary containment must also be used.

9.11.2 REQUIREMENTS FOR TRANSPORT AND PACKAGING BY AIR, SEA, ROAD OR RAIL, OUTSIDE CAMPUS

The transport of radioactive material by road and rail must meet the Australian Radiation Protection and Nuclear Safety Agency ‘Code of Practice for the Safe Transport of Radioactive Material’.

The transport of radioactive materials by air and international waterways must meet the requirement from the International Atomic Energy Agency 2012 Regulations under the jurisdiction of Civil Aviation Act 1988 and the Navigation Act 2012 respectively.

9.11.3 HAZMAT TRANSPORT COMPANIES

The transport of regulated radioactive substances outside of campus must be approved by the University RSO and carried out by a specialist transport company. Below are two examples of companies who can arrange the transport of radioactive substances:


10 REGULATORY REQUIREMENTS

10.1 UNIVERSITY RADIATION MANAGEMENT LICENCE

The University of Sydney holds a licence to possess, store, sell or give away regulated material. This licence is renewed annually and must be kept up to date by adding new regulated material and removing disposed items.

10.2 RADIATION USER LICENCES

Individuals using regulated materials must hold a radiation user licence issued by the NSW EPA or hold an exemption approval. The condition ‘to use’ includes to operate, have in possession for use, handle or manipulate.

Most types of radiation apparatus are regulated and require EPA licensing. The types of radiation apparatus that are exempt from licensing can be found in Part 3 and 4 of Schedule 3 of the Radiation Control Regulation 2013.

Most types of radioactive substances are regulated and require EPA licences. The types of radioactive substances exempted from licensing can be found in Part 1 and 2 of Schedule 3 of the Radiation Control Regulation 2013.

10.3 EXEMPTION AND SUPERVISION REQUIREMENT

There are several exemptions from licensing, but within the University these only applies to currently enrolled students or short-term visitors, including volunteers approved by the Head of School.

A mandatory condition for exemption is that the exempted person works under the supervision of a licensed person. A list of exempted persons working under supervision must be displayed in the local work area.

General supervision ensures that the exempted person follows safe work procedures. It is the responsibility of the supervisor to determine the experience and knowledge of the exempted person and carry out their supervisory responsibilities accordingly. In some cases, this may require the supervisor to be physically present while the radiation work is being conducted.

Both the person who grants the exemption and the person who supervises the exempted person must hold a user licence that corresponds to the type of usage the exemption is related to. The person who grants the exemption must hold the condition GE1 (condition to grant exemption) on their radiation user licence.

The exemption must be given in writing and indicate:

- The radioactive substances or radiation apparatus to which it relates
- Any conditions of use
- The identity of the exempted person
- The identity of the supervisor.

A copy of the exemption must be provided to the University RSO, and displayed in the work area. A template is provided in Appendix K.

11 REVIEW AND EVALUATION

Performance standards and the associated procedures and guidelines will be reviewed by Safety Health & Wellbeing at least once every two years to identify and implement opportunities for improvement.
12 REFERENCES

NSW Work Health and Safety Regulation, 2017

Australian Code for the Transport of Dangerous Goods by Road and Rail 2014

Australian Standard Laboratory design and construction, AS/NZS 2982 2010

Australian Standard Safety in laboratories, Part 4: Ionising radiations AS/NZS 2243.4 2018

NSW Radiation Control Act 1990

NSW Radiation Control Regulation 2013

13 DOCUMENT CONTROL

<table>
<thead>
<tr>
<th>Acknowledgements</th>
<th>Related Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Laboratory Safety Standard</td>
</tr>
</tbody>
</table>

<table>
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<th>Date released</th>
<th>Author/s</th>
<th>Custodian</th>
<th>Approved by</th>
<th>Amendment</th>
</tr>
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<tr>
<td>1.0</td>
<td>07/09/2018</td>
<td>Felix Werner, Matthew Mitchell</td>
<td>Manager, WHS Services</td>
<td>Director, Safety Health &amp; Wellbeing</td>
<td>Original</td>
</tr>
</tbody>
</table>

*Printed copies of this document are uncontrolled. Verify version before using.*
APPENDIX A - RADIATION CONTROL REGULATION 2013, SCHEDULE 1 PRESCRIBED ACTIVITY OF A RADIOACTIVE SUBSTANCE

- **Group 1: 40 kBq**
  
  Ac227  Am241  Am243  Cf249  Cf250  Cf252  Cm242  Cm243  Cm244  Cm245  Cm246  Np237  Pa231  Pb210  Po210  Pu238  Pu239  Pu240  Pu241  Pu242  Ra223  Ra226  Ra228  Th227  Th228  Th230  U230  U232  U233  U234

  Any alpha emitting radionuclide that is not included in any other Group in this Schedule

- **Group 2: 400 kBq**
  
  Ac228  Ag110m  At211  Ba140  Bi207  Bi210  Bk249  Ca45  Cd115m  Ce144  Cl36  Co56  Co60  Cs134  Cs137  Eu152  Eu154  Ge68  Hf181  I124  I125  I126  I131  I133  In114m  Ir192  Mn54  Na22  Pa230  Pb212  Ra224  Ru106  Sb124  Sb125  Sc46  Sr89  Sr90  Ta182  Tb160  Te127m  Te129m  Th234  TI204  Tm170  U236  Y91  Zr95

  Any radionuclide that is not alpha emitting and is not included in any other Group in this Schedule

- **Group 3: 4 MBq**
  
  Ag105  Ag111  Ar41  As73  As74  As76  As77  Au196  Au198  Au199  Ba131  Ba133  Be7  Bi206  Bi212  Br75  Br76  Br82  Ca47  Cd109  Cd115  Ce141  Ce143  Cl38  Co57  Co58  Cr51  Cs129  Cs131  Cs136  Cu64  Cu67  Dy165  Dy166  Er161  Er169  Er171  Eu152m  Eu155  F18  Fe52  Fe55  Fe59  Ga67  Ga72  Gd153  Gd159  Hf175  Hg195m  Hg197  Hg197m  Hg203  Ho166  I123  I130  I132  I134  I135  In111  In115  In115m  Ir190  Ir194  K42  K43  Kr85m  Kr87  La140  Lu177  Mg28  Mn52  Mn56  Mo99  Na24  Nb93m  Nb95  Nd147  Nd149  Ni63  Ni65  Np239  Os185  Os191  Os193  P32  P33  Pd103  Pd109  Pm147  Pm149  Pr142  Pr143  Pt191  Pt193  Pt197  Rb81  Rb86  Re183  Re186  Re188  Rh105  Rn220  Rn222  Ru103  Ru105  Ru97  S35  Sb122  Sc47  Sc48  Se75  Si31  Sm151  Sm153  Sn113  Sn121  Sn125  Sr85  Sr91  Sr92  Tc96  Tc97  Tc97m  Tc99  Te125m  Te127  Te129  Te131m  Te132  Th231
- Group 4: 40 MBq

Ar37  C11  C14  Co58m  Cs134m  Cs135  Cu62  Ga68  H3  H3  I129
In113m  Kr81m  Kr85  N13  Nb97  Ni59  O15  Os191m  Pt197m  Pt197m  Rb87
Re187  Se73  Se73  Sm147  Sr85m  Sr87m  Tc96m  Tc99m  Th nat  U nat  U235
U238  Xe131m  Xe133  Y91m  Zn69  Zr93
APPENDIX B - UNIVERSITY RADIATION SAFETY COMMITTEE, TERMS OF REFERENCE

1. PURPOSE

The Radiation Safety Committee (RSC):

- Reviews all proposed teaching and research activities involving the use of ionising radiation
- Validates that the facilities used for work with ionising radiation are appropriate
- Approves and/or advises on work involving the use of ionising radiation.

Work with ionising radiation must not be carried out unless approved by the RSC.

2. TERMS OF REFERENCE, MAY 2018

- To undertake the assessment and review of all University research involving the use of ionising radiation, including the qualifications and experience of workers involved
- To provide advice to the University workers on potential hazards of the use of ionising radiation and their management
- To assess that radiological laboratories meet AS/NZS 2243.4.2018 ‘Safety in laboratories Part 4: Ionizing radiations’ design requirements, and inspect these laboratories
- To ensure that ionising radiation laboratories, facilities and equipment consistently meet the appropriate safety requirements
- To maintain a register of projects, ionising radiation facilities and researchers licensed to use sources of ionising radiation
- To communicate to the University community changes in the radiation regulation and associated legislation and guidelines: Radiation Control Act 1990, Radiation Control Regulations 2013, Australia/New Zealand Standards of Safety in Laboratories (AS/NZS 2243.4.2018), …
- To make inspections of laboratories or other work areas to ensure that research safety requirements are being met
- To liaise with the Research Office, and Safety Health and Wellbeing
- To advice the DVC(R) on membership of the University Radiation Safety Committee.

3. MEETINGS

RSC meetings are held every second month.

4. REPORTING

The RSC reports to:

- Safety Health and Wellbeing
- University Executive
- DVC (Research)
- NSW Environment Protection Authority (NSW EPA).
APPENDIX C - UNIVERSITY RADIATION SAFETY OFFICER

1. PRIMARY FUNCTION INCLUDING UNIT CONTEXT:

The primary function of the Radiation Safety Officer is to provide strategic guidance to the University in relation to radiation safety and compliance, and to establish and monitor the elements of the safety management system related to radiation safety.

2. KEY ACTIVITIES AND ACCOUNTABILITIES:

The RSO role is to:

- Provide professional radiation safety advice to workers dealing with ionising and non-ionising radiation
- Develop and communicate radiation safety policies, procedures and programs designed to minimise exposure to radiation hazards and comply with related legislation
- Develop and implement radiation safety support services and information in line with the University’s strategic plan for WHS
- Provide leadership and support for the Radiation Safety Committee (RSC)
- Coordinate the assessment of research projects involving radiation
- Coordinate the inspection of radiation facilities and equipment
- Establish and maintain a database relating to radiation facilities, equipment and activities
- Monitor and report on radiation risk management performance across the University
- Investigate and report on radiation safety matters raised within the University community
- Liaise with relevant regulatory authorities on matters of radiation safety compliance.
This matrix should be used in conjunction with the Risk Assessment form.

<table>
<thead>
<tr>
<th>Potential Consequences</th>
<th>L6</th>
<th>L5</th>
<th>L4</th>
<th>L3</th>
<th>L2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor injuries or discomfort. No medical treatment or measurable physical effects.</td>
<td>Not Significant</td>
<td>Minor</td>
<td>Moderate</td>
<td>Major</td>
<td>Severe</td>
</tr>
<tr>
<td>Injuries or illness requiring medical treatment. Temporary impairment.</td>
<td></td>
<td>Medium</td>
<td>High</td>
<td>Very High</td>
<td>Very High</td>
</tr>
<tr>
<td>Injuries or illness requiring hospital admission.</td>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>Injury or illness resulting in permanent impairment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Fatality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Likelihood**

- Expected to occur regularly under normal circumstances: Almost Certain
  - Low: Red
  - Medium: Orange
  - High: Yellow
  - Very High: Green
- Expected to occur at some time: Likely
  - Low: Red
  - Medium: Orange
  - High: Yellow
  - Very High: Green
- May occur at some time: Possible
  - Low: Red
  - Medium: Orange
  - High: Yellow
  - Very High: Green
- Not likely to occur in normal circumstances: Unlikely
  - Low: Red
  - Medium: Orange
  - High: Yellow
  - Very High: Green
- Could happen, but probably never will: Rare
  - Low: Red
  - Medium: Orange
  - High: Yellow
  - Very High: Green
1. PRIMARY FUNCTION INCLUDING UNIT CONTEXT:

A local radiation safety officer (LRSO) is appointed by the Head of School or Director of a research institute to act on their behalf in relation to radiation safety. Their role is to monitor work involving ionising radiation and ensure it is carried out in accordance with University requirements and processes. The LRSO should serve as the first point of contact for staff and students within a specific area or organisational unit.

Whilst the University Radiation Safety Officer (RSO) carries out the majority of the work related to radiation safety at the University, the network of LRSO is an integral component of the radiation safety program.

The LRSO may or may not hold a valid licence issued by the EPA. Where there are numerous radiation projects within a School/Centre it is anticipated there will be a number of licence holders with responsibility for specific projects. There will be only one LRSO for the School/Institute/Centre.

2. KEY ACTIVITIES AND ACCOUNTABILITIES:

The LRSO role is to:

- Liaise with the University RSO regarding changes or issues related to radiation safety
- Advise local staff on University requirements and processes
- Maintain local records including local inventories, license holders and exemptions, personnel dose and contamination monitoring reports, waste disposal records and any specific information related to the use of radiation within their area or organisational unit.
- Providing copies of relevant documentation to the University RSO, on request.

The LRSO will provide advice to researchers and course coordinators in relation to:

- Local hazards associated with ionising radiation
- Application of the ALARA principle
- Project planning including assistance with applications to the University Radiation Safety Committee
- Applying for licenses and issuing exemptions for licensing
- Radiation monitoring requirements (e.g. personal, ambient, surface contamination)
- Safe temporary storage of radioactive materials pending radioactive decay
- Disposal of radioactive waste in accordance with University’s Hazardous Waste Program
- Reporting of incidents and accidents involving to the University RSO.
APPENDIX F - GRADING OF LABORATORY IN WHICH UNSEALED SOURCES ARE USED OR STORED

The following information is based on the Australian Standard AS/NZS 2243.4.2018.

The grading of a laboratory is defined by the activity and toxicity group of the isotope used, as well as the complexity of the operation (see modifying factors below).

For commonly used isotopes and normal wet chemical operations:

1. LOW LEVEL LABORATORIES:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Toxicity group</th>
<th>Activity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr-90, Am-241</td>
<td>1</td>
<td>&lt; 0.2 MBq</td>
</tr>
<tr>
<td>H-3, C-14, F18, Cr-51, Cu-64, Ga-67, I-123</td>
<td>3</td>
<td>&lt; 2 GBq</td>
</tr>
<tr>
<td>C-11, Tc-99m</td>
<td>4</td>
<td>&lt; 0.2 TBq</td>
</tr>
</tbody>
</table>
## 2. MEDIUM LEVEL LABORATORIES:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Toxicity group</th>
<th>Activity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr-90, Am-241</td>
<td>1</td>
<td>0.2 MBq - 20 MBq</td>
</tr>
<tr>
<td>Na-22, P-32, P-33, S-35, Ca-45,</td>
<td>2</td>
<td>20 MBq - 2 GBq</td>
</tr>
<tr>
<td>Fe-55, Co-57, Co-60, Ge-68, Zr-89,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-124, I-125, I-131, Cs-137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-3, C-14, F18, Cr-51, Cu-64,</td>
<td>3</td>
<td>2 GBq - 200 GBq</td>
</tr>
<tr>
<td>Ga-67, I-123</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-11, Tc-99m</td>
<td>4</td>
<td>200 GBq - 20 TBq</td>
</tr>
</tbody>
</table>

## 3. HIGH LEVEL LABORATORIES:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Toxicity group</th>
<th>Activity range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr-90, Am-241</td>
<td>1</td>
<td>&gt; 20 MBq</td>
</tr>
<tr>
<td>Na-22, P-32, P-33, S-35, Ca-45,</td>
<td>2</td>
<td>&gt; 2 GBq</td>
</tr>
<tr>
<td>Fe-55, Co-57, Co-60, Ge-68, Zr-89,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-124, I-125, I-131, Cs-137</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-3, C-14, F18, Cr-51, Cu-64,</td>
<td>3</td>
<td>&gt; 200 GBq</td>
</tr>
<tr>
<td>Ga-67, I-123</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-11, Tc-99m</td>
<td>4</td>
<td>&gt; 20 TBq</td>
</tr>
</tbody>
</table>
4. MODIFYING FACTORS:

To reflect an increased risk of radioactive contamination according to the complexity of the operation, the following factors must be applied to the activity range:

<table>
<thead>
<tr>
<th>Type of operation</th>
<th>Modifying factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple storage</td>
<td>x 100</td>
</tr>
<tr>
<td>Simple handling of liquids (using stock solutions or aliquots)</td>
<td>x 10</td>
</tr>
<tr>
<td>Analysis of simple chemical preparations</td>
<td>x 1</td>
</tr>
<tr>
<td>Incorporating biological or organic compounds, or complex handling of liquids</td>
<td>x 0.1</td>
</tr>
<tr>
<td>(risk of splashing or vaporisation)</td>
<td></td>
</tr>
<tr>
<td>Complex handling of liquid incorporating biological or organic compounds</td>
<td>x 0.01</td>
</tr>
<tr>
<td>Simple dry operation and work with volatile compounds</td>
<td>x 0.01</td>
</tr>
<tr>
<td>Simple dry operation incorporating biological or organic compounds</td>
<td>x 0.001</td>
</tr>
<tr>
<td>Work with radioactive gases</td>
<td>x 0.001</td>
</tr>
</tbody>
</table>

5. EXAMPLE:

<table>
<thead>
<tr>
<th>Isotope: H-3 (Group 3)</th>
<th>Type of operation: Storage (modifying factor x 100)</th>
<th>Max activity in storage = 12 GBq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low level limit &lt; 2 GBq</td>
<td>Adjusted low level limit: 2 GBq x 100 = 200 GBq</td>
</tr>
<tr>
<td></td>
<td>Therefore: Low Level laboratory</td>
<td>(activity in storage: 12 GBq &lt; adjusted low level limit: 200 GBq)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Isotope: Zr-89 (Group 2)</th>
<th>Type of operation: Incorporating biological compounds (modifying factor x 0.1)</th>
<th>Max activity used = 150 MBq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low level limit &lt; 20 MBq</td>
<td>Medium Level limit &lt; 2 GBq</td>
</tr>
<tr>
<td></td>
<td>Adjusted low level limit: 20 MBq x 0.1 = 2 MBq</td>
<td>Adjusted medium level limit: 2 GBq x 0.1 = 0.2 GBq = 200 MBq</td>
</tr>
<tr>
<td></td>
<td>Therefore: Medium Level Laboratory</td>
<td>(activity used: 150 MBq &gt; adjusted low level limit: 2 MBq and &lt; adjusted medium level limit: 200 MBq)</td>
</tr>
</tbody>
</table>
APPENDIX G - DESIGN REQUIREMENTS FOR LABORATORIES USING UNSEALED SOURCES

The following information is based on the Australian Standard AS/NZS 2243.4.2018. These requirements are in addition to the standard requirements of AS/NZS 2982 2010.

<table>
<thead>
<tr>
<th>Laboratory grading</th>
<th>Additional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level</td>
<td>Sealed floor and bench top joints</td>
</tr>
<tr>
<td></td>
<td>Smooth washable waterproof bench tops</td>
</tr>
<tr>
<td></td>
<td>Smooth walls finished with washable paint</td>
</tr>
<tr>
<td></td>
<td>Secure isotopes storage facilities</td>
</tr>
<tr>
<td></td>
<td>Stainless steel sinks</td>
</tr>
<tr>
<td></td>
<td>Hands free operated washbasin</td>
</tr>
<tr>
<td></td>
<td>A fume cupboard (may be optional)</td>
</tr>
<tr>
<td>Medium level</td>
<td>Floor covering coved to walls</td>
</tr>
<tr>
<td></td>
<td>Bench tops coved to walls</td>
</tr>
<tr>
<td></td>
<td>Knee or foot operated wash basins</td>
</tr>
<tr>
<td></td>
<td>Continuous drainage systems labelled at accessible points</td>
</tr>
<tr>
<td></td>
<td>Smooth ceilings including flush light fittings</td>
</tr>
<tr>
<td></td>
<td>A fume cupboard</td>
</tr>
<tr>
<td></td>
<td>Coved ceilings to walls (for upper activity levels of the range)</td>
</tr>
<tr>
<td>High level, contact the University RSO</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX H - RESTRICTED ACCESS SIGNAGE

Hazards in this area:

IONISING RADIATION RISK

Safety precautions:

FOOT PROTECTION MUST BE WORN
LAB COAT OR GOWN MUST BE WORN
SAFETY EYEWEAR MUST BE WORN
HAND PROTECTION MUST BE WORN
WASH HANDS BEFORE LEAVING THIS AREA

EMERGENCY CONTACTS:

Millie Boss (Head of Area) 04XX XXX XXX
Sam Fireman (Chief Warden) 04XX XXX XXX
Elmo Getwell 04XX XXX XXX
Campus Security 9351 3333
Fire, Police, Ambulance Triple Zero (000)

University Health Service 9351 3484

LOCAL CONTACTS:

Beaker Muppet (Area Supervisor) 04XX XXX XXX
Homer Simpson (Radiation Safety Officer) 04XX XXX XXX
Bunsen Honeydew (Principal Research Investigator) 04XX XXX XXX

Radiation Safety Committee Approval Numbers.
University Radiation Management Licence No: 5061026 / RSCYYXX

Approved by Millie Boss 2018/05/18
Sydney University Authorized Entry Only sign v3.0
APPENDIX I - INVENTORY TEMPLATES

A record for each radiation source shall be kept and reviewed at least annually or when changes are made. The record for each source should be kept for two years after the disposal of that source.

1. SEALED SOURCES:

<table>
<thead>
<tr>
<th>Building Name and Code</th>
<th>Room number</th>
<th>Department name</th>
<th>Radionuclide</th>
<th>Supplier</th>
<th>Serial number</th>
<th>Date received</th>
<th>Activity upon receipt</th>
<th>Mass</th>
<th>Date of disposal</th>
<th>Manner of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>K07</td>
<td>306</td>
<td>Work Health and Safety</td>
<td>Felixium 39</td>
<td>Amersham</td>
<td>78543</td>
<td>01/05/1978</td>
<td>42 MBq</td>
<td>5 mg</td>
<td>06/06/2015</td>
<td>Transferred to Hurtful Hospital</td>
</tr>
</tbody>
</table>

2. UNSEALED SOURCES:

<table>
<thead>
<tr>
<th>Building Name and Code</th>
<th>Room number</th>
<th>Department name</th>
<th>Radionuclide</th>
<th>Supplier</th>
<th>Serial number</th>
<th>Date received</th>
<th>Activity upon receipt</th>
<th>Physical Form</th>
<th>Volume</th>
<th>Chemical Form</th>
<th>Date of disposal</th>
<th>Manner of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>K07</td>
<td>306</td>
<td>Work Health and Safety</td>
<td>Felixium 39</td>
<td>ANSTO</td>
<td>78543</td>
<td>01/05/1978</td>
<td>42 MBq</td>
<td>Liquid</td>
<td>5 mL</td>
<td>Sucrose</td>
<td>06/06/2018</td>
<td>Returned to supplier</td>
</tr>
</tbody>
</table>
### 3. APPARATUS:

<table>
<thead>
<tr>
<th>Building Name and Code</th>
<th>Room number</th>
<th>Department name</th>
<th>Description of apparatus</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Serial number</th>
<th>Fixed, Portable, Mobile</th>
<th>Next periodic check due date</th>
<th>Date of disposal</th>
<th>Manner of disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>K07</td>
<td>306</td>
<td>Work Health and Safety</td>
<td>Veterinary X-ray</td>
<td>Varian</td>
<td>B150</td>
<td>3615</td>
<td>Fixed</td>
<td>06/06/2019</td>
<td>03/10/2018</td>
<td>Returned to supplier</td>
</tr>
</tbody>
</table>
APPENDIX J - RADIATION MONITORING

1. AMBIENT DOSE:

The ambient dose rate in micro Sievert per hour (uSv/h) can be measured with a dose-rate meter. These instruments usually consist of an ionisation chamber, a Geiger Muller (GM) tube or a scintillation detector. It is important to remember that dose-rate meter can saturate in high intensity fields, in which case they might indicate erroneous dose rate values.

Narrow beam X-ray apparatus (for example diffractometers) usually produce low energies with a very small cross-section. This requires the use of a small volume, sensitive detector. Alternatively, a photographic film could be used to detect the presence and extent of the beam.

2. RADIOACTIVE CONTAMINATION ON SURFACES:

A count-rate meter fitted with a Geiger tube or a scintillation detector is required. Surface contamination is usually expressed in counts per minute (CPM) or counts per second (CPS). An area is considered to be contaminated if the count rate reaches more than twice the background rate. For low-energy beta emitters (e.g. C-14, S-35, H-3), direct monitoring is inappropriate. Wipe testing with liquid scintillation counting should be used.

Examples of recommended radiation meters for commonly used isotopes:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Radiation type</th>
<th>Energy (keV)</th>
<th>Monitoring recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-14</td>
<td>Beta</td>
<td>156</td>
<td>Poor efficiency with GM tube (~10%). Wipe test with liquid scintillation counting is recommended</td>
</tr>
<tr>
<td>H-3</td>
<td>Beta</td>
<td>18.6</td>
<td>Wipe test with liquid scintillation counting</td>
</tr>
<tr>
<td>I-125</td>
<td>Gamma</td>
<td>27 – 35.5</td>
<td>Mini instrument 42 A, or Ludlum 44-21</td>
</tr>
<tr>
<td>I-131</td>
<td>Gamma</td>
<td>364 – 723</td>
<td>Mini instrument 41 S, or Ludlum 44-21</td>
</tr>
<tr>
<td></td>
<td>Beta</td>
<td>606 – 807</td>
<td></td>
</tr>
<tr>
<td>P-32</td>
<td>Beta</td>
<td>695 – 1710</td>
<td>Ludlum 44-21 or Mini instrument 44A</td>
</tr>
<tr>
<td>S-35</td>
<td>Beta</td>
<td>167.5</td>
<td>Poor efficiency with GM tube (~10%). Wipe test with liquid scintillation counting is recommended</td>
</tr>
<tr>
<td>F-18</td>
<td>Gamma</td>
<td>511</td>
<td>Mini instrument 41S or 44A</td>
</tr>
<tr>
<td></td>
<td>Beta</td>
<td>634</td>
<td></td>
</tr>
</tbody>
</table>

Radiation monitors must be calibrated annually.

For more information on radiation monitors, contact the RSO or consult Section 6 ‘Monitoring Ionising Radiations’ of the Australian Standard AS/NZS 2243.4.2018.
## APPENDIX K - RADIATION LICENCE EXEMPTION FORM

This completed form must be displayed in the laboratory where the exempted person is working with radiation. A copy must also be sent to the University RSO.

Note that the exemption does not necessarily have to be given to an individual. It can also be given for a class of persons (e.g. ‘Second Year Physics Students’).

<table>
<thead>
<tr>
<th>Project related to this exemption</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Regulated material specification (Isotope and activity, or Apparatus type and details)</th>
<th></th>
</tr>
</thead>
</table>

### Person granting the radiation licence exemption:

<table>
<thead>
<tr>
<th>Name</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Position</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Contact</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Radiation licence number</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Licence number: .................</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Condition: □ GE1 □ IA5 □ IA8 □ IA9 □ IA22 □ S8 □ ED3 □ Other: .................</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
<th></th>
</tr>
</thead>
</table>
**Person supervising the exemptee:**

<table>
<thead>
<tr>
<th>Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>Radiation licence number</td>
<td></td>
</tr>
</tbody>
</table>

**Licence number: ………………**

**Condition:**

- ☐ GE1
- ☐ IA5
- ☐ IA8
- ☐ IA9
- ☐ IA22
- ☐ S8
- ☐ ED3
- ☐ Other: ………………

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

**Person exempted:**

<table>
<thead>
<tr>
<th>Name or Class of person</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td></td>
</tr>
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