



This Policy Standard states University policy to ensure the safety of staff, students, contractors and any other personnel who may be exposed to open sources of ionising radiation. It details how the University manages the use of open sources in order to protect both personnel and the environment.

The requirements of this Policy must be followed by all Colleges and Departments handling open sources of ionising radiation, in addition to all guidance given by the University's Radiation Protection Advisor (RPA), Radiation Waste Advisor (RWA) and Radiation Protection Officer (RPO).

The Policy Standard states duties and responsibilities of the University and its Colleges, Departments, staff, students and maintenance personnel.

The document applies to:

- *Each College and Department.*
- *Staff, students and maintenance personnel.*
- *All open sources of ionising radiation.*

The document does not apply to:

- *Radon**
- *X-Rays**
- *Sealed sources of ionising radiation*

**These are dealt with by other specific Policy Standards.*

Date of Implementation: 1st April 2010 (amended June 2012)

POLICY STATEMENT

It is the policy of Bangor University, so far as is reasonably practicable, but in accordance with the relevant legislation, statutory requirements and good practice, to ensure the health and safety of staff, students and visitors to the University.

1. INTRODUCTION

This document describes Bangor University's Policy for ensuring the safety of staff, students, contractors and any other personnel who may be exposed to sources of ionising radiation. It details how the protection of personnel and the environment against ionising radiation are managed by Bangor University.

By law the University must ensure that:

- Procedures and protocols are in place to ensure all statutory duties are discharged.
- Radiation doses achieved are as low as reasonably practicable (ALARP).

Section 2 contains the formal *Ionising Radiation Policy Statement*.

It is the duty of all employees, students, contractors and visitors to comply with all aspects of local rules and other health and safety documents relevant to the area they are working in (or entering). Section 3 identifies responsibilities for delivering the environmental and health and safety commitments and outlines the specific duties of 'responsible persons'.

The main relevant legislative articles / Bangor University documents that affect the use of Ionising Radiation at the University are:

- Environmental Permitting Regulations (EPR2010) 2010.
- The Ionising Radiations Regulations (IRR) 1999.
- Work With Ionising Radiations (IRR 99) ACOP L121.
- Bangor University Policies and Local Rules.

NOTE: The Standard does not apply to:

- Radon.
- X-Rays.
- Sealed sources of ionising radiation.

Terminology

When this Policy Standard refers to the Ionising Regulations, this refers to the use of 'open sources' of radiation only.

- **'Open Source':** *Is a source of Ionising Radiation in the form of a radioactive material which is not encapsulated or otherwise contained. This means the open radioactive material can move around and if uncontrolled would lead to contamination.*
- **'ALARP':** *As Low As is Reasonably Practicable.*

2. IONISING RADIATION POLICY STATEMENT

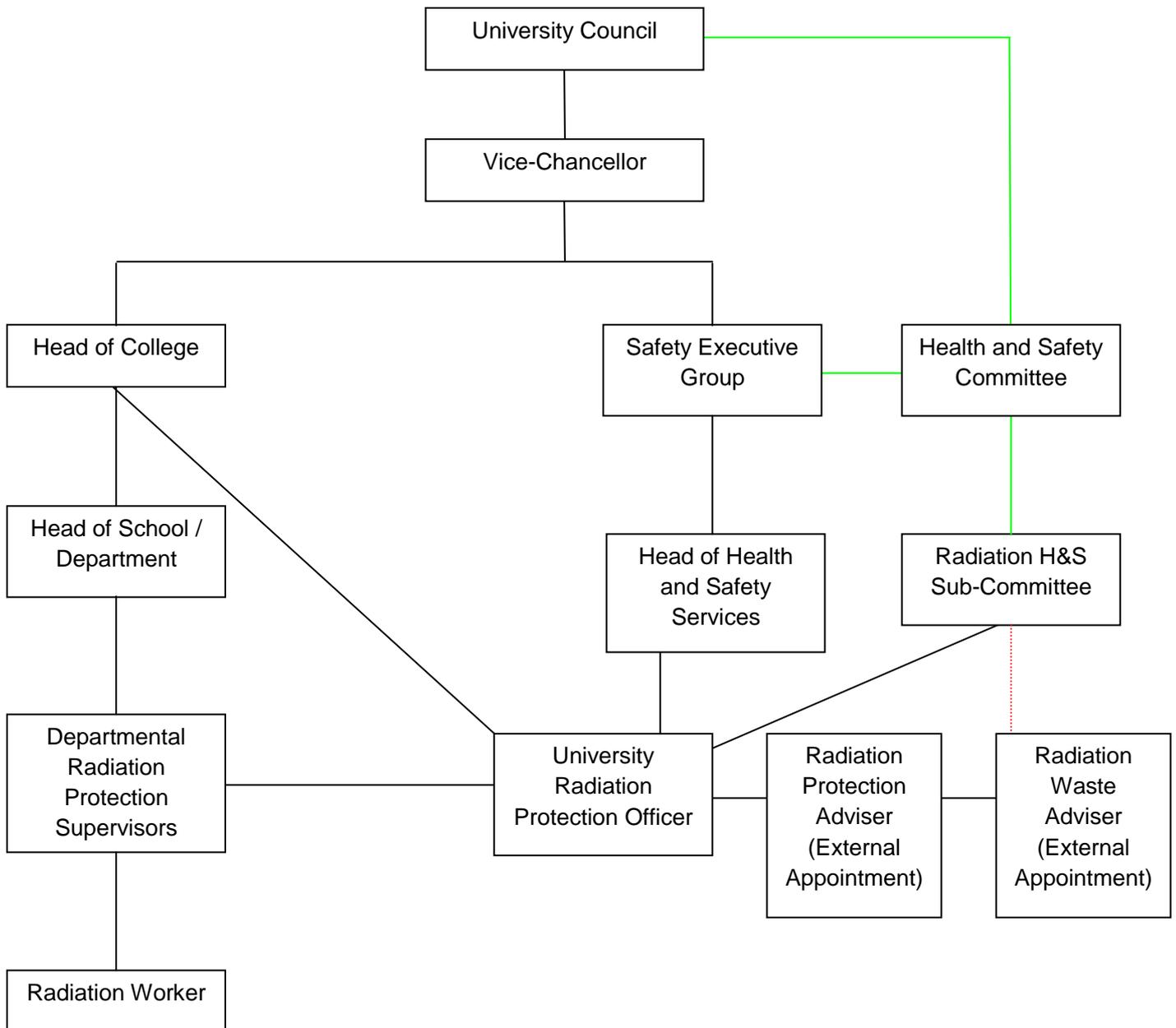
Bangor University is committed to the effective management of ionising radiation. The ALARP principle is applied to all radiation work to ensure employees, students, contractors, visitors and the environment is protected. To ensure doses are ALARP the following controls will be implemented:

- 2.1 The University will comply with the standard conditions issued by the Environment Agencies authorisations to accumulate and dispose of radioactive waste, and in particular will apply “best practicable means” for all work carried out.
- 2.2 All work will be carried out in accordance with relevant legislation, in particular:
 - The Ionising Radiation Regulations 1999 and its supporting ACOP and guidance.
 - Environmental Permitting Regulations (EPR2010) 2010.
 - Overall responsibility for effective protection against radiation on site lies with the University Council. At the operational level, the Head of College is responsible for radiation protection within his/her area of responsibility.
- 2.3 Where appropriate, a Radiation Protection Advisor (RPA) will be consulted to provide advice to the University on all work with ionising radiation.
- 2.4 The University will appoint a ‘*Qualified Expert*’, Radioactive Waste Adviser (RWA) who will be consulted as necessary to achieve and maintain an optimal level of protection of the environment and population.
- 2.5 The University will appoint a Radiation Protection Officer (RPO) to oversee the University’s Radiation Protection Supervisors (RPSs).
- 2.6 The RPSs will oversee, on a day to day basis work with ionising radiation within their areas of responsibility. RPSs are named in the appropriate local rules document.
- 2.7 In each location where ionising radiation is used, local rules, approved by the RPA, will detail arrangements to achieve radiation protection of employees, students, contractors and visitors.
- 2.8 All new research or teaching, involving the use of ionising radiation, will be subject to a prior risk assessment to justify its use, identify measures needed to restrict exposure to individuals and any contingency arrangements needed to manage foreseeable accidents and incidents.
- 2.9 The Radiation Health and Safety Sub-Committee will provide advice to senior management to ensure the safe use of ionising radiation. The Committee meets twice a year and in turn reports to the University Health and Safety Committee that meets three times a year.

Date:

3. ORGANISATION

UNIVERSITY ORGANISATION CHART - RADIATION PROTECTION



4. ROLES AND RESPONSIBILITIES

The University will appoint the following to ensure compliance with all relevant legislation, and in order to protect the health and safety of its students, staff and visitors:

University Health and Safety Committee

The University Health and Safety Committee meets three times per year and is attended by members of the University Executive, University Council and Trades Union representatives.

The Committee receives and acts on reports from various specialist sub-Committees including the Radiation Health and Safety Sub-Committee, and is the route by which all health and safety issues are channelled to the Employer (University Council).

Radiation Health and Safety Sub-Committee

The Radiation Health and Safety Sub-Committee which includes the RPA, RPO and RPSs meet twice a year to discuss, monitor and examine radiological issues affecting the University and to update on potential or impending changes to legislation.

Head of College

Heads of College are responsible for the implementation of the Ionising Radiation Policy and the (as identified by the RPA and RPO) Local Rules. The Head of College, with guidance from the RPO and RPA shall nominate a suitably qualified and trained member of staff to manage radiation safety on a daily basis i.e. Radiation Protection Supervisors. The Head of College must also be satisfied that all relevant staff and students within their area of responsibility are aware of the University's rules and requirements regarding the management of open sources of ionising radiation.

Radiation Protection Advisor (RPA)

In accordance with the Ionising Radiation Regulation 1999, the University has appointed a Radiation Protection Advisor (RPA). The RPA, who is an external consultant, shall advise University management of all aspects of the use of ionising radiation and radioactive substances relating to the health and safety of workers, including the designation of workers and the classification of controlled areas. The RPA's responsibilities include:

- Implementation of requirements relating to Controlled and Supervised Areas.
- Prior examination of plans for installations and the acceptance into service of new or modified sources of ionising radiation in relation to any engineering controls, design features, safety features and warning devices.
- Regular checking of work systems provided to restrict exposure to ionising radiation.
- Annual calibration of radiation monitoring equipment and ensuring such equipment is serviceable and correctly used.
- Periodic examination and testing of engineering controls, design features, safety features, and warning devices and regular checking of systems of work to restrict exposure to ionising radiation.

The RPA will also be consulted in relation to:

- Prior Risk Assessments.
- The conduct of various investigations required by IRR 99.
- The drawing up of contingency plans.
- Dose assessments and required records.

Radiation Waste Adviser (RWA)

The environment agencies of England, Wales, Scotland and Northern Ireland require the permit holder to consult a Radioactive Waste Adviser on the following matters and have due regard to the advice provided by the Radioactive Waste Adviser:

- Achieving and maintaining an optimal level of protection of the environment and the population.
- Checking the effectiveness of technical devices for protecting the environment and the population.
- Acceptance into service, from the point of view of surveillance of radiation protection, or equipment and procedures for measuring and assessing, as appropriate, exposure and radioactive contamination of the environment and the population.
- Regular calibration of measuring instruments and regular checking that they are serviceable and correctly used.

Radiation Protection Officer (RPO)

To ensure the requirements of the Ionising Radiation Regulations and the Environmental Permitting Regulations are met, the University has appointed a Radiation Protection Officer (RPO) to provide guidance and support. In addition, the RPO will provide support and co-ordinate with both the RPA and the RPS's on ionising radiation issues.

Radiation Protection Supervisors (RPS)

As required by the IRR99, the University will appoint Radiation Protection Supervisors in all Colleges using ionising radiation to provide an adequate level of day-to-day supervision for all radiation work.

Persons appointed to the role of RPS should be suitably competent through their knowledge, ability, training and experience to carry out this role. The RPO and RPA will make recommendations to the Head of College as to the suitability of potential / proposed RPS's. Each RPS must be appointed in writing by their Head of College and will:

- Know and understand the requirements of the IRR99 and relevant Local Rules.
- Command sufficient authority from radiation workers to allow them to supervise the radiation protection aspects of their work.
- Understand the necessary precautions to be taken and the extent to which these precautions restrict exposure.
- Know what action to take in an emergency.

RPS's will also assume responsibility as competent persons under EPR2010 except where work with electrically generated x-rays is the only ionising radiation source use.

Radiation Worker

Radiation workers have a legal responsibility to protect both themselves and others from any hazard arising from their work and must not expose themselves or others to ionising radiation more than is reasonably necessary for the purpose of their work. They must also make full use of all protective equipment provided for their safety and dosimeters, reporting all defects immediately to the RPS.

As documented below, training will be provided to all new radiation workers. Before starting work with ionising radiations, radiation workers must receive a copy of the Local Rules for the area they will be working in, and which they must familiarise themselves with before training.

Maintenance Engineers

Maintenance personnel carrying out any maintenance/repairs to equipment in Designated Areas must be authorised and supervised by the RPS or RPO.

5. TRAINING AND INFORMATION

New Radiation Workers

To become registered as a University Radiation Worker, all radiation workers must receive the following training.

The RPO will provide EPR2010, IRR99 and University Health and Safety Policy training to all new workers and maintain a record of such training. Following this awareness training the RPS will provide practical training, including both method and local rules training and maintain a record of this. The RPO / RPA will periodically audit the RPS's training methods.

RPS(s)

Prior to appointment, all RPS's will be required to attend a 1 day site based RPS training course run by the RPA. Refresher training should be attended at least every 5 years.

Maintenance Engineers

The local RPS will provide job awareness training which covers the hazards and risks to maintenance engineers before they are permitted access to radiological areas.

Records of Training

Records of training are kept by the RPO. Records of unsealed source user training are maintained on the radiation data base.

Local Rules and other Information

Local Rules are a legal requirement for Controlled and if applicable, Supervised Areas and are designed to ensure all exposures to ionising radiation are kept to as low as is reasonably practicable. Local Rules reflect good practice, and are the cornerstone in ensuring compliance

with IRR99 and EPR2010. As such the University issues Local Rules (produced by the RPO and RPA) for all Designated Areas.

Radiation workers are informed and instructed about all Local Rules relevant to their work, and which are also available in each Designated Area.

6. PLANNING AND IMPLEMENTATION

Risk Assessments – General and Equipment

Radiation workers must complete a risk assessment before commencing any new work activity involving ionising radiation.

The risk assessment must identify the hazards and evaluate the nature / magnitude of the risks to which workers and others could be subjected. In addition, it should take account of both normal operating conditions and realistic foreseeable accidents and incidents. Where an accident / incident is reasonably foreseeable a contingency plan must be detailed in the Local Rules and all radiation workers trained in implementing the contingency plan.

Installation of X-ray Equipment / Sealed Sources

See specific Policy Standard.

Reporting of Incidents

Major incidents such as contamination of persons, spillage of stock material, contamination spread outside the work area, failure of sealed source engineering controls etc must be reported immediately to the RPS and then the RPO.

The RPO (with assistance from the RPA) will be responsible for investigating the incident, acting on the results of the investigation and preparing a report for the RPA and Senior Management. The RPO, with guidance from the RPA, will determine if the incident is notifiable to the regulator/s (EA, HSE) and the Police.

Notification of Certain Occurrences

The release to atmosphere or spillage of a quantity of radioactive material in excess of specified amounts must be reported immediately to the RPS then the RPO and RPA. The RPO will inform Senior Management, and the RPO (or RPA) will notify the Health and Safety Executive and Environment Agency immediately and commence an investigation.

If there is reason to believe a radioactive substance has been lost or stolen the RPO and RPA must be informed immediately, and after further investigation must inform the HSE, EA and Police immediately.

7. AUDITS

This Radiation Management System will be audited by the RPA on an annual basis with the formal report and any remedial actions required sent to the RPO for implementation.

Policy Standard Ends.



**BANGOR UNIVERSITY
IONISING RADIATION (OPEN SOURCES)
MANAGEMENT SYSTEM**

1. STATEMENT ON BEST AVAILABLE TECHNIQUE (BAT)

The University's EA authorisations to accumulate and dispose of radioactive waste, issued under the Environmental Permitting Regulations requires the use of BAT to:

- The use of alternative materials, other than radioactive sources where possible.
- Minimise waste arising from the activity.
- Minimise the volume of waste transferred off site.
- Minimise the radiological effects on the environment and the public.
- Maintain in good repair the systems and equipment provided.
- Checking of the effectiveness of the systems, equipment and procedures provided.

The University's Radiological Impact Assessments associated with the license AI3330/CB3586 (Science Site) and BS8222/BS8222 (School of Ocean Sciences) have indicated that the dose to the public from the discharges from each site is significantly below 20 $\mu\text{Sv/y}$. This assessment was based on:

- i. Disposing of the maximum activity permitted per month.
- ii. The activity disposed of being the same isotope which has the highest ingestion dose coefficient.

The procedures given below are necessary to ensure the University continues to minimise the radiological effects on the environment and the public from the use of ^3H , ^{14}C , ^{32}P , ^{33}P and ^{125}I . This BAT statement relates to the use of open source radionuclides only.

1.1 Justification and Optimisation of the Use of Radioactive Material

Researchers in the School of the Environment, Natural Resources and Geography, School of Biological Sciences and School of Ocean Sciences (all part of the College of Natural Sciences) periodically conduct biological research involving the use of radio labelled compounds. This research is essential in the understanding of biological systems at the ecosystem, organism and cellular level.

Levels of radioactivity will be selected which are as low as possible, but still allow detection of metabolites and residues in the test systems. The radioactive material used in experiments will be kept as low as possible, in order to reduce the amount of waste produced.

1.2 Assessment to demonstrate Optimisation of Radiation Waste Production and Disposal Procedures

Waste is generated from plant, fish, soil and other biological research. A significant amount of the radioactivity used in this research is associated with activity balance work where known amounts of radioactivity are administered to test systems, e.g. soil is routinely collected and analysed to check overall recovery of radioactivity.

Routes available for disposal of such waste are detailed in the current Certificate of Authorisation for the Accumulation and Disposal of Radioactive Waste.

Currently the accumulation routes available on the Science Site and the School of Oceans Sciences are:

1. Organic liquid waste
2. Solid waste
3. Very low level waste
4. Aqueous waste (only on the Science site - ^3H only)

The disposal routes available on each site are:

1. Aqueous waste
2. Organic liquid waste
3. Solid waste
4. Very low level waste

These are summarised in Figure 1.

The disposal route used, where several are available, will be largely dictated by the radioisotope, the chemical form it is present in and the Best Available Technique (BAT). These are summarized for each research group below:

1) ^{32}P - use in Cancer Research within the School of Biological Sciences

The best practicable environment option is to accumulate all ^{32}P wastes up to 6 months so activity levels reduce to <0.015% of the original. Waste should then be disposed of as VLLW to landfill. Approximately 30% of the ^{32}P waste produced in an assay is in the aqueous form and because accumulation of aqueous ^{32}P waste is not authorised and there are significant negative health & safety implications for solidification of this waste, all aqueous ^{32}P waste are immediately disposed to drains via a designated sink. The remaining 70% of the waste produced is in the solid form and is accumulated for decay storage and subsequent VLLW disposal.

2) ^3H - School of Ocean Sciences

Tritium is used to determine protein synthesis rates in fish. Tritiated amino acids are injected into fish and the proportion of tritium incorporated into protein measured. The process produces (90%) aqueous waste and since accumulation of aqueous waste is not authorized and there are significant negative health and safety risks for the solidification of this waste all aqueous tritium waste is immediately disposed to drains via a designated sink. Liquid scintillation counting produces organic waste (1%) which is incinerated via the licenced waste contractor. The fish carcasses are disposed of as VLLW (9%).

3) ^{14}C / ^{33}P – SENR

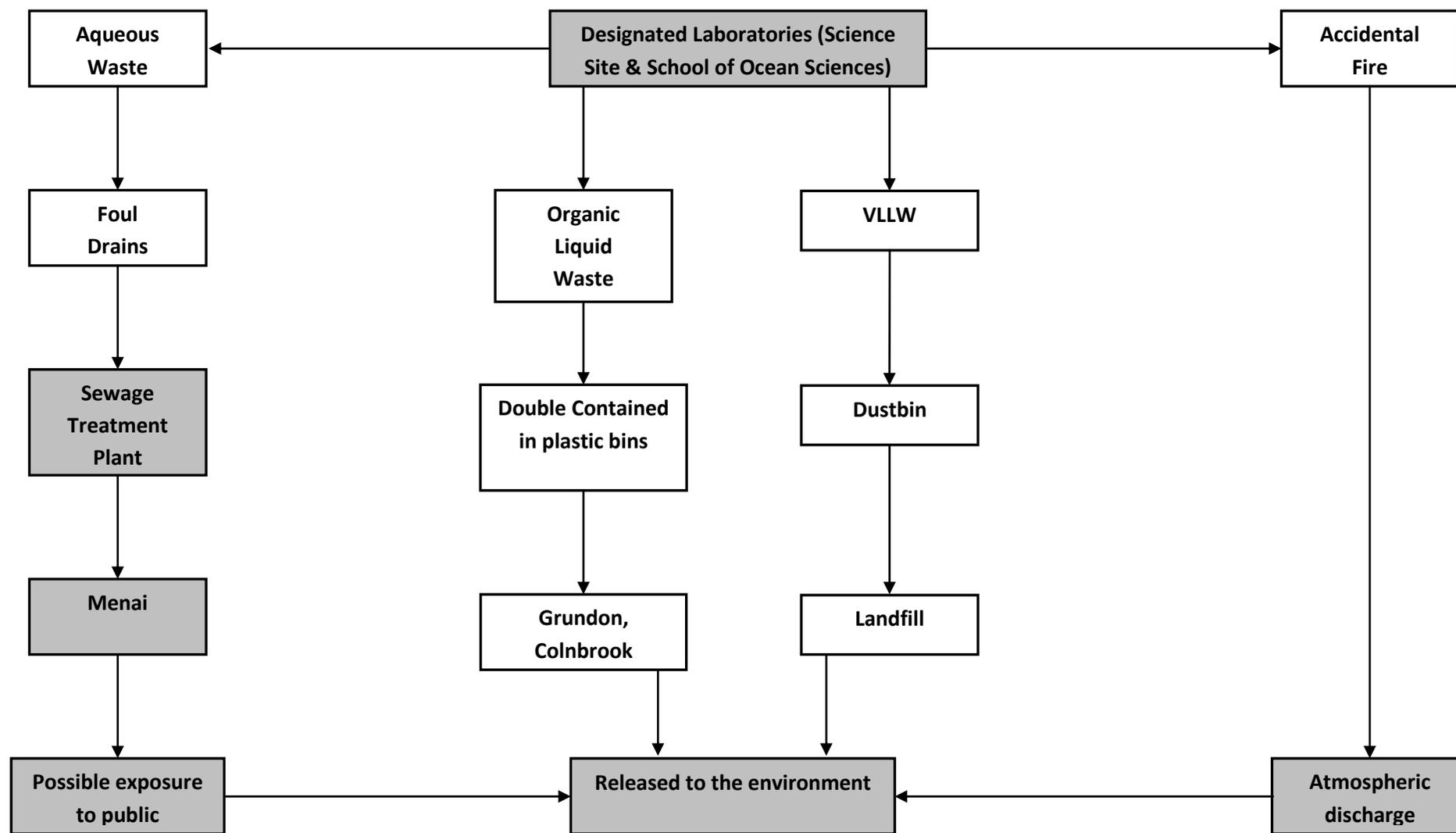
Radionuclides are used in SENRGY to determine respiration rates in soil samples. Very small amounts of radioactive material are used to spike the soil such that contaminated soil can be safely disposed of as VLLW(50%). Carbon dioxide given off as a product of respiration is chemically trapped producing aqueous waste (20%) and because accumulation of aqueous ^{33}P and ^{14}C waste is not authorised and there are significant negative health & safety implications for solidification of this waste all aqueous waste is disposed of immediately to drains via a designated sink. Liquid

scintillation counting produces organic waste (30%) which is incinerated via the licenced waste contractor.

4) ^{125}I – School of Biological Sciences

Iodinations produce approximately 30% solid waste and 70% aqueous waste. The solid waste is accumulated for decay storage and subsequent VLLW disposal. The aqueous waste is disposed of to drains immediately via a designated since accumulation of liquid waste is not permitted and there are substantial health and safety risks associated with solidifying the waste.

Figure 1 Routes for the Disposal of Radioactive Substances



1.3 Source Acquisition

- 1) The University's registration limits are apportioned between research groups / laboratories such that if the maximum activity is held within each research group / laboratories then the license limit is not exceeded.
- 2) The RPS will ensure minimal quantities of radioactivity are ordered, to cover use in experiments.
- 3) Only the relevant RPS may order a new unsealed source; the RPO is notified when the source is ordered.
- 4) The RPSs maintain current lists of unsealed sources held in their radiation work area department.
- 5) The RPS will produce a unique record sheet for each source for completion by the end user for each source use.

1.4 Storage

- 1) All radiochemical stocks are stored in designated laboratories only.
- 2) Access to these laboratories is restricted to authorised radiation workers only.
- 3) Shielded containers are used for hard beta and gamma sources.
- 4) Regular contamination monitoring of source storage areas is conducted (organised by RPS).

1.5 Use of Radiochemicals

- 1) Risk assessments of new procedures are performed, and the risk assessment approved by the RPS and RPO before the start of any work.
- 2) Experiments using radioactivity are miniaturised wherever possible, to reduce usage, waste volumes and activity.
- 3) Stock levels and location are recorded on a paper copy at the point of storage, removal of stock for experiments is recorded at the time of use.
- 4) A summary of stock holdings is provided to the RPO monthly.
- 5) Use of stocks is monitored by the Radiation Protection Supervisor.
- 6) All radioactive work is performed in spill trays (or on Benchcote) in designated areas, and behind appropriate shielding (when using hard beta and gamma sources).
- 7) Monitoring for contamination of designated radioactive work areas is performed immediately after use.

1.6 Waste Production & Accumulation

- 1) The University's authorisation limits are apportioned between research group / laboratories such that if the maximum activity is held within each research group / laboratories then the license limit is not exceeded.
- 2) Aqueous waste is not accumulated.
- 3) ^3H & ^{14}C solid and organic liquid waste is stored double contained in one way burn bins provided by the waste contractor. A record of the inventory of waste inside each bin and its

storage location is maintained by the RPS and provided to the RPO monthly. When full each bin is sealed and stored within the designated area prior to collection.

- 4) ^{125}I and ^{32}P solid waste is double contained inside shielded containers for the time required for the activity to decay to below VLLW waste limits. Each waste bag is labeled with a unique ID and the waste production date so that it is clear at any one time which bags can be disposed as VLLW. This waste is stored for up to 6 months before disposal as VLLW (see below).
- 5) Waste storage areas area will be monitored for contamination as part of the routine laboratory survey.
- 6) The RPS provides a summary of the waste accumulated in each designated area to the RPO each month.

1.7 **Waste Disposal**

- 1) The University's authorisation limits are apportioned between research group / laboratories such that if the maximum activity is disposed within each research group / laboratories then the license limits are not exceeded.
- 2) ^3H and ^{14}C solid and organic liquid wastes are collected six monthly by Grundon Waste Management. It is Grundon policy to collect only waste hermetically sealed in plastic one-way burn bins. The RPO/RPA completes the Grundon declaration form using the information provided by the RPSs. The RPO is the point of contact to the Grundon driver and assists with collection.
- 3) Aqueous waste is disposed of immediately to the designated disposal sink and a record made on the source stock sheet. Designated disposal sinks and surrounding areas are monitored for contamination immediately after disposal (after flushing with water or decon).
- 4) Decay stored ^{32}P and ^{125}I wastes and other laboratory items such as gloves tissues, benchcote etc are monitored and then disposed of into black polythene bags in designated radiation laboratories. These are taken to outside wheelie bins which are collected weekly by the University's waste contractor.

1.8 **Records**

The paper based record system provides a unique record sheet for each stock item held on site. The record keeping system requires each radiation worker (end-user) to enter stock use and waste production / disposal activity on the form immediately. The RPS is responsible for routinely checking these records, collating this information and providing a summary to the RPO on a monthly basis.

During 2009 / 2010 the University will be installing an electronic system which will replace the paper based system.

1.9 **Maintaining Best Practice**

- 1) The University RPA is to be notified by the RPO of a researcher's intention to begin work with a radionuclide not covered by this BAT document or when a significant increase in activity is proposed. The RPO, RPA and RPS will assess the methodology provided and advise on stock use and waste production, accumulation and disposal so as to maintain best practice. This document will then be amended.

- 2) The RPO / RPA will meet to discuss continuing best practice at least annually and these discussions will be summarised in the RPA report
- 3) A formal review of this document will take place every two years.