University of Aberdeen

Ionising Radiation Safety Arrangements

Version 4

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Authorised by Radiation Hazards Sub Committee

This document is available online at:-

https://www.abdn.ac.uk/staffnet/working-here/resources-5988.php#faq49

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Contents

1. Introduction

This document describes arrangements for the safe use of ionising radiation in the University of Aberdeen (UOA). All exposure to ionising radiation is assumed to be detrimental. However, by following the practices described in this document and the local rules for each area, the risks associated with using ionising radiations can be kept to a minimum and well within safe and legal working limits[1].

It is the University's responsibility to limit the exposure to ionising radiation of staff, students, contractors, members of the public and the environment to a level that is as low as reasonably practicable and this document describes the procedures that are in place to achieve this.

Work with unsealed radioactive substances and sealed radioactive sources are covered by this document.

Ionising radiation should only be used if other techniques not using ionising radiation are unavailable or impractical.

Staff or students who wish to start working with ionising radiation should apply through their lab supervisor or line manager to your local Radiation Protection Supervisor. Before you start work you must have completed the University radiation safety course and have received local training from your RPS or supervisor.

If you are working in a radiation area then safety procedures specific to your area or lab are contained in LOCAL RULES - you must follow these instructions.

[1] These arrangements have been put in place to comply with conditions of the Ionising Radiation Regulations 2017 (IRR17), the Environmental Authorisations (Scotland) Regulations 2018 (EAR 2018) and the Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME)R).

2. Hazards

Radiation hazards are usually classed as **internal** or **external**. The internal hazard arises from the ingestion of a radioactive material, through the mouth, nose or through the skin and can occur through a cut or directly through the skin if certain organic solvents are also present. Once in the body and incorporated into body tissues there is very little, if anything, that can be done to remove a radionuclide. It is only removed by natural excretion with the normal biological half-life of the non-radioactive form of the element and, of course, by physical decay of the radionuclide. The internal hazard is the one most people are exposed to in research laboratories and most of the recommended working procedures are aimed at minimising it.

An external hazard exists when the radioactive source is sufficiently large to create a radiation field around it. Although it is mainly sealed sources that produce external hazards, large quantities of unsealed sources of γ and beta emitting nuclides can also produce them. The dose rates close to these sources can be very high, particularly high-energy beta emitters. External hazards of this nature can be reduced in three ways:

- by keeping the **TIME** of exposure to a minimum.
- by using **DISTANCE**; the dose rate falls off as the square of the distance from the source – **double the distance quarter the dose**;
- by using **SHIELDING** to reduce the dose rate;

The biological effects of ionising radiation are, in research institutions, really confined to the long-term effects of cancer and leukaemia arising from low doses. The genetic effect and the short-term effects following high radiation doses are most unlikely to occur. Few sources exist in the University which could produce even localised skin injuries without an almost deliberate attempt to do so. The main exceptions to this statement are X-ray equipment where even a very short accidental exposure to an X-ray beam can result in localised skin burns.

3. Radiation legislation

Radiation users do not have to be familiar with the fine detail of the laws that govern the use of ionising radiation however it is useful to have some background knowledge to highlight the importance of these procedures. Different legislation covers different aspects of the use of ionising radiation in the workplace as described below.

3.1. Ionising radiation regulations 2017 (IRR17)

These regulations seek to limit exposures to employees and the public that arise due to the use of ionising radiation in the workplace. The regulations require an employer to ensure exposures to ionising radiation are **as low as is reasonably practicable**. Employers must ensure suitable risk assessments are carried out to establish what protection measures are required. IRR17 sets limits on the radiation exposure a UK radiation worker (or student) can receive. There are also other limits for pregnant workers and members of the public. Local rules must be drawn up that summarise protection measures specific to areas where work with ionising radiation takes place. Employers must consult with a certified Radiation Protection Adviser (RPA) for advice on compliance with the regulations. IRR17 is enforced by the Health and Safety Executive (HSE).

3.2. Environmental Authorisations (Scotland) Regulations 2018 (EAR 2018)

These regulations impose controls on the holding and disposal of radioactive material. Before work commences all new uses of radioactive material must be discussed with the Radiation Protection Service will advise if a suitable authorisation is in place or if a new application to Scottish Environmental Protection Agency (SEPA) is required. It is the responsibility of the Departmental Manager to ensure no work commences unless it is covered under an appropriate authorisation and that provisions are in place to ensure that the requirements imposed by the authorisation are complied with. The University is required to keep detailed records to show that the provisions required by the authorisation are complied with.

Authorisations also require an employer to appoint a Radioactive Waste Adviser (RWA) to advise on storage and disposal of radioactive waste. NOTE: The RPA appointed by the university has also been appointed as RWA. For the rest of this document any reference to RPA will also infer RWA.

3.3. Ionising radiation (medical exposure) regulations 2017 (IR(ME)R)

These regulations are designed to protect patients undergoing medical exposures or volunteers involved in a research study. The regulations require that all medical or research exposures are justified i.e. do more good than harm. In research exposures the ‘good’ may be directed at the individual or society. Where work on human subjects takes place as part of a collaboration with the NHS and in these situations the NHS normally takes responsibility for compliance with IR(ME)R (see section 10).

4. Management arrangements and responsibilities for the control of exposures and radioactive materials

Compliance with the laws that cover the use of ionising radiation at work is the responsibility of the employer, in our case the University Court. Heads of Schools (or equivalents) are responsible to the Court through the University's line management structure for ensuring the procedures described in this document are followed within their school (or equivalent).

In turn laboratory supervisors are responsible to the Head of School through the School's line management structure for compliance in their area. Radiation Protection Supervisors (RPS) are appointed (see section 4.1) in each school to oversee the arrangements and to advise the Head of School and laboratory supervisors. The system of audit described in section 8 is a mechanism by which Heads of School can assess compliance within their school and any action that is required.

The Radiation Hazards Sub Committee formulates university wide radiation safety procedures and monitors compliance with those procedures and with the laws relating to radiation safety. This committee is a sub-committee of the University Health and Safety Committee which reports to the Operating Board. The Operating Board reports to the University Court. The sub-committee will be chaired by a senior member of the academic or management staff.

A certified Radiation Protection Advisor (RPA) has been appointed to advise the University on compliance with the regulations. The RPA works closely with the RPSs and is a member of the Radiation Hazards Committee. The RPA oversees a program of audits and reports the findings to the Heads of Schools and the Radiation Hazards Sub Committee. The RPA is available for advice on all aspects of compliance with IRR17 but holds no management responsibilities for the day to day radiation safety.

4.1. Radiation Protection Supervisors

The task of the RPS is to supervise the arrangements summarised in the local rules for each area and to bring them to the attention of all staff affected. In addition to these duties the RPS will assist the Head of School and lab supervisors to implement the arrangements described in this document. The full list of duties is given in appendix 3 but the following should be noted:-

- only employees with sufficient authority within an area should be appointed as an RPS;
- the appointment as an RPS will be made in writing following a recommendation by the Head of School (or Head of Division in the School of Medicine) and approval of the appointment by the RPA;
- new RPSs should attend a RPS training course during the first year of their appointment;
- the RPS will normally be a member of the academic staff with a sound working knowledge of the activities they are covering;

- the RPS has the authority to temporarily suspend the use of ionising radiations in a laboratory if Local Rules are not adhered to;

- the RPS shall will confer directly with the Radiation Protection Adviser on all matters concerning Ionising Radiation;

- some schools may appoint more than one RPS, in such cases, the areas of responsibility of each RPS will be clearly defined when they are appointed and described in the local rules (for example, the particular building for which the RPS will be responsible).

4.2. Responsibilities of Employees/students

The Ionising Radiation Regulations 2017 require that employees who work with ionising radiations:

- shall not knowingly expose themselves or any other person to ionising radiation to an extent greater than is reasonably necessary for the purposes of their work, and shall exercise reasonable care while carrying out such work;

- shall make full and proper use of any personal protective equipment;

- shall forthwith report to their employer any defect they discover in any personal protective equipment;

- shall take all reasonable steps to ensure that personal protective equipment is returned to its storage location.

Individual employees and students, therefore, have a serious responsibility towards themselves and others. They must be certain that they follow the instructions contained in the local rules for their area.

5. General arrangements for Users of radioactive materials

5.1. New uses of radioactive material

New uses of ionising radiation involving radioactive materials should first be discussed with the RPA who will advise on risk assessments and the measures that should be put in place to ensure exposure is minimised. Please note SEPA charges for adjustments to authorisations and the application process takes a minimum of 4 months.

5.2. Becoming a radiation worker

New radiation workers must apply by registering on the University ISO-inventory system. This should only be done with the approval of your Lab supervisor or line manager after having discussed the work you wish to carry out. Consideration must always be given to alternative techniques that do not involve ionising radiation and if practicable MUST always be used in preference.

Instructions for making an application using the iso-inventory system can be found on the radiation protection page of the University Health and safety web site or by clicking the following link:

https://www.abdn.ac.uk/staffnet/working-here/resources-5988.php#ionising-radiation

The application will be processed by the RPS of the school where the work will take place, but before your application is approved you must undertake appropriate training as described in the next section.

5.3. Training

All radiation workers should take the University Radiation Safety Course. This is available online at the following address:-

https://www.abdn.ac.uk/medical/elearning/login/index.php

Once you have completed this course you must undertake additional training specific to your area. This will be coordinated by your supervisor or RPS and must include a familiarisation with your lab, basic laboratory skills, instruction on the use any equipment involved in the work, a discussion of the local rules for the area you will be working in and instruction for contamination monitoring. This training must be documented on your registration form.

5.4. Risk assessments

Risk assessments must be carried out before new work with ionising radiation is started and existing risk assessments should be reviewed at regular intervals. The risk assessment should be used as a tool for assessing the risks that arise from radiation hazards and as a means of documenting control measures that should be adopted.

The radiation risk assessment must address the following:

- an estimate of the dose to workers from routine exposure and accidental exposures;
- measures that should be put in place so that the doses are as low as reasonably practical (e.g. shielding, personal protective equipment etc);
- designation of workers and work areas;
- personal monitoring requirements;
- contingency plans for foreseeable accident scenarios;
- content of local rules.

For much of biological research work using unsealed sources that takes place in the University, the radiation hazards are of similar magnitude. A risk assessment to establish broad protection measures across the University is given in appendix 2. The risk assessment considers activity limits for the use of the standard range of unsealed sources in supervised radiation areas, these limits are summarised in Table 5.1. In areas where sources above the activities listed below are used or that propose to use radionuclides not listed a dedicated assessment will be required

Radionuclide	Limit for use of non-volatile substances	Limit for use of volatile substances in fume cupboard	Addition limits for pregnant workers	Personal monitoring	Bench shield	Syringe/pipette shield
H-3 (Water)	132 GBq	33 GBq	/	/	/	/
H-3 (OBT)	56 GBq	14 GBq	/	/	/	/
C-14	4 GBq	1 GBq	/	/	/	/
S-35	1.8 GBq	450 MBq	/	/	/	/
P-32	100 MBq*	100 MBq*	100 MBq*	Finger dosimeters	>7mm Perspex	>7mm Perspex
P-33	1.7 GBq	420 MBq	340 MBq	/	/	/
I-125	156 MBq	39 MBq	/	Body dosimeters	1mm lead	1mm lead
Ca-45	888 MBq	222 MBq	178MBq	/	/	/

*Limited by external hazard to the fingers

Table 5.1 Summary of finding from risk assessment for general labs

In addition to this assessment each time you order a new radionuclide using the iso-inventory system you will be asked to fill out an on-line risk assessment. This ensures that the protection measures for each experiment are consistent with those described in existing risk assessments. Guidance for filling in the risk assessments for sources orders can be found in the instructions for using the iso inventory system. (https://https://www.abdn.ac.uk/staffnet/documents/ISO_user.pdf).

5.5. Radiation areas

IRR17 requires areas where work with ionising radiation is to take place to be designated according to the level of hazard that results from the work. The risk assessment should be used to determine how an area should be designated.

5.5.1. Controlled areas

In an area where a risk assessment has indicated that either:

- special procedures, specific to the area, need to be followed in order to restrict significant exposure or prevent or limit the probability or magnitude of radiation accidents or their effects; or
- effective doses in excess of 6mSv are likely to be received in a year; or
- equivalent doses in excess of 15mSv a year to the lens of the eye or in excess of 150mSv a year to the skin or extremities are likely to be received;

then that area will be required to be designated as a Controlled Area. Special procedures mean more than just simple commonsense precautions such as working with volatiles in a fume-cupboard or working behind a screen. A risk assessment should consider the special procedures are required to ensure that dose limits are not breached and doses are as low as reasonably practicable.

5.5.2. Supervised areas

Supervised Areas are those where a risk assessment has indicated that effective doses are likely to exceed 1mSv per year and/or that an equivalent dose greater than 5mSv a year to the lens of the eye, or greater than 50mSv a year to the skin or the extremities and/or where working conditions of an area need to be kept under review to ensure that designation as a controlled area is not required. Most areas in the University are supervised areas.

5.5.3. Non designated areas

Areas that do not require designation as either Controlled or Supervised areas, because effective doses to personnel are not likely to exceed 1mSv per annum, shall be referred to as 'non-designated areas'.

5.6. Local rules

Local rules should be in-place for all areas using unsealed radioactive sources and in areas using sealed sources and X-ray equipment where there is a risk of exposure. The local rules are a set of working instructions which if followed will ensure exposures are limited. It is the responsibility of the Head of School to ensure local rules are in place although in practice it is normally the RPS who will draw them up. A template for local rules in given in appendix 4. It is the employer's responsibility to bring the rules to the attention of all staff and students affected by them. **Anyone working with ionising radiation must read and obey the local rules. ASK YOUR RPS OR SUPERVISOR FOR A COPY**

5.7. Personal dose limits and designation of workers

Doses to workers (or students) and the public as the result of work activities are limited by IRR17. The regulations list dose limits for classified workers, non-classified workers and members of the public as shown in Table 5.2. A brief discussion of radiation dose and the difference between effective dose and equivalent dose is given in appendix 1.

A worker must be classified if the risk assessment indicates it is reasonably foreseeable that the worker will receive a dose greater that 6mSv (or 150mSv for skin and extremities or 15mSv to the eye). All classified workers must be subject to dose assessment and medical surveillance and records must be kept. Appendix 7 summarises arrangements for classified workers.

Non classified workers are limited to less than the doses quoted in the paragraph above. A non-classified worker must receive adequate training to understand the risk of the work they are carrying out and how to limited exposure to themselves and others.

Members of the public or employees untrained in radiation protection are limited to annual exposures resulting from work activities of 1mSv effective dose to the body, 15mSv equivalent dose to the lens of the eye, and 50mSv equivalent dose to the skin and extremities.

Dose limit	Effective whole body dose (mSv)	Equivalent dose to the skin (averaged over 1cm^2) (mSv)	Equivalent dose to lens of the eye (mSv)	Equivalent dose Hands, forearms, feet and ankles (mSv)
Classified radiation workers	20	500	20	500
Non classified workers	6	150	15	150
Member of the public	1	50	15	50

Table 5.2 - UK Dose limits

5.8. Pregnant workers and nursing mothers

The Ionising Radiations Regulations 2017 require that once a pregnancy has been declared by the worker, the equivalent dose[2] to the foetus must not exceed 1mSv. Laboratories handling low levels of tritium and carbon-14 provide little, if any, risk to the foetus. Some chemical compounds and some elements in particular are, however, selectively absorbed by a foetus if ingested by the mother, the most significant ones being iodine, phosphorous and calcium. The risk assessment in appendix 2 considers pregnant workers and concludes that additional restrictions are required with work with

[2] See appendix 1 for definitions of equivalent dose.

phosphorous and calcium. If for some reason this is not felt possible, a direct approach to the Radiation Protection Adviser can be made.

Any worker who becomes pregnant should inform the Radiation Protection Supervisor as soon as possible and discuss the situation. It is also the University's policy that anyone who works with any form of ionising radiation and becomes pregnant should be given the option of alternative work. This recommendation would also apply to breast feeding mothers. However if the pregnant or breast feeding woman continues working a risk assessment should be carried out to assess the hazard and additional protection measures that may be required. The RPA can advise.

Arrangements for pregnant and breast feeding females must be summarised in the local rules.

5.9. Personal Monitoring

Personal monitoring can be used to demonstrate that dose limits have not been exceeded and is mandatory for classified workers. For non-classified workers personal monitoring is often used to demonstrate that classification is not required and that dose are kept as low as reasonably practicable. However for much of the work carried in the University (covered be the risk assessment in appendix 2) personal dose monitoring is unnecessary due the very low activity levels used and because many of the commonly used radionuclides used have very low Beta energies that present no external hazard. Table 5.4 below sets out the criteria upon which dosimeters will be issued.

Criteria	Monitoring
Working with radionuclides other than P-32 or I-125 covered by the risk assessment in appendix 2	No monitoring required
Work with P32 covered by appendix 2	Finger dosimeters to be worn and changed monthly
Work with I125 covered by appendix 2	Body dosimeter must be worn and changed every two months
Potential Routine body doses above 0.05mSv/month Potential accident dose above 1mSv	2-monthly body dosimeter
Potential Routine body doses above 0.1mSv/month Pregnancy if advised by RPA	Monthly TLD badge
Potential Routine extremity doses above 1mSv/month	Finger dosimeters

Potential accident dose above 3mSv Situations requiring additional dose scrutiny Pregnancy in some situations	Electronic Personal Dosimeter

Table 5.4 - Personal Monitoring Criteria

If personal dosimeters are issued to member of staff or student then they must be worn when working in radiation areas. Body dosimeters should be worn at waist or chest height. Finger dosimeters should be worn at the base of the middle finger on the appropriate hand (red for left and blue for right). Other types of dosimeter may be issued on the advice of the RPA to monitor other body parts such as legs or eyes, instructions on how to use such devices will be provided if issued.

Each school should ensure that arrangements are in place to issue dosimeters at the start of the wear period and to exchange them at the end of the wear period. These arrangements should be summarised in the local rules.
It is the wearer's responsibility to ensure that their dosimeter is kept in a good condition, any loss or damage should be reported immediately to the RPS and radiation protection service.

The RPS of each area that issued with dosimeters will be sent regular dose reports summarising the doses that have been received by each wearer. This information must be shared with the wearers.

5.10. Dose investigation levels and incident reporting

The regulations require employers to set a dose investigation level for radiation workers (classified or non classified). This is set to a level that would reveal excessive exposure above that expected from the work being undertaken. Dose investigation levels for each area will be stated in the local rules and unless advised otherwise by the RPA will be those listed in table 5.5. If a worker exceeds these levels an investigation will be carried out by the RPS with help from the RPA and reported to the Head of School and the Radiation Hazards Sub Committee. The RPS will receive a form from the Radiation Protection Service indicating the dose. The incident and investigation should be recorded on the form and duplicated on the online university reporting form (http://www.abdn.ac.uk/safety/general/accidents/). The aim of the investigation should be to identify the causes of the incident and recommend changes to local rules and working practices to prevent a reoccurrence.

	Effective whole body dose (mSv)	Equivalent dose to the skin (averaged over <1cm^2) (mSv)	Equivalent dose to lens of the eye (mSv)	Equivalent dose Hands, forearms, feet and ankles (mSv)
Investigation level for non-classified workers - over the wear period of the dosimeter[1]	0.3	7.5	0.3	7.5
Investigation level for Classified Workers - over the wear period of the dosimeter[1]	0.5	13	0.3	13
Investigation level for non-classified workers - over 1 year	0.5	30	25	30
Investigation level for Classified Workers - over 1 year	1	30	25	30

[1]wear period will either 1 or 2 months as directed by RPA

Table 5.5 - UOA dose investigation levels

5.11. Contamination and environmental monitoring

Contamination monitoring is a requirement of IRR17 and a condition of the SEPA authorisation to hold unsealed sources. The purpose of contamination monitoring is to prevent the spread of radioactive material and to ensure that workers are not contaminated. The general procedure and recording forms for contamination monitoring is given in appendix 5. The procedure covers most of the common unsealed radioactive sources including PET radionuclides. **Instructions on how to carry out contamination monitoring must be part of the training to all radiation workers.** In areas where there is an external hazard additional environmental monitoring may be undertaken on the advice of the RPA by the radiation protection service.

5.12. Contingency arrangements

Employers are required by IRR17 to formulate contingency plans for accidents or incidents involving ionising radiation that are reasonably foreseeable. Such incidents will include spills of radioactive material. The risk assessment should be used to consider likely scenarios and any contingency plans required. Contingency plans must be summarised in local rules and it may also be useful to display them in each laboratory. It is the responsibility of the RPS to ensure all staff are familiar with the plans and to ensure plans are practised on a regular basis. If an incident does occur it should be reported without delay to the RPS and RPA. All incidents should be formally reported using the University on-line reporting form that can be found at http://www.abdn.ac.uk/safety/general/accidents/.

6. Purchasing and storing unsealed radioactive sources and disposal of radioactive waste

The Environmental Authorisations (Scotland) Regulations 2018 regulate the holding, storage and disposal of radioactive material. The act requires that detailed records are kept to show that the organisation has not breached the conditions of the authorisation certificate. In the University the iso inventory system is used to control the usage of unsealed sources and generate records. All purchasing, storage, usage and disposal of unsealed radioactive material must be made using the iso inventory system. The only exception to this will be the PET centre where separate arrangements are in place. Full instructions for users on how to use the system can be found in on the radiation protection web page https://www.abdn.ac.uk/safety/resources/radiation/ionising/.

6.1. Purchasing unsealed radioactive materials

Before any material can be ordered users must be registered on the iso system and have carried out a risk assessment for the usage of the source they wish to purchase. All new orders must be entered on the iso system and by doing this a check is made to ensure limits set out in the authorisation are not exceeded when the source is received. If you try to purchase a source that exceeds the authorisation limits then the system will prevent you doing this. Once the system has accepted an order it will assign a source number to the item. The order can then be printed off. Each school must have a system in place, documented in the local rules, for processing orders. Users must always seek permission from the supervisor and or the RPS before an order is placed with a supplier.

6.2. Receiving unsealed radioactive materials

Orders are normally delivered to a central storage area within a school. A system must be put in place for each school to ensure the speedy transfer of radioactive material from the central storage area to a secure storage location. These arrangements must be documented in the local rules. Once a user has received an order they must immediately log it on to the iso inventory system as having been received.

6.3. Storing unsealed radioactive materials

Radioactive material can only be stored in the areas designated for storage by the School's Radiation Protection Supervisor and identified on the iso-inventory system. Stock solutions should be kept in a locked store with controlled access. All storage areas must be suitably marked. Generally, radioactive materials and non-radioactive materials must not be kept in the same storage unit/fridge, however if this is unavoidable then there should be clear demarcation and additional containment for the radioactive items. Advice should be sought from the Radiation Protection Supervisors on the storage of radioactive substances that pose additional hazards e.g. chemical toxicity and flammable liquids.

The dose rate at the surface of the store should be less than 2.5 μSv/h, although up to 7.5 μSv/h may be allowed in controlled or supervised areas. Where access is strictly controlled, dose rates in excess of 7.5 μSv/h are allowed.

6.4. Disposal of radioactive waste

Radioactive waste can only be disposed of according to the conditions of the authorisation certificate issued by SEPA. Currently the University holds authorisation certificates for:

- Foresterhill site
- Old Aberdeen site

The authorisation certificate stipulates the conditions that apply and the waste routes that may be used for each site. A copy of this certificate should be displayed in all areas that dispose of radioactive material.

6.5. Waste minimisation

One of the conditions of the authorisation certificate is that we should seek to minimise the amount of radioactive waste we produce, both in volume and activity. Some the steps that will help to minimise waste are:-

- Techniques that do not use radioactive material should always be used in preference to those that do, unless there is a justifiable reason not to. Justifiable reasons may be that there is no alternative technique or that alternatives are not sensitive enough.

- Never dispose of non-radioactive waste with radioactive waste. If you are unsure check the waste with a suitable contamination monitor. Cans and packaging in which radioactive material has been supplied are not normally contaminated. These should be checked with a suitable monitor and if no contamination is detected treated as non-radioactive waste. Be sure to remove references to radioactivity; for example, the outer labels of cans should be removed or obliterated or otherwise defaced.

- Only take into a syringe or pipette the amount that is to be used. If any is left after dispensing, dispose of it down the sink. Any waste material left in a vial must be washed down the sink before the vial is disposed of. Make the necessary estimate of the activity of the waste which has been disposed of to drains and record it in the IsoInventory system.

- If Benchcote is contaminated, monitor the area which is contaminated, cut it from the rest of the Benchcote and treat only the contaminated portion as radioactive waste.

6.6. Radioactive waste routes

Typically under the authorisation a number of different disposal routes may be allowed as set out below.

6.6.1. Aqueous liquid waste to drain

This is the waste route of choice but should only be used for aqueous liquids if it would be permissible to dispose of the liquid to the drain if it were not radioactive. In practice a large proportion of the radioactive waste produced is disposed of down the plug hole. The advantages of drain disposal is that it is does not cost anything and there is no additional handling. Waste should only be disposed of via labelled designated sinks. Before actually making the disposal you should log the disposal onto the iso inventory system and the system will flag up if you are attempting to dispose of a quantity that would exceed the monthly disposal limits. If larger than normal amounts are to be disposed of, first consult the School's RPS.

6.6.2. Liquid waste accumulation

An alternative to direct disposal to drain when the liquid for disposal is hazardous is to store the liquid in containers for disposal via an authorised contractor. This route is not generally used in the University and can only be used after consultation with the Radiation Protection Adviser.

6.6.3. Gaseous

Gaseous radioactive waste can only be produced after consultation with the Radiation Protection Adviser.

6.6.4. Solid radioactive waste

Solid radioactive waste consists of any items that are contaminated with radioactive material including empty vials, experimental materials, contaminated gloves etc. Within the laboratory waste items should be collected in dedicated bins with a lid. Bins used for radioactive waste must not be used for non-active waste. For Foresterhill and Old Aberdeen sites all solid waste must be transferred to the waste store beside the Institute of Medical Science on the Foresterhill site.

6.6.5. Streaming of radioactive waste

When you make a disposal using the iso inventory system you have choice of routes. As already mentioned the preferred route is the liquid waste to drain. If this is not possible then some labs may be authorised to transfer liquid waste to the waste store in storage containers, most will dispose of the remainder of their waste items as solid waste. All solid waste bags are given a number generated by the iso inventory system.

It is not necessary to separate different radionuclides into to separate bags.

Scintillation waste and vials must be disposed of using a solid plastic bin with a sealable lid to prevent leakage in the waste store.

Once a bag is full it will either be transferred to a local store before being transferred to the main University store or will be transferred directly. Specific arrangements for schools should be summarised in the local rules. When a bag is transferred to a waste store it must be labelled appropriately using the labels shown in Figures

6.2 to 6.4. The total activities of each of the radionuclides are taken from the iso inventory system. If a bag contains more than one radionuclide the activities of each must be stated. When transferring bags to waste store, the transfer must be recorded on the iso inventory system.

6.6.6. Assigning activities to waste

The activity of the waste disposed of to drain or put into waste bags must be entered into the Iso Inventory system as soon as the waste is produced. The on-line risk assessment includes a section for describing the proposed disposal routes for each experiment. Details for measuring or estimating the activity of each waste item should also be included.

Figure 6.1 solid waste streams

SOLID WASTE FOR DISPOSAL **Bag Number……**

SCINTILLATION FLUID must be contained in a sealed container

Radionuclide	^{22}Na	^{32}P	^{33}P	^{35}S	^{36}Cl	^{45}Ca	^{51}Cr
MBq							

Radionuclide	^{125}I	^{3}H	^{14}C				
MBq							

Activity:…… MBq

Date Transferred to waste store: ……..

School: ……Building……..

Laboratory: ……Packed by……..

Figure 6.3 - Label for waste bags

7. Keeping Sealed Radioactive sources

7.1. Definition of a sealed source

A sealed radioactive source is a source with a structure such as to prevent under normal conditions of use dispersion of the radioactive material into the environment. This type of source is normally contained with some form of instrumentation.

Sealed sources will not be listed on the authorisation (unless they are High Activity Sealed Sources (HASS)). The standard conditions for the authorisation state that the total activity of all sealed sources (excluding HASS) must not exceed the limit set down in IAEA "Categorisation of Radioactive Sources" Category 3. **The Radiation Protection Service should be contacted before ordering any sealed source, who will ensure that the requirements of the standard conditions have been met**.

No sealed sources should be ordered without approval from the RPA.

A member of staff must be named who is responsible for the safe keeping of the source. This person will typically be the RPS.

7.2. Storing sources and security

When sources are not in use they should be stored in a secure location such as a locked room or cupboard. The person responsible for the source must ensure that a list of authorised users is drawn up who are allowed access to the source. Arrangements must be put in place for the keeping and issuing of keys to authorised users, these arrangements must be summarised in the local rules and when appropriate the site security plan (see section 7.7). Authorised users must have received training in the safe use of the source or equipment.

The ionising radiation symbol and the word "radioactive" must be displayed at all times at the immediate location where any registered source is kept.

If sources are moved from their designated store then a record must be made of when they are taken, where they have been taken and by whom. Once the source is returned it should be signed back in. If sources are moved regularly then the person responsible for the source must make checks at suitable intervals to ensure all sources are present. These arrangements must be summarised in the local rules.

7.3. University of Aberdeen Sealed Sources inventory

All sealed sources including exempt sources must be recorded on the University sealed source inventory held by the radiation protection service. The inventory will indentify each source by a unique identifier and hold information of the radionuclide, the date the source was purchased, reference activity and current activity. When a new source is received it will be accompanied by a source certificate this certificate should be held

by the person responsible for the source and a copy forwarded to the radiation protection service.

7.4. Labelling of sources

All source containers or equipment containing sources should be suitably labelled. The label must state the unique identifier for the source, the radionuclide, the activity and reference date. If no labels are present or are not visible on the front of the equipment then additional labels as should be displayed. Suitable labels are shown in Figure 7.1 and can be obtained from the Radiation Protection Service.

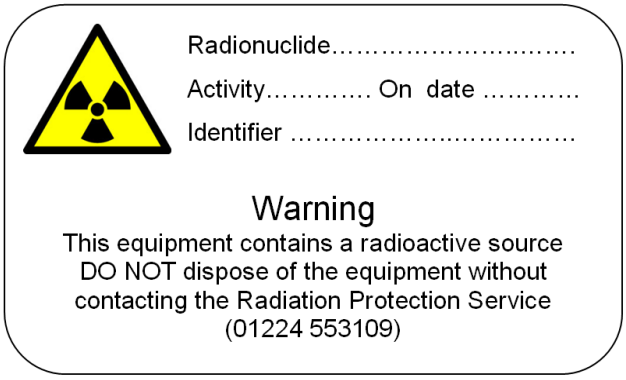

Figure 7.1 – Source label.

7.5. Wipe testing and source inspection

All sealed sources must be wipe tested each year to check the integrity of the source. These tests are carried out by the Radiation Protection Service. Test certificates will be issued and should be retained by the responsible person. The date of the last wipe test is included against each source in on the sealed source inventory.

7.6. Special arrangements for HASS sources

For these sources additional security measure must be put in-place and summarised in a site security plan. The security arrangements will be scrutinised regularly by the Grampian Police Counter Terrorism Security Adviser.

7.7. Disposing of sealed sources

All sources that are not in use and are not likely to be used in the future should be disposed of. Disposal of sealed source can incur significant costs. All disposals will be arranged by the Radiation Protection Adviser.

8. Auditing of radiation safety arrangements

Once health and safety arrangements have been put in place it is important to audit the arrangements at regular intervals to ensure they are being observed and that they are effective. Auditing arrangements are described in appendix 6 and include regular laboratory checks made by the RPS every 4 months and an overview audit carried out by the radiation protection service every two years.

9. Decommissioning of areas where radioactive materials have been used

If work with radioactive materials ceases in an area, then before that area can be returned to normal use it must be decommissioned as a radiation area to ensure all radioactive materials have been removed and the area is free of contamination. An area will need to be decommissioned whenever it is to be put to a different use, is refurbished or demolished. A list of the main occasions when decommission is required is given below:

a) When work with radioactive materials in a dedicated radioactive laboratory ceases and the lab is to be put to a different use.

b) When part of a laboratory that has been used for radioactive work is to be put to a different use.

c) When a radioactive store or other facility closes.

d) When a radioactive lab or part of a lab is to be refurbished, it will need to be temporarily decommissioned before refurbishment can start.

e) When a building that contains laboratories that use radioactive material or where there has been historical usage of radioactive materials during the life of the building, is to be put to a new use, sold or demolished.

f) When a site containing buildings that house or have housed radioactive laboratories, radioactive store rooms or other radioactive facilities or installations is to be vacated.

The form in appendix 8 should be used when part of a whole laboratory, store or other facility is to be decommissioned. The process should be led by the RPS who **must** seek advice from the RPA. The RPA must sign the decommissioning document before the area is released. Notes for carrying out this process are included in appendix 8.

Where a substantial facility such as a building floor, whole building or site is to be decommissioned then a comprehensive decommissioning plan should be prepared. The RPA must be consulted during the preparation of the plan and it would normally be expected that the plan be submitted to SEPA prior to decommissioning work starting. The decommissioning plan should consider who will carry out the decommissioning work; methods for carrying out contamination monitoring and decontamination; and disposal of waste material. To inform the decommissioning plan a characterisation study should first be carried out to assess the extent of any contamination in the facility and to investigate the historical usage of radioactive materials within the facility over its lifetime. The RPA will assist in carrying out this study.

10. Ionising radiation (Medical Exposure) Regulations 2017(IR(ME)R)

The Ionising Radiation (Medical Exposures) Regulations 2017 place controls on all medical radiation exposures, to ensure that they are only carried out when absolutely required and in the safest way possible. The regulations apply to all medical exposures including research exposures.

10.1. Ethical Approval for research exposures

If you are planning research work which will involve exposing patients or volunteers to ionising radiation please note that such work can only proceed once it has been granted approval by a Research Ethics Committee. The application to the ethics committee must be made through the Integrated Research Application System (IRAS, https://www.myresearchproject.org.uk/). As part of the application you will need assistance from Medical Physics Expert (MPE) and Clinical Radiation Expert.

10.2. Justification and Optimisation

IR(ME)R requires that all medical and exposures must be **justified** – i.e. the benefits to be obtained from the exposure must outweigh the risks introduced by the exposure. For research exposures the benefits may include benefits to society rather than to an individual and it is up to the ethics committee to assess these benefits and compare them to the risks.

IR(ME)R also requires that the dose are optimised and kept to a level **As Low As Reasonably Practicable** (ALARP) consistent with the intended purpose.

10.3. Duty holders

Responsibilities under IR(ME)R are shared between a number of duty holders: the employer, the referrer, the practitioner and the operator.

10.3.1. The **Employer** is responsible for ensuring compliance with the regulations,

10.3.2. A ***Referrer*** is any registered healthcare professional who is entitled by the employer to refer an individual for a medical exposure. Referrers are responsible for supplying the practitioner and operator with information to identify the patient or volunteer; and relevant information so that the exposure can be justified.

10.3.3. **Practitioner**s are defined as any registered healthcare professional who is entitled by the employer to take clinical responsibility for an individual medical exposure. Practitioners must have received sufficient training and be competent to justify a procedure for a particular patient.

10.3.4. An **operator** is any person who is entitled by the employer to carry out any practical aspect associated with a medical exposure. Operator duties include identifying the patient, making an x-ray exposure, carrying out a clinical evaluation etc.

10.3.5. A **Medical Physics Expert (MPE)** is a person having the knowledge, training and experience to act or give advice on matters relating to radiation physics applied to exposure and who is listed on the MPE register held by RPA2000. The MPE should be consulted on risk assessment for ethics application, selection of equipment, optimising doses and quality assurance.

10.4. Written procedures and documentation

IR(ME)R requires an employer to create and maintain written procedures describing the arrangements for compliance. These procedures must include provisions for identifying and entitling duty holders, identifying patients/volunteers, document control, dose and clinical audit, incident investigation, dose assessment, risk communication, equipment QA, carers and comforters, and enquiries for pregnant patients/volunteers.

There must also be documentation in place to define and record training and for conferring the status of duty holders following an assessment for competence.

Implementing the arrangements for complying with IR(ME)R can be complex and you must also seek advice from the Radiation Protection Service.

11. X-ray equipment

The University owns and has control of a number of pieces of equipment that generate X-rays. Due to the hazard from ionising radiation this equipment must be assessed. In many cases the equipment is self-shielded and requires no more than regular maintenance, in other cases we will need to carry out extensive risk assessments and put in place local rules, designated controlled areas and specific training.

Each piece of equipment will be assessed by the Radiation Protection Service and the findings of the assessment will be recorded on the X-ray Equipment assessment form4 given in appendix 9. The form will be issued to the relevant authority in the School and copied to the Health and Safety Advisers.

12. Contacts

Radiation Protection Supervisors – from May 2021

IMS Building

Dr Isabel Crane	IMS lead RPS
Dr Ian Fleming	
Dr Fiona Murray	

MRF

Andrew Brown

Rowett Institute of Nutrition and Health

Ms Dana Wilson	Rowett Institute for Nutrition and Health
Mrs L Thomson	Rowett Institute for Nutrition and Health (Deputy to Dana Wilson)
Mrs Sylvia Stephen	Rowett Institute for Nutrition and Health

Other locations

Mr Gary Cameron	Polwarth Building
Dr Lenka Mbadugha	School of Biological Sciences – Cruickshank Building
Dr Stephen Bowden	Geosciences – Meston Building
Dr William Harrison	Chemistry - Meston Building
Caroline Dempsey	Marischal College

Radiation Protection Service

Dr Stephen McCallum, Radiation Protection Advisor
Tel 553109 email stephen.mccallum@nhs.scot

Claire Redford, Chief Technologist
Lynsey McKay, Senior Clinical scientist
Rebecca Duguid, Senior Clinical scientist
Nadia Latif, Clinical Scientist (for non-ionising)

For URGENT enquires only call 01224 559049
For general enquires email gram.radiationproection@nhs.scot or call 01224 559491

Emergency response for radiation incident
Contact NHS Grampian switch board on **0345 456 6000**