UNIVERSITY OF AUCKLAND
RADIATION SAFETY PLAN

Version 15 – September 2019

CONTENTS

Fundamental Requirements

The following Fundamental Requirements apply to all ionising radiation sources (ie unsealed, sealed radioisotope or irradiating apparatus) used and stored in the University of Auckland

A. Any use of a radiation source must:

1. Ensure the expected benefits to people and society outweigh the risk of harm to people and the environment.

2. Observe ALARA principles

3. Ensure that exposure that results from a planned operation or activity does not exceed that set for Members of the Public as set out in ICRP 103 (i.e. no more than 1 mSv per annum).

B. Radiation sources must be fit for intended purpose and safe use.

C. Radiation sources must be used and stored to:

1. Ensure that the sources are secure from unauthorised use or removal.

2. Ensure safe placement and containment of the radiation source at all times.

3. Minimise the likelihood of any accident, incident, or emergency

D. Security of sources is paramount. For all radiation sources there must be appropriate security measures in place to prevent:

1. Unauthorised access to the radiation source.

2. Loss, theft or sabotage of the radiation source.

3. Unauthorised use of the radiation source (i.e. use must have received prior approval from the Responsible Principal Investigator)

4. Unauthorised transfer or unauthorised removal of the radiation source:

1. UNIVERSITY OF AUCKLAND RADIATION SAFETY PLAN

Introduction

1. The University of Auckland acknowledges that radioactive material and irradiating equipment are an important and invaluable tool in education and research within the University.

2. The University reaffirms the roles and responsibilities laid out in the University of Auckland Health and Safety Policy will also apply to the safe use, storage, transport, security and disposal of all radionuclides and irradiation equipment.

3. The requirements of this Radiation Safety Plan are a means by which University of Auckland Health and Safety Policy is fulfilled with regard to ionising radiation

4. The University affirms that Fundamental Requirements of Radiation Safety (which are also laid out in sections 9-12 of the Radiation Safety Act) will be observed for all radiation sources (regardless of statutory status).

5. The requirements of this Radiation Safety Plan are a means by which the Fundamental Requirements of Radiation Safety will be observed in the University of Auckland

Implementation of the Radiation Safety Plan

1. The purchase or acquisition of radionuclides (both sealed and unsealed) material and irradiating equipment by University of Auckland staff will only be undertaken by named Responsible Principal Investigators approved by Dean of that Faculty.

2. It is the primary responsibility of Responsible Principal Investigators and staff to ensure safe use, storage, transport and disposal of radionuclides as laid out in this Radiation Safety Plan.

3. Responsible Principal Investigators must meet the statutory requirements of the Radiation Safety Act, Radiation Safety Regulations and Codes of Safe Practice promulgated by the Office of Radiation Safety and are accountable to their Deans and ultimately to the Vice Chancellor.

4. Responsible Principal Investigators must ensure that they are able to provide adequate supervision and instruction of staff and students using radionuclides or irradiating equipment. To do this the Responsible Principal Investigators must nominate all users of radionuclides and irradiating equipment and ensure that they are adequately trained in safe use. Training and Competency may be recorded in Canvas.

5. Responsible Principal Investigators will also ensure that risk of incurring exposure from any isotopic source or irradiating equipment is kept As Low As Reasonably Achievable (ALARA)

6. The University will assist Responsible Principal Investigators by providing training collateral to enable safe use of radionuclides and irradiating equipment and, where appropriate, ALARA principals are adopted.

7. The University will maintain an accurate inventory of all radioactive sources. In order to maintain this inventory Responsible Principal Investigators must purchase all radioactive sources through University procurement systems and in order to fulfil statutory reporting requirements Responsible Principal Investigators must report the acquisition of such sources in a timely manner to the Hazards and Containment Manager.

8. The University will ensure that its responsibilities with regard to irradiating equipment as well as sealed and unsealed radio-isotopic sources are met by the establishment of:
   a) Internal verification and reporting systems.
   b) A radiation safety training system
   c) Systems for document retention
   d) Management oversight of radionuclide work

9. As line managers for their respective areas, Deans and Heads of Department are an integral part of the management of safe use of radionuclides. The Deans, Heads of Department and Hazards and Containment Manager will work with Responsible Principal Investigators to ensure that all users of radionuclides are aware and follow statutory obligations, IAEA protocols, Office of Radiation Safety (ORS) Codes of Safe Practice and the University of Auckland Radiation Safety Plan.

Roles and Responsibilities

A. Vice Chancellor's Office

1. In conjunction with Responsible Principal Investigators, University/Faculty Administration will provide overall management oversight on the safe use of radionuclides in their respective areas of responsibility and satisfy themselves that statutory obligations with regard to purchase, use, storage and disposal of radionuclides as well as irradiating equipment have been fulfilled. To this end Deans and the Deputy Vice Chancellor (Research) will receive annual verification reports from the Hazards and Containment Manager.

2. Will direct the Hazards and Containment Manager and the University Health and Safety Coordinator to disseminate information and ensure all

Responsible Principal Investigators are fully informed of all developments with regard to policy.

3. Will direct the Hazards and Containment Manager to conduct annual verification visits to ensure that provisions of the Radiation Safety Plan are being met.

4. Will direct that appropriate courses/training materials in the safe handling of radioactive materials/irradiating equipment are made available.

5. Where Responsible Principal Investigators leave employment at the University of Auckland, the University will ensure provision is made for storage of documents relating to the statutory obligations of those Responsible Principal Investigators. It will be the responsibility of Responsible Principal Investigators to deposit records with the Health and Safety Office.

B. Deans, Directors of Research Institutes and Heads of Department

1. Will provide management oversight on the safe use of radionuclides in their respective areas of responsibility and satisfy themselves that statutory obligations with regard to purchase, use, storage and disposal of radionuclides as well as irradiating equipment have been fulfilled.

2. Will ensure relevant Source licenses and ensure Use licenses are obtained.

3. Will approve appointment of new Responsible Principal Investigators.

4. Receive copies of annual verification reports from the Hazards and Containment Manager

5. Ensure any corrective actions required of Responsible Principal Investigators as a result of verification visits are carried out as soon as practicable

6. Will inform the Deputy Vice Chancellor (Research) of any Corrective Action Report with significant health and safety implications.

C. University of Auckland Health, Safety and Wellness Office

The University of Auckland Health, Safety and Wellness Office is responsible for coordinating all aspects of health and safety within the University of Auckland including receipt of all accident and incident reports. The Hazards and Containment Manager will ensure that the Health, Safety and Wellness Office receives copies of any reports, verifications and recommendations concerning the use of radionuclides and irradiating equipment.

In the event of accidental radiation exposure, the Health, Safety and Wellness Office will ensure that the individual received appropriate medical assistance and will ensure appropriate follow-up monitoring of the individual is coordinated and appropriately documented.

D. Responsible Principal Investigators (RPIs)

Sources of ionising radiation will require a Source license and in some cases a Use License issued by the Office of Radiation Safety. Faculties will apply for the relevant Source license. All sources of ionising radiation will be under the control of a Responsible Principal Investigator regardless of whether they require a Source license. Where a source of ionising radiation requires a User license, the User licensee will be the Responsible Principal Investigator. Responsible Principal Investigators and User licensees will be accountable to their Head of School, Dean/Head of Institute. The Dean/Head of Institute will approved their appointment on recommendation of the Hazards and Containment Manager.

Approved Responsible Principal Investigators are accountable for:

1. The safe use, storage and disposal of unsealed radionuclide or irradiating equipment purchased or otherwise obtained. Responsible Principal Investigators will follow relevant license conditions (which may include the relevant ORS Code of Safe Practice).

2. Ensuring that the safe receipt, use, storage and disposal of radionuclides and irradiating equipment is in accordance with University of Auckland Radiation Safety Plan and is in compliance with the Radiation Safety Act and associated Regulations and ORS policy (which may include the ORS Safe Codes of Practice). The guiding principal will be to ensure that all exposures are kept As Low As Reasonably Achievable (ALARA).

3. Ensuring that adequate records of training, purchase, transfer, use and disposal specified in relevant Sections 4-10 of this Radiation Safety Plan are maintained and available for inspection by the Hazards and Containment Manager and the ORS. In the majority of cases training records will be maintained in Canvas, so the Responsible PI will ensure that new staff and students are enrolled and pass Canvas course and any competency assessments before handling isotope or irradiating equipment.

4. Ensuring accurate inventories of sealed and unsealed sources specified in relevant Sections 4-10 of this Radiation Safety Plan are maintained.

5. Purchasing all ionising radiation sources through University procurement systems including SciQuest ERM.

6. In the event that procurement of radiation sources falls outside SciQuest ERM (i.e. a Capex request), the Responsible Principal Investigator will report

the acquisition of such sources outside the University procurement systems to the Hazards and Containment Manager in a timely manner in order to fulfil statutory reporting requirements.

7. Ensuring users of a qualifying radiation source have at least one Use license issued by the Office of Radiation Safety where this Use license is required

8. Reporting annually to relevant Dean or Director of Research Institute that requirements of items 1- 3 above have been fulfilled.

9. Ensure reporting requirements as a condition of Consent to Import are completed on time.

10. Participate in annual verification exercises conducted by Hazards and Containment Manager and ensure any corrective actions are completed as soon as practicable.

11. Ensure all users have received facility specific or equipment-specific radiation safety training prior to use of ionising radiation source. In the case of work with unsealed radionuclides, this means that all staff and students have completed isotope specific training and understand its requirements prior to use of radioisotope. The list of trained persons will be maintained in Canvas.

12. Where radionuclides will be used by undergraduate students, students will be given detailed instructions in the laboratory teaching material which will include information about the hazards and steps required to ensure potential exposure is kept to a minimum.

13. In the case of irradiating equipment, ensuring that all users of this equipment receive general training in radiation protection principles as well as machine specific training. Responsible Principal Investigators are required to ensure users are enrolled and have passed the requisite Canvas course prior to use of equipment.

14. Ensuring that the Hazards and Containment Manager is notified of the purchase of **sealed** radioisotope sources (above exempt levels) or irradiating equipment. The Responsible Principal Investigator must also notify the Hazards and Containment Manager of any transfers or disposal of the such radionuclide or equipment. Responsible Principal Investigators are also required to furnish copies of reports required as a condition of a Consents to Import to the HCM.

15. Undertaking lawful disposal or transfer of radionuclides under their control prior to leaving the University of Auckland. This will include completing any statutory notification to the ORS of disposal and notification to the Hazards and Containment Manager.

16. Ensuring a copy of the Radiation Safety Act, any Regulations and the Safe Code of Practice is readily available to all staff/students under their supervision. These documents may be available on Canvas.

17. Ensuring adequate monitoring procedures (including wipe tests) are established and documented. These monitoring programs may be conducted on their behalf by the Faculty or School.

18. Ensuring that adequate survey meters (where applicable) are available for monitoring work and work areas in which radionuclides are held and used.

19. Ensuring that adequate safety equipment (including shielding and PPE) is available for the safe use of radionuclides.

20. Ensuring that there is no transfer of radionuclides to unauthorised individuals.

21. Ensuring that exposure of employees is maintained as low as reasonably achievable (ALARA) and always less than 1mSv per annum above background.

22. Distributing, collecting and collating results of personnel monitoring devices for any staff where recommended or required by the ORS Safe Code of Practice

23. Ensuring that any exposure of pregnant female staff/students is kept well within the ORS guidelines for ionising radiation by observing the dose limits specified in this Radiation Safety Plan.

24. Reporting any incidents involving accidental exposure immediately to the University Health and Safety Coordinator. Any overexposure (as defined in Safe Codes of Practice) must be reported to the Director of the ORS within 24 hours. Responsible Principal Investigator must inform the Health and Safety Coordinator and Head of Department at the same time.

25. Ensuring that radiation emission data and/or calculated doses that staff are likely to exposed to in the course of conducting experiments is recorded and retained for inspection.

E. Users of Exempt Quantities of Radionuclide

Exempt quantities of Radionuclide are as defined in Schedule 2 of the Radiation Safety Act 2016**.** Use of exempt quantities will under the oversight of a Responsible Principal Investigator (RPI). Users of exempt quantities of radionuclide (and the Responsible Principal Investigator) will be responsible for:

1. The safe use, storage and disposal of exempt unsealed radionuclide or irradiating equipment. The relevant ORS Safe Code of Practice will be followed.

2. Accurate documentation of radionuclide purchase will be kept as specified in Sections 4 and 5. SciQuest ERM records may suffice.

3. Ensuring the safe receipt, use, storage and disposal of radionuclides and irradiating equipment is in accordance with the ORS Safe Codes of Practice and the University of Auckland Radiation Safety Plan.

4. Ensuring that they have completed isotope specific training in Canvas and understand its requirements.

5. Ensuring adequate monitoring procedures are established and documented.

6. Ensuring that adequate survey meters are available for monitoring work (where appropriate) and work areas in which radionuclides are held and used.

7. Ensuring that adequate safety equipment (including shielding and PPE) is available for the safe use of radionuclides.

8. Ensuring that the exposure of users is maintained as low as reasonably achievable (ALARA).

9. Ensuring that any exposure of pregnant staff/students is kept well within the ORS guidelines for ionising radiation.

F. All Users of Irradiating Equipment and Radionuclide Sources

1. All users of Irradiating Equipment and Radionuclide Sources (both staff and students) must comply with the Radiation Safety Act and associated Regulations, license conditions (which includes ORS Safe Codes of Practice) and this Radiation Safety Plan. The guiding principal will be to ensure that all exposures are kept As Low As Reasonably Achievable (ALARA).

2. Users must comply with the directives concerning use of Irradiating Equipment and Radionuclide Sources issued by the Responsible Principal Investigator and the University. Where exempt quantities of radionuclide are used, directives issued by the University will be followed.

G. Hazards and Containment Manager

Will work primarily in an advisory capacity with University and Faculty Administration, Responsible Principal Investigator and Radiation Safety Officers and is responsible for:

1. Providing advice on all aspects of the safe use of radionuclides and irradiating equipment in the University.

2. Providing training material on all aspects of radionuclide use, storage and disposal.

3. Verifying that the purchasing/processing of transfer of sources of radionuclide/irradiating equipment meets statutory and University requirements.

4. Ensuring an accurate inventory of unsealed and sealed sources, irradiating equipment and handheld survey meters is maintained and ensuring the ORS is notified of acquisition or disposal of licensable radiation sources in a timely manner.

5. Undertaking periodic verification visits of all facilities and irradiating equipment. These verification visits will ensure relevant requirements of the Radiation Plan are followed. The Hazards and Containment Manager will report to and make recommendations to management and Responsible Principal Investigators in the University.

6. Ensuring radiation disposal facilities provided by Faculties are maintained in a safe and secure manner.

7. Ensuring Responsible Principal Investigators and all radionuclide and irradiating machine users are kept informed of University and ORS policy directives.

8. Ensuring Faculty Administrations and Directors of Institutes are kept fully informed of all reports, verifications and recommendations.

2. LICENSING, PURCHASE AND RECEIPT OF RADIONUCLIDE AND IRRADIATING EQUIPMENT

2.1 SOURCE LICENSES FOR RADIONUCLIDES AND IRRADIATING EQUIPMENT IN THE UNIVERSITY OF AUCKLAND

(i) All use of radioactive materials and irradiating equipment (except as noted in (ii) below) ***shall*** be under a Source license and a Responsible Principal Investigator.

(ii) Exempt sources may be stored and used provided they are under the direct control of a Responsible Principal Investigator.

(iii) The Responsible Principal Investigator who has direct control over such sources will undertake the obligations specified in the relevant section of this Radiation Safety Plan.

2.2 USE LICENSES FOR RADIONUCLIDES AND IRRADIATING EQUIPMENT IN THE UNIVERSITY OF AUCKLAND

(i) All use of Ionising Radiation source (except as noted in (ii) or (iii) below) will only be conducted by a person who either obtains a Use license or who is under the written instructions of a User licensee. The User licensee will be deemed the Responsible Principal Investigator.

(ii) Irradiating equipment whose use is deemed either to be mechanical or procedural by the ORS may be operated under written instructions of source licensee under s21(4) of the Radiation Safety Act, 2016. Such irradiating Equipment must be under the control of a Responsible Principal Investigator.

(iii) Irradiating equipment whose use is deemed either to be passive or limited by the ORS under s17(2) of the Radiation Safety Act, 2016. Such irradiating Equipment must be under the control of a Responsible Principal Investigator.

2.3 RECORDS OF RADIONUCLIDES AND IRRADIATING EQUIPMENT IN THE UNIVERSITY OF AUCKLAND

(i) The Hazards and Containment Manager (HCM) will ensure an accurate record of:
   a.) all current Responsible Principal Investigator in the University of Auckland
   b.) the location of experimental work involving radionuclides and irradiating equipment

and the above is maintained and is also readily available in the event of an emergency.

(ii) The HCM shall liaise with ORS to ensure University of Auckland records of licenses and license conditions are correct.

2.3 ABSENCE OF RESPONSIBLE PRINCIPAL INVESTIGATOR

Where a Responsible Principal Investigator is on extended leave (longer than 6 weeks and less than 6 months), that Responsible Principal Investigator must apply to the Faculty to appoint a replacement Responsible Principal Investigator in that person's absence

2.4 CODES OF SAFE PRACTICE AND RADIATION SAFETY PLAN

(i) All staff and students working with sealed and unsealed sources of radionuclides or irradiating equipment ***shall*** observe their statutory obligations under the Radiation Safety Act and its associated Regulations and, where appropriate, the relevant ORS Safe Code of Practice.

(ii) All Responsible Principal Investigators ***shall*** observe the requirements of this University Radiation Safety Plan.

(iii) Staff and students handling radionuclides or irradiating equipment ***shall*** have ready access to a copy of the Radiation Safety Plan, the relevant Acts, Regulations and applicable ORS Codes of Safe Practice - this access will include web-based access.

2.5 PURCHASE OR TRANSFER OF RADIOACTIVE SOURCES AND IRRADIATING EQUIPMENT

Orphan sources (i.e. those sources whose origin cannot be determined) represent a risk for the University and the attendant cost of disposal is significant. The University must accept responsibility for any radionuclide source or irradiating equipment on its premises.

The following notification provisions are designed to reduce these risks:

(i) The Responsible Principal Investigator must notify the Hazards and Containment Manager of any purchase or transfer of **sealed radioactive sources** or **irradiating equipment**.

(ii) Purchase of **all** radionuclide sources ***shall*** be made via SciQuest ERM and the Designated Laboratory Person (DLP) ***shall*** declare the proposed purchase as Radioactive using the 'Radioactive' checkbox.

(iii) Any purchase of a radionuclide source shall receive Hazard Approvers approval before further processing to a Purchase Order. Hazard Approvers ***shall*** liaise with HCM to ensure the radioactive source or irradiating apparatus will be under the control of a competent Responsible Principal Investigator.

(iv) Receipt of licensable sealed sources and irradiating equipment ***shall*** be notified within 10 working days of receipt of goods. Failure to comply will be brought to the attention of the Head of Department and Dean.

2.6 ORS CONSENTS TO IMPORT RADIONUCLIDE SOURCES

Copies of consents granted by the ORS to import radionuclide sources will be sent to the HCM. Copies of quarterly returns and notification of receipt (required under specific consents) will be sent to the HCM.

2.7 INVENTORY RECORDS OF RADIOACTIVE SOURCES

Accurate records of purchase as well as an ongoing inventory of all sealed and unsealed sources with location ***shall*** be recorded in SciQuest by Designated Laboratory Person (DLP). DLP will update SciQuest on disposal of sources. The Responsible Principal Investigator shall be informed.

2.8 RECEIPT OF UNSEALED AND SEALED RADIONUCLIDE SOURCES

(i) The purchaser ***shall*** immediately uplift any delivery of sealed or unsealed isotope and ensure that it is placed in a secure laboratory area.
(ii) All packages containing unsealed radionuclide in Categories B and C activities ***shall*** be monitored to ensure that isotope has not leaked in transit.
(iii) Any suspected contamination of outer or inner packaging materials ***shall*** be reported to the Hazards and Containment Manager immediately.
(iv) All warning labels ***shall*** be removed or rendered unreadable before disposal of packaging.

2.9 VACATING RADIATION USE AREA

(i) When an area or equipment where unsealed or sealed sources of radionuclide have been used is to be returned to normal laboratory use, the facility is to be disestablished or the equipment to be scrapped, the Responsible Principal Investigator ***shall*** contact the Hazards and Containment Manager.

(ii) The Responsible Principal Investigator ***shall*** take and document all necessary steps to ensure the area or equipment is free of contamination. In addition to any statutory requirement to notify the ORS, a copy of the documentation ***shall*** be forwarded to the Hazards and Containment Manager and the Head of Department in the first instance.

(iii) The above requirement will not apply to use of temporary radiation use of unsealed sources areas where activities are less than Category A. Responsible Principal Investigator ***shall*** document all surveys taken to determine that the areas are safe to return to normal laboratory use. Responsible Principal Investigator ***shall*** retain the results of these surveys on file.

2.10 DECLARED PREGNANCY POLICY

The Responsible Principal Investigator (RPI) or Hazards and Containment Manager ***shall*** inform any female staff or student who chooses to declare themselves pregnant of recommended dose limits that apply to pregnant women. Hazards and Containment Manager is able to provide assistance as and when required.

Reasonable efforts ***shall*** be taken by the RPI and female staff member (which include documented instruction) to maintain effective dose to a minimum.

3. CLASSIFICATION OF IRRADIATING EQUIPMENT, SEALED AND UNSEALED RADIONUCLIDE SOURCES

3.1 CLASSIFICATION OF UNSEALED SOURCES

Unsealed sources will be classified according to:

1. Whether they qualify as radiation sources as per Schedule 2 of the Radiation Safety Act. These not qualifying as radiation sources will be regarded as Exempt Sources.
2. Unsealed Radiation Sources will be further classified according to activities stipulated in Appendix 2 of ORS C1 and Appendix 1 of this Radiation Safety Plan. Requirements specified in this Safety Plan for handling unsealed sources will vary according to this classification

3.2 CLASSIFICATION OF SEALED SOURCES

Sealed sources will be classified according to whether they are licensable or exempt as specified in Schedule 2 of the Radiation Safety Act

3.3 CLASSIFICATION OF ANALYTICAL X-RAY EQUIPMENT

X-ray emitting equipment will be categorised into one of the following categories:

i. **Type A equipment** - Open beam XRD/XRF equipment
ii. **Type B Equipment** - Desktop XRD/XRF equipment or Micro CT scanners with built in shielding and interlocks so that exposure is not possible unless the equipment is opened and inbuilt shielding is removed.
iii. **Type C Equipment -** Desktop or Handheld equipment with low intensity x-ray beams, such that concerted and prolonged exposure is required.

Note that electron microscopes are not included in any of the above categories

3.4 CLINICAL X-RAY EQUIPMENT – DEXA SCANNERS

These include qCT scanners and all DEXA scanners and will be under a Medical license

3.5 CLINICAL X-RAY EQUIPMENT – FLUOROSCOPES

Portable fluoroscopes will treated as a separate category

3.6 OTHER IRRADIATING EQUIPMENT

These include Cobalt 60 irradiating equipment, Linear accelerators and neutron sources. Each item will have its own requirements.

4. OPERATIONAL DOCUMENT (EXEMPT AND REGULATED QUANTITIES OF UNSEALED SOURCES)

Responsible Principal Investigators for unsealed sources will document the following:

4.1 Records of Radionuclide purchase, Importation or Transfer

Records of purchase of unsealed sources ***shall*** be kept in the form of an inventory of primary vials purchased. Purchase records ***shall*** show for each primary vial of isotope:

1. Radionuclide and its chemical form
2. Activity
3. Purchase date
4. Disposal or consumption of the radionuclide

These records may be kept in SciQuest ERM

A model form for lab inventory which may be used is given in Appendix 2

(i) Purchase records shall be kept up-to-date act as an inventory of primary vials of radioisotope.

(ii) The Responsible Principal Investigator ***shall*** keep a record of any transfer of radionuclide notified to the ORS.

(iii) The Responsible Principal Investigator shall keep a record of importation under any consent to import and furnish copies of any ORS consents and reports to the HCM.

4.2 Additional Operating Procedures for the Use of the Radionuclide in Categories B and C.

For radionuclide use in Categories B and C (see Appendix 1), RPIs ***shall*** maintain accurate records of quantities remaining after each use of radionuclides. A model usage log is provided in Appendix 3.

4.3 Record of Personnel Training

(i) Responsible Principal Investigators ***shall*** ensure training for those persons handling 3H, 14C, 35S, 33P and 125I unsealed sources or X-ray diffraction equipment. The Canvas web portal (refer to Attachments) is the preferred method of delivery as each module is designed to draw users attention to the specific safety requirement to use these isotopes in specific areas and the need to take care with disposal of waste. Responsible Principal Investigators ***shall*** ensure those person enrolled in Canvas have passed the quiz and where necessary indicate competency before working with isotope.

(ii) Responsible Principal Investigators shall keep a current list of persons handling unsealed radionuclides and their training. This may be undertaken in Canvas.

(iii) Training ***shall*** be conducted ***prior to*** handling of sealed and unsealed radionuclides.

4.4 Laboratory Facilities

(i) Unsealed sources of radionuclide ***shall*** be handled in dedicated areas designed to ensure containment of any spill and have appropriate shielding. These dedicated areas may be established on a temporary basis for the purposes of experimentation (e.g. may consist of a labelled tray for handling exempt activities of unsealed sources).

(ii) Dedicated areas ***shall*** have appropriate warning signage. Laboratories containing activities of unsealed isotopes requiring whose activities are classified as Category B or C (refer to Appendix 1) ***shall*** have appropriate warning signage on the door. It is sufficient for exempt activities of unsealed isotopes to have appropriate warning signage near areas where isotopes are used.

(iii) Storage areas for all activities (including exempt activities) ***shall*** have appropriate warning signage.

(iv) If activity of 125I or 131I handled in an open container exceeds 50 MBq, then work ***shall*** be undertaken in dedicated laboratory equipped with a fume hood. All radioiodination procedures ***shall*** be conducted in these dedicated laboratory facilities.

(v) Category C and radioiodination facilities ***shall*** have a logbook documenting use or entry and that a scan with survey meters has been undertaken after each and every use to verify that the area is clean and not contaminated.

4.5 Monitoring

(i) A system of regular monitoring contamination in the dedicated area, in and around storage locations as well as disposal areas ***shall*** be established by the Responsible Principal Investigator – wipe test monitoring may be undertaken on a Faculty, School or Departmental basis on behalf of the Responsible Principal Investigators in that sector.

(ii) Wipe tests ***shall*** be conducted at least on a 6 monthly basis where low energy beta emitting isotope are regularly ***handled***. ***Storage*** areas ***should*** also be monitored on a 6 monthly basis. The procedure for wipe testing is documented in Radioisotope Procedure 1. – Wipe tests which is in the Appendix and available via Canvas.

(iii) Records of wipe tests with location of wipe tests ***shall*** be maintained by the Responsible Principal Investigator, department, school or faculty.

(iv) Where use of survey meters is appropriate, regular monitoring with these meters ***should*** be recorded.

(v) Records of monitoring ***shall*** be retained for at least 5 years.

4.6 Verification

HCM shall conduct annual verification visits of all areas in which unsealed isotopes are handled. A typical verification form is shown in Appendices 4 and 5.

4.7 Use of Unsealed Radionuclides in Undergraduate Teaching

(i) Use of radionuclides in undergraduate teaching ***shall*** be limited to tracer studies using exempt quantities

(ii) Students ***shall*** be provided with adequate warning and instruction in the laboratory handbook.

(iii) Students ***shall*** be issued with gloves and trays to ensure proper containment of radiolabeled solutions.

(iv) Wipe tests shall be conducted as soon as possible after the completion of the section of the laboratory program involving isotopes.

4.8 Use of Unsealed Uranyl and Thorium salts

(i) Users of Uranyl and Thorium salts shall treat uranyl and thorium salts as toxic chemicals.

(ii) Disposal of Uranyl acetate shall follow Radioisotope Procedure #2 – Disposal of Uranyl acetate – which is in the Appendix and also available in Canvas.

5. OPERATIONAL DOCUMENTATION (SEALED SOURCES)

5.1 Inventory

Responsible Principal Investigators in charge of sealed sources will undertake an inventory of all sealed sources under their control and this inventory will be recorded in SciQuest detailing:

1. Radionuclide
2. Activity (with reference date)
3. Any unique identifier (serial number)
4. Exempt status
5. Date of wipe test. This will not apply to sources where it is unsafe to perform direct wipe tests.

5.2 Laboratory Facilities

(i) All Sealed sources of radionuclide ***shall*** be stored in rooms or cupboards appropriate warning signage.

(ii) Laboratories containing activities of sealed isotopes requiring a source license ***shall*** have appropriate warning signage on the door.

5.3 Wipe Tests

(i) Wipe test ***shall*** be conducted on all sealed sources using survey meters annually.

(ii) Any source with leakage rate of more than 0.2 kBq will be withdrawn immediately and disposed.

(iii) The above will not apply to sources where it is unsafe to perform direct wipe tests.

(iv) Wipe tests will be performed every two years and for sources older than 30 years every 12 months.

(v) Records of monitoring ***shall*** be retained for at least 5 years

5.3 Training

Responsible Principal Investigators shall keep an accurate and up-to-date list of all persons who use sealed sources of radionuclide that are not exempt. Records will be kept for a minimum of 5 years (see Section 4.1)

5.4 Verification

HCM shall conduct annual verification visits of all areas in which sealed sources are handled. A typical verification form is shown in Appendix 6

6. OPERATIONAL DOCUMENTATION (ANALYTICAL X-RAY EQUIPMENT)

Notwithstanding that only Type A and C XRD and XRF equipment requires a source and Use License, all such equipment (including Type B equipment) must be under the supervision of a Responsible Principal Investigator. The Responsible Principal Investigator for analytical x-ray equipment ***shall*** document the following:

6.1 Security of Equipment

The Responsible Principal Investigator will ensure that the irradiating equipment is secure and cannot be operated by an untrained or unsupervised person.

6.2 Local Rules - Operating Procedures for the use of the Equipment.

(i) Responsible Principal Investigator ***shall*** document procedures for the safe operation of a particular piece of equipment. These shall be deemed to be Local Rules.

(ii) Responsible Principal Investigator ***shall*** ensure staff and students are aware and comply with these Local Rules.

(iii) Specific instructions ***should*** be given to ensure only trained Responsible Principal Investigators or suitably licensed staff undertake repair of these machines.

(iv) For Type A and C Equipment, Local Rules ***shall*** detail actions in the event of an emergency.

6.3 Record of Training on Use of the Equipment

(i) Responsible Principal Investigator ***shall*** keep an accurate and up-to-date list of all persons who use irradiating equipment.

(ii) Responsible Principal Investigator ***shall*** ensure that staff and students who operates equipment capable of delivering ionising radiation know and understand the Operating Procedures/Local Rules before the machine is used by that student or staff member. In some cases these Operating Procedures may draw heavily on procedures specified by the manufacturers in the equipment handbook.

(iii) Users are also required to have core knowledge in radiation safety. This core knowledge can be obtained by undertaking an on-line learning program on Analytical X-rays available on Canvas in the case of x-ray equipment. This training may be customised for each facility to ensure relevance.

(iv) The Responsible Principal Investigator ***shall*** have a record that the staff or student has passed the Canvas on-line learning program on Analytical X-rays and displays the required competency and understanding of Local Rules to safely operate that equipment. Competency will also be recorded in Canvas.

6.4 User logs for the equipment and key holders having access to the Equipment

Logs for all irradiating equipment detailing use of equipment will be kept beside each machine. Booking sheets constitute a use log.

6.5 Equipment Maintenance

Equipment maintenance ***shall*** be carried out by a person possessing a license to maintain analytical X-ray equipment (as per clause 2.4.1 ORS C17), the responsibility for the maintenance licensee will cease once machine has been repaired, safely re-commissioned and documentation of verification completed (see below). Safe Use of the machine then becomes the responsibility of the Responsible Principal Investigator.

6.6 Record of Equipment Maintenance

(i) Responsible Principal Investigator will maintain record of all maintenance performed on the x-ray equipment.

(ii) Responsible Principal Investigator will pay particular attention to the ability of maintenance personnel to bypass safety interlocks and remove shielding. In such cases, Maintenance licensees will document verification that interlocks have been reinstated, shielding has been reinstated safely and dose rates are within acceptable limits.

(iii) Maintenance licensees ***shall*** provide a written statement to record verification that interlocks are functioning, shielding has been properly reinstated and dose rates are within acceptable limits.

6.7 Monitoring Protocols

Irradiation equipment leakage and scatter will be measured at intervals specified in Section 6.8 or after any alteration to the machine.

All records will be kept for a minimum of 5 years.

6.8 Variations for Different Types of XRD/XRF Equipment

Type A equipment - Open beam XRD/XRF equipment

- All of the above requirements (6.1 - 6.7) apply with leakage/scatter monitoring undertaken on a 3 monthly basis
- Can only be operated by a person possessing a User License or under written instruction of a User Licensee.

Type B Equipment - Desktop XRD/XRF or MicroCT equipment with built in shielding and interlocks so that exposure is not possible in normal operation

- Local rules may be solely drawn from manufacturer's instructions but must include emergency procedures. Radiation Safety Training may consist of a modified form of web-based safety training delivered via Canvas.
- Annual leakage/scatter measurements to be undertaken.
- No User licenses are required.

Type C Equipment - Desktop equipment with low energy beams, such that concerted and prolonged exposure is required

- Local rules and training may be solely drawn from manufacturer's instructions but must include emergency procedures.
- No leakage measurements are required.
- No User licenses are required.

6.9 Verification

HCM shall conduct annual verification visits of all areas in which analytical x-ray equipment is used. A typical verification form is shown in Appendix 7

7. OPERATIONAL DOCUMENTATION FOR DXA and qCT SCANNERS

7.1 Documentation

Where DXA scanners are used on patients, Responsible Principal Investigator for DXA Scanners ***shall*** ensure there are procedures to document:

(i) the name of the patient/participant (or identifier) and referring clinician for clinical studies
(ii) That all clinical trials performed on the DXA scanner have appropriate ethical approval and that all subjects have signed the approved consent form for the scanning procedures.
(iii) Low dose mode is used for children and all scans performed on children are clinically appropriate.
(iv) Rerun scans for the same patient/participant are documented

7.2 Warning signage and Consent

Warning signage on entrance to areas containing DXA scanners ***shall*** be present
Patients ***shall*** be informed of the dose that they are likely to incur. It is recommended that dose is equated to a meaningful measure to a lay person (such as number of hours on an international flight).

7.3 Scanning Records and QA records

Responsible Principal Investigators ***shall*** ensure that:

(i) A software system or a machine use log is maintained so that it is possible to:
    a) Cross-reference scan data with the patient's name (or identifier).
    b) Determine average number of scans per day
(ii) QA is run each day before use.
(iii) Regular phantoms are performed and meet the established machine normal range and these phantom scans are reviewed every month by the Responsible Principal Investigator to ensure safe and accurate performance. If any issues arise with the performance of the scanner, this is to be reported to a qualified service technician and rectified before further use.
(iv) QA and phantom data is retained for at least 5 years and is retrievable.

7.4 Record of Training on Use of the DXA Scanners

(i) Responsible Principal Investigator ***shall*** hold a User license and ensure that any person who operates DXA scanners is under their supervision.

(ii) Responsible Principal Investigator ***shall*** ensure that every person who operates DXA scanners understands the Operating Procedures/Local Rules before the scanner is used.
(iii) Responsible Principal Investigator ***shall*** keep an accurate and up-to-date list of all persons who are specifically authorised by the Responsible Principal Investigator to use DXA Scanners (i.e. that the Responsible Principal Investigator is satisfied that the person displays the required competency and understanding of operating procedures to safely operate that equipment). Competency will be recorded in Canvas.
(iv) Users are also required to have core knowledge in radiation safety. This core knowledge can be obtained by undertaking a self-directed DXA programme available as a Canvas Course. This training may be customised to each facility to ensure relevance.
(v) Where clinical studies are undertaken, it is preferable that operators undertake registered DXA training (such as offered by the ANZBMS) which will meet the requirements of (iv) above.

7.5 Equipment Maintenance

(i) Scanner maintenance ***shall*** only be carried out by a person possessing a license to maintain DXA x-ray equipment. The Responsible Principal Investigator is notified once the machine has been repaired and safely re-commissioned and the responsibility for ongoing safe usage of the DXA machine is returned to the Responsible Principal Investigator.
(ii) Maintenance license holders ***shall*** document verification to ensure that if safety features have been bypassed or removed, these features have been reinstated, and dose rates are within acceptable limits before use.
(iii) The Responsible Principal Investigator ***shall*** retain copies of maintenance reports for 5 years

7.6 Scatter Measurements

(i) Operating procedures ***shall*** ensure the operator is seated at the machine recommended distance or shielded if space does not allow adequate distance between the machine and the operator.
(ii) Where shielding is used, Responsible Principal Investigator ***shall*** retain records of verification of shielding efficiency.
(iii) All records will be kept for a minimum of 5 years.

7.7 Verification

HCM shall conduct annual verification visits of all areas in which DEXA scanners are used. A typical verification form is shown in Appendix 8

8. OPERATIONAL DOCUMENTATION FOR FLUOROSCOPES

Where fluoroscopes **under University control** are used in animal studies, the Responsible Principal Investigator for fluoroscopes ***shall*** document the following:

(i) The equipment is only operated only by a Use licensee or a suitably qualified radiographer
(ii) Log of use
(iii) Annual certification of Machine is conducted by a certified Medical physicist that the instrument meets CSP21 (in particular Appendix A)
(iv) Annual certification of lead aprons, gloves and thyroid screens provide shielding.
(v) All others present in the room must have written instructions to stand at least 1 meter from operating table while x-ray machine in operation

Room where the fluoroscope is to be used must have documented shielding or environmental dose rates ***shall*** be recorded every 2 years

All records ***shall*** be kept for a minimum of 10 years.

Verification
HCM shall conduct annual verification visits of all areas in which fluoroscopes **under University control** are used. A typical verification form is shown in Appendix 9

9. OPERATIONAL DOCUMENTATION FOR NEUTRON SOURCES

The Responsible Principal Investigator for the neutron source ***shall*** document the following:

(i) The equipment is only operated only by a Use licensee or a suitably qualified nurse
(ii) Log of use
(iii) Verification of dose to patient and operator
(iv) Environmental survey at dose at various locations in the facility

All records ***shall*** be kept for a minimum of 10 years.

Verification
HCM shall conduct annual verification visits of all areas in which neutron sources are used. A typical verification form is shown in Appendix 10

10. OPERATIONAL DOCUMENTATION FOR LINEAR ACCELERATORS, Cs137 BLOOD and COBALT 60 IRRADIATORS

10.1 Security of Equipment and Authorised Access

Responsible Principal Investigator ***shall:***

(i) Take reasonable steps to keep access to facilities with Cobalt 60 sources, Blood Irradiators and linear accelerators to a minimum.
(ii) Keep an accurate register of key holders and reconcile those with access to training records.
(iii) ensure that only Use Licensees or those working under the authority and written instruction of User Licensee operate this equipment
(iv) ensure that Use Licensees or those working under the authority and written instruction of User Licensee who operate Linear accelerators, Blood and Cobalt 60 Irradiators understand Operating Procedures/Local Rules before operating the equipment.
(v) Ensure key holders who access to the facilities but do not operate the equipment are given instructions concerning the hazards and what to do in an emergency.
(vi) Ensure emergency instructions and up-to-date contact list is posted in the log book or in a prominent place in the Facility.

10.2 Training

(i) Responsible Principal Investigator ***shall*** keep an accurate and up-to-date list of all persons who have access or who are Use Licensees and that this record is reported annually to the Dean

(ii) Responsible Principal Investigator ***shall*** ensure that all User Licensee and Operators who use Linear Accelerators, Blood and Cobalt 60 irradiators understand Operating Procedures/Local Rules before the machine is used by that operator.

(iii) Local Rules will include Emergency Protocols

(iv) Users are also required to have core knowledge in radiation safety. This core knowledge can be obtained by undertaking a program as part of the training.

(v) The Responsible Principal Investigator ***shall*** have a record that the staff and student displays the required competency and understanding of Local Rules to safely operate that equipment with signoff by the User Licensee.

10.3 Personal Dosimetry Records

Responsible Principal Investigator ***shall*** ensure:

(i) All users wear dose monitoring devices (such as film badges) and have these read at regular intervals (as per Appendix 13).
(ii) Records of dose received are kept in a secure place and retained for at least 10 years.
(iii) Missing records are accounted for.
(iv) All readings from pocket microprocessor dosimeters are recorded in a logbook.
(v) Pocket microprocessor dosimeters are checked annually if used in addition to personal dosimeters.

10.4 Use of Equipment

The Responsible Principal Investigator shall ensure accurate records of use are kept.

10.5 Maintenance

Responsible Principal Investigator shall ensure the following are undertaken and documented:

(i) All interlocks and warning devices are tested on a 6 monthly basis
(ii) 24 monthly environmental survey with positions for readings marked on floor plans

10.6 Verification

HCM shall conduct annual verification visits of areas in which linear accelerators and Cobalt 60 irradiators are used. A typical verification form is shown in Appendix 11

Summary of documentation

User licensee for Linear accelerators, Cs137 Blood and Cobalt irradiators ***shall*** document the following:

(i) Record of the User licensees along with license numbers.
(ii) Record of those persons operating the equipment under instructions of User Licensee and their training.
(iii) Log of use.
(iv) Maintenance log (this may be part of Log of Use).
(v) 6 monthly test of interlocks and warning lights.
(vi) 6 Monthly testing of any warning alarms.
(vii) 12 Monthly check of any pocket dosimeter if used in conjunction with personal dosimetry badges.
(viii) 24 monthly environmental survey with positions for readings marked on floor plans.
(ix) List of users and personal dosimetry checks (film badges) as per protocol in Appendix 13.

All records will be kept for a minimum of 10 years.

11. OCCUPATION HYGIENE AND MONITORING

11.1 PERSONNEL MONITORING

(i) Laboratory personnel handling 125-I or 131-I with activities greater than 17 MBq (0.5 mCi) in a volatile form (i.e. performing radio-iodinations) ***shall*** have a thyroid scan once a week or after each occasion radioactive iodine is used, which ever is less frequent. A survey monitor fitted with a scintillation detector ***may*** be used for monitoring within one week of the manipulation. Readings ***shall*** be recorded in the local logbooks. If any thyroid uptake is detected, a calibrated thyroid scan using a suitable neck phantom ***shall*** be used to ensure reproducible geometry.

(ii) Calibrated thyroid scans ***shall*** be performed by Nuclear Physics Department, Auckland Hospital. Copies of reports ***shall*** be sent to Responsible Principal Investigator and be retained by the HCM.

(iii) Staff are handling 32-P in quantities greater than 34 MBq (1.0 mCi) in any single experiment ***shall*** be monitored using finger TLDs.

(iv) Staff or students using 60Co sources ***shall*** be monitored using film badge or microprocessor dosimeter. Dosimeters will be calibrated every 2 years. Procedures for issuing and reviewing dosimeters are detailed in Appendix 12. Refer also to 10.3.

(v) Staff handling more than1.5 GBq (45 mCi) 3-H or 14-C ***should*** submit a urine sample within 48 hours of using the radionuclide to ensure ingestion of radionuclide has not occurred. Once permission has be obtained from staff submitting samples, results of any monitoring ***shall*** be retained by the University Health and Safety Office ensuring that generally accepted standards pertaining to retention of information and respect for individual privacy are observed.

11.2 DOSE MONITORING

(i) Where appropriate, the Hazards and Containment Manager ***shall*** monitor doses received in the course of typical experiments involving unsealed sources.

(ii) Dose levels ***shall*** be measured around Category A x-ray diffraction equipment when it is possible for users to have access to the immediate vicinity of the x-ray beam. The measurements ***shall*** be undertaken every 3 months and ***shall*** be documented

11.3 RADIATION DOSE LIMITS

Notwithstanding the statutory requirement to maintain dose limits within those limits specified in ICRP 103 (2007), the University will adopt ALARA principles. Limits for persons exposed to radiation as a normal condition of employment ***should*** be maintained at dose limits set for members of public.

Effective dose to body	1mSv
Equivalent dose to skin	50mSv
Equivalent dose to eye	15mSv

Following precautionary principle, The University adopts the position that the equivalent dose to abdomen of pregnant women during the course of pregnancy should be no more than 0.6 mSv.

11.4 CONTAMINATION MONITORING

Wipe tests shall be undertaken at least on a 6 monthly basis to monitor use of unsealed low energy beta emitters. Records shall be forwarded to the Hazards and Containment Manager or may be retained in the laboratory for inspection.

Survey Monitors will be used to monitor work area for contamination where higher energy beta and gamma emitting radionuclides are used. Work areas ***shall*** be monitored after each use.

11.5 INVENTORY OF MONITORING AND SURVEY EQUIPMENT.

(i) The Hazards and Containment Manager ***shall*** maintain an accurate register of monitoring and survey equipment along with calibration status. Monitoring equipment shall include radiation area monitors near Cobalt 60 sources and other irradiating equipment.

(ii) Calibration of survey equipment ***shall*** be determined using a check source of known activity. Probes will be placed as close as possible to check source containing either beta or gamma source to obtain maximum possible reading and to minimise variation contingent on distance and orientation of check source.

(iii) Where possible, detection efficiency readings obtained will be compared to average efficiencies for the same meter. Efficiencies that are lower than 30% from average will indicate further investigation is required. Survey equipment that fails to meet acceptable standards ***shall*** be withdrawn from service for repair or disposed

(iv) These records ***shall*** be kept with the Hazards and Containment Manager.

(v) University dosimetry equipment used to verify local dosimetry readings ***shall*** be calibrated every 4 years.

11.6 ENVIRONMENTAL SCANNING.

(i) Areas surrounding high activity gamma sources (i.e. > 1 Ci) or neutron sources ***shall*** conduct environmental scans every 2 years. A plan showing position of readings ***shall*** be part of the documentation. Readings ***shall*** be taken with source in exposed and shuttered position. Documentation will be retained with each instrument.

(ii) With the exception of DXA equipment, leakage and scatter measurements will be taken every 12 months on x-ray equipment.

12. VERIFICATION AND DOCUMENTATION

12.1 INTERNAL VERIFICATION

The over-riding consideration in conducting any verification ***shall*** involve facilitation with Responsible Principal Investigator to ensure safe working practices are adopted and that Fundamental Requirements are observed.

The following verification ***shall*** be carried out by the HCM:

a. Verification that documentation required of each Responsible Principal Investigator is being held
b. Environmental surveys of exposure levels and tests for contamination.
c. User training verification.
d. Comparison of survey meters.
e. Verification of work areas – including signage.

Note: Examples of verification documents are given in Appendices 4-11.

The frequency of verification ***shall*** be at least annually but will ultimately depend on use/purchase of radionuclide and levels of risk involved.

As a result of verification, the University Radiation Safety Plan ***shall*** be reviewed to ensure currency and adequacy.

Responsible Principal Investigator, Head of Department Dean or Director ***shall*** be advised of the outcome of the verification.

12.2 REQUESTS FOR CORRECTIVE ACTIONS

(i) Where internal verification or ORS verifications result in significant non-conformances and corrective action requests, the Head of Department and Dean ***shall*** be informed of these requests.

(ii) The Deputy Vice Chancellor (Research) ***shall*** be advised of any corrective action request where significant hazard is present.

12.3 VERIFICATION REPORTS

(i) Electronic summary of the Verification visits ***shall*** be retained by the Hazards and Containment Manager for inspection.

(ii) A Verification Reports will be presented to the Deans of the relevant Faculty.

12.4 TRAINING RECORDS

In addition to license obligations for training outlined in Sections 4-10, the Hazards and Containment Manager will ensure the following:

a) Undergraduate students using radionuclides are issued with adequate instruction.
b) Where appropriate, an awareness program for maintenance staff is established.

12.5 RETENTION OF RECORDS

(i) Responsible Principal Investigator ***shall*** retain all records relating to sealed and unsealed radionuclides or irradiating apparatus (including dosimetry) for 5 years.

(ii) Where a Responsible Principal Investigator relinquishes their license or leaves the University, all records relating to the radionuclides or irradiating apparatus ***shall*** be forwarded to the Hazards and Containment Manager.

(iii) It ***shall*** be the responsibility of the Responsible Principal Investigator to ensure that such records are deposited with the Hazards and Containment Manager.

12.6 RADIATION SAFETY PLAN

(i) The Radiation Safety Plan ***shall*** be issued with date and version number.

(ii) A copy ***shall*** be lodged with the Health, Safety and Wellness Office as part of the Health and Safety Document Control system.

(iii) The Hazards and Containment Manager ***shall*** be responsible for ensuring currency of the Plan.

(iv) The Hazards and Containment Manager ***shall*** ensure Faculties and Responsible Principal Investigators are aware of any changes or amendments to the Radiation Safety Plan

13. DISPOSAL

13.1 DISPOSAL OF SEALED SOURCES AND IRRADIATING EQUIPMENT

(i) Records of disposal or transfer of ownership of irradiating equipment and equipment containing licensable sealed sources of radionuclides ***shall*** be forwarded to the National Radiation Laboratory.

(ii) Records of disposal or transfer ***shall*** include any source that may be present in scintillation counters.

(iii) A copy of the transfer or transfer ***shall*** be sent to the Hazards and Containment Manager. Disposal of equipment ***shall*** follow procedures outlined in relevant Codes of Safe Practice.

13.2 DISPOSAL OF UNSEALED RADIOISOTOPIC SOURCES

Wherever possible, decay to activities less than 0.1x activities specified as limits for disposal will be used a method of disposal

<u>Solid Waste</u>

(i) Where radionuclide has a half-life of less than 90 days, waste ***shall*** be allowed to decay to levels specified by the relevant ORS Safe Code of Practice. To enable reasonably accurate calculation of the time allowed to decay isotopic waste, Responsible Principal Investigators ***shall*** keep good approximation of isotopic activities disposed. No allowance will be made for decay prior to storage of waste to decay.

(ii) All warning signs of containers and overpacks ***shall*** be removed before disposal.

(iii) Designated decay facilities ***shall*** be used for storage for the purposes of decay.

(iv) Detachable labels ***shall*** be used for waste containers stored in decay facilities.

(v) For radionuclides with half life longer than 90 days, waste ***shall*** be disposed of in accordance with Appendix 5 of ORS Safe Code of Practice C1.

(vi) Responsible Principal Investigators are strongly advised to allow a margin of safety of at least 5 in their calculations (i.e. they should 1/5 the limits used in Appendix 5 of ORS C1)

Liquid Waste

(i) Where radionuclide has a half-life of less than 90 days, waste ***shall*** be allowed to decay to activities 10 times less than ***specified for sewer*** by the National Radiation Laboratory Safe Code of Practice ORS C1 before disposal to sink.

(ii) Designated decay facilities ***shall*** be used for storage where decay can be employed as a method of disposal.

(iii) Detachable labels ***shall*** be used for waste containers stored in decay facilities.

(iv) To enable reasonably accurate calculation of the time allowed to decay isotopic waste, Responsible Principal Investigators ***shall*** keep good approximation of isotopic activities disposed. No allowance will be made for decay prior to storage of waste to decay.

(v) For unsealed liquid radionuclides with half-life longer than 90 days, waste ***shall*** be disposed of in accordance with Appendix 5 of the ORS Safe Code of Practice ORS C1, with the exception that allowable levels for disposal at sink ***shall*** be those **specified for sewer** in the Safe Code of Practice.

(vi) Responsible Principal Investigators are strongly advised to allow a margin of safety of at least 5 in their calculations.

(vii) Disposal to sewer ***shall*** be **via labelled sink.** The sink and associated exposed pipe fittings should be routinely monitored.

Syringes, needles, glass pasteur pipettes, razor blades

Sharp material will be packed and stored in approved plastic pails specifically used for sharp rubbish and allowed to decay wherever possible.

Contaminated Radionuclide Waste with hazardous chemical or biological properties

(i) Waste contaminated with radionuclides which also possesses hazardous chemical or biological properties cannot be treated with single protocol.

(ii) All radionuclide waste with hazardous chemical or biological properties will be notified to the Hazards and Containment Manager to ensure protocols that deal with multiple properties are drafted.

(iii) Wherever possible, biodegradable liquid scintillation cocktails with high flashpoints will be employed to facilitate disposal.

13.3 RECORDS OF DISPOSAL

Records of disposal ***shall*** be kept for all radionuclides in Category C Laboratories and retained for 10 years.

13.4 RADIONUCLIDE DECAY FACILITIES

The Hazards and Containment Manager ***shall*** inspect all facilities set aside for radionuclide decay at least every 6 months to ensure facilities have adequate security, adequate signage and storage procedures are observed.

14. CONTINGENCY PLANS

14.1 ACCIDENTS/INCIDENTS

(i) The Hazards and Containment Manager and the Health, Safety and Wellness Office ***shall*** be informed immediately in the event of:

a. Injury related to work with radionuclides/irradiating equipment
b. Exposure to ionising radiation resulting an equivalent dose of 0.6 mSv.
c. Any unaccounted loss of radionuclides.
d. Theft of radionuclides/irradiation equipment
e. Sabotage of irradiation equipment

(ii) Although it is anticipated that reports should be forwarded via Responsible Principal Investigators, Responsible Principal Investigators ***shall*** be notified immediately.

(iii) Accident/incident reports ***shall*** be reported on the University report form and forwarded to Health, Safety and Wellness Office.

(iv) Where the accident/incident involves significant potential exposures (as detailed in section 14.3) the Responsible Principal Investigator ***shall*** inform the Office of Radiation Safety within 24 hours. The Responsible Principal Investigator will also inform the Faculty Manager (via the Head of Department) and the following will be undertaken:

a. An internal investigation will commence immediately.
b. Corrective action will be undertaken as soon as possible.
c. In the event of a breach in security access control or locks would be changed within 24 hours.

(v) Records of the incident, internal investigation and corrective actions ***shall*** be retained by the Responsible Principal Investigator, the Hazards and Containment Manager and the Health and Safety Office.

14.2 ACCIDENT/INCIDENT INVESTIGATION

(i) ***All*** accidents and incidents involving radionuclides or irradiating equipment ***shall*** be reported to the University of Auckland Health and Safety Office in the manner prescribed for all accidents and incidents.

(ii) Both Head of Department and Responsible Principal Investigator ***shall*** be informed prior to reporting to the H&S Office.

(iii) The H & S Office ***shall*** advise the Hazards and Containment Manager of any accidents or incidents involving radionuclides or irradiating equipment in

order that the Hazards and Containment Manager can conduct an investigation.

14.3 ACTION LEVELS

(i) Where the accident results in a potential exposure level greater than 10% of the dose detailed below under ICRP 103 or results in ingestion of radionuclide of more than one-twentieth of the ALI (annual limit of intake), Responsible Principal Investigators ***shall*** immediately inform the Health and Safety Office and their Faculty Manager (via Head of Department).

(ii) Where the accident results in a potential exposure level greater than detailed below or results in ingestion of radionuclide of more than three-tenths of the ALI (annual limit of intake), Responsible Principal Investigators ***shall*** immediately inform the Office of Radiation Safety, Health and Safety Office and their Faculty Manager (via Head of Department).

Note: the equivalent dose limits for abdomen of pregnant women is lower and set at 0.6 mSv.

Effective dose to body	1mSv
Equivalent dose to skin	50mSv
Equivalent dose to eye	15mSv

14.4 SPILL

HCM shall be notified of any spill to ensure adequate decontamination and arrange follow up wipe tests if necessary.

14.5 PROCEDURES IN THE EVENT OF AN EMERGENCY

a. Unsealed sources at Category C Level

Procedures in the event of an emergency ***shall*** kept in each category C laboratory

b. Irradiating Equipment

Standard Operating Procedures ***shall*** be kept with each item of equipment detailing procedures to be adopted in the event of an emergency and nominating the person responsible for ensuring the equipment is turned off before evacuation.

14.6 HAZARD PLANS

Hazard Plans will identify location on floor plans of unsealed and sources of radionuclide and irradiating equipment in the University of Auckland to enable Emergency Services to be informed. Hazard Plans will be kept in Sprinkler Rooms in a locked cabinet accessible by the Fire Service.

14.7 RISK AND SECURITY MANAGEMENT PLAN

(i) The Hazards and Containment Manager will assess security risks under international obligations. These risks will include an assessment in the event of a major emergency posed by use and storage of high activity radionuclides or irradiating apparatus for the University of Auckland.

(ii) A Risk and Security Plan will be drafted annually to report the above risk assessment and will be forwarded to the appropriate Responsible Principal Investigators and the Deans of Faculties who will be required to manage these risks in the event of an emergency.

(iii) Where irradiating equipment is located in leased premises the Hazards and Containment Manager and the Responsible Principal Investigator involved will ensure the owner of the premises is aware of the equipment and assist that owner in developing Emergency Plans for the equipment or source.

15. USE OF IONISING RADIATION IN CLINICAL RESEARCH

15.1 USE OF RADIATION IN CLINICAL RESEARCH

(i) Responsible Principal Investigator ***shall*** comply with the relevant ORS Code of Safe Practice for clinical practice.

(ii) Responsible Principal Investigator ***shall*** ensure that the procedure is under the oversight of a clinician and Human Ethics Committee approval.

(iii) Responsible Principal Investigator ***shall*** take all reasonable efforts to ensure recommended calibration procedures are undertaken at intervals specified by the manufacturer. Results of these calibration procedures ***shall*** be retained on file by the RPI.

(iv) Patients ***shall*** be informed of the typical dose of ionising radiation they will receive in the course of the procedure. Comparison with typical doses received in other clinical or dental x-ray procedures ***may*** be useful to ensure patients are adequately informed.

(v) Warning signs ***shall*** be posted warning pregnant women of the presence of x-rays or ionising radiation.

(vi) Every effort ***shall*** be made to ensure paediatric doses are used (to ensure lowest effective doses are employed) where children are part of clinical studies

(vii) Responsible Principal Investigator ***shall*** employ a licensed radiographer or medical physicist where directed to do so by the ORS or by a ORS Code of Practice

(viii) Hazards and Containment Manager ***shall*** receive a copy of all correspondence with the ORS.

APPENDIX 1: Activity Categories

Radionuclide	O	Category A	Category B	Category C
H-3	< 1 GBq < 30 mCi)	1 GBq - 10 GBq 30 - 300 mCi	10 Gbq - 100 GBq 300mCi - 3 Ci	1 TBq 3 - 30 Ci
C-14	< 10 MBq <300 uCi	10 MBq - 1 GBq 300 uCi - 30 mCi	1 - 10 GBq 30 - 300 mCi	10 - 100 GBq 300 mCi - 3Ci
P-32	< 30 kBq <1 uCi	30 kBq - 100 MBq 1 uCi - 3mCi	1 GBq 3 - 30 mCi	10 GBq 30 - 300 mCi
P-33	< 30 MBq <1 mCi	30 - 100 MBq 1 - 3mCi	100MBq - 1 GBq 3- 30 mCi	1 - 10 GBq 30- 300 mCi
S-35	< 30 MBq <1 mCi	10 - 100 MBq 1 - 3 mCi	100 MBq - 1 GBq 3 - 30 mCi	10 GBq 30 - 300 mCi
I-125	< 3 MBq <100 uCi	3 - 10 MBq 100 - 300 uCi	10 - 100 MBq 300uCi - 3 mCi	100 MBq - 1 GBq 3 - 30 mCi

Activities Requiring Documented Usage

Radionuclide	
H-3	> 10 GBq (> 300 mCi)
C-14	> 1 GBq (> 30 mCi)
P-32	> 100 MBq (> 3 mCi)
P-33	> 100 MBq (> 3 mCi)
S-35	> 100 MBq (> 3 mCi)
I-125	> 10 MBq (> 300 uCi)

Appendix 2:
UNIVERSITY OF AUCKLAND
Unsealed Radioisotope Purchase Log

Location:

Date purchased	Radionuclide and Compound	Activity	Date consumed or Disposed

Appendix 3:
UNIVERSITY OF AUCKLAND
Radioactive Usage Log
(for Category B and C activities only)

Location:

Radionuclide and chemical form:

Date:

Date	Name	Activity removed	Activity Remaining

APPENDIX 4: INTERNAL VERIFICATION CHECKLIST – UNSEALED RADIONUCLIDES (Exempt and Category A levels)

Responsible Principal Investigator:

Department and Room Number:

Isotope Used: **Activities:**

Documentation

License required ☐ Code of Practice readily available ☐
Records of purchase ☐ List of users ☐
Users – all Trained ☐

Examples:

Substandard Items:

Monitoring program

Method Frequency

Area included in Wipe Test program Date of last check:

Laboratory Facilities

Prominent warning signs on storage areas ☐ Surfaces impervious ☐
Washbasins/soap/towels ☐ Fume Hood available ☐

Hot Area

Clearly defined ☐ Adequate signage ☐
Free of Clutter ☐ Adequate containment – trays etc ☐
User Log? ☐ Hot sink labelled ☐

Contamination Check (32P; 125I only) ☐

Substandard items:

Shielding

Correct shielding ☐ Adequate Shielding ☐

Survey instrument

Correct type ☐ Battery charged ☐
Included in UoA survey ☐

Storage Areas

Fridges/Storage areas labelled ☐ Containers labelled ☐
Activities present match records ☐

Comments:

Verification performed by: _____ Date: _____

Follow up Verification (where necessary)
To check items:

Performed by: _____ Date: _____

APPENDIX 5: INTERNAL VERIFICATION CHECKLIST – UNSEALED RADIONUCLIDES (Category B and C levels)

Responsible Principal Investigator:

Department:

Room Number:

Isotope Used: **Activities:**

Frequency of use:

Documentation

Current License	☐	Code of Practice readily available	☐
Records of purchase	☐	Records of use	☐
List of users	☐		

Substandard Items:

Monitoring program

Method Frequency

Documentation

Substandard Items:

Laboratory Facilities

Prominent warning signs on doors	☐	Surfaces impervious	☐
Washbasins/soap/towels	☐	Fume Hood available	☐
Refrigerator labelled	☐		

Hot Area

Clearly defined	☐	Adequate signage	☐
Free of Clutter	☐	Adequate containment – trays etc	☐
User Log?	☐	Hot sink labelled	☐
Correct shielding	☐	Adequate Shielding	☐

Substandard items:

Survey instrument

Correct type ☐ Battery charged ☐

Included in UoA survey ☐

Storage Areas

Fridges/Storage areas labelled ☐ Containers labelled ☐

Activities present match records ☐

Contamination Check (32P; 125I only)

Area clean ☐ Storage Area clean ☐

Training and OHS

All Users are trained ☐

Emergency protocols? (Class C only) ☐

Thyroid monitoring records ☐

Comments:

Verification performed by: _____ Date: _____

Follow up Verification (where necessary)
To check items:

Performed by: _____ Date: _____

APPENDIX 6: INTERNAL VERIFICATION CHECKLIST – SEALED RADIONUCLIDE SOURCES (Excluding fixed sources inside Irradiators)

Responsible Principal Investigator:
Department: **Room Number:**

Documentation

Inventory Present	☐ Inventory correct/matches license	☐
Log-out/Login Procedure	☐ List of Users	☐
Users trained	☐ Warning signage on storage area	☐

Wipe Tests

Date of Last Wipe test:

Comments:

Verification performed by: _____ Date: _____

Follow up Verification (where necessary)
To check items:
Performed by: _____ Date: _____

APPENDIX 7: INTERNAL VERIFICATION CHECKLIST – ANALYTICAL X-RAY EQUIPMENT

Responsible Principal Investigator:

Department:

Room Number:

Make: **Model:**

Category of X-ray equipment (A, B or C):

Documentation

Log of use ☐ Local Rules/Procedures ☐

Procedures to Prevent Unauthorised Access

Prominent warning signs on doors ☐
Equipment key actuated? ☐
Software password protected? ☐
Door locked or swipe card controlled when equipment unattended ☐

Equipment Verification

Equipment labelled with warnings ☐
Equipment warning lights functioning ☐

Dosimetry readings

Leakage and scatter survey undertaken ☐ Date:

Work Practices

Is there more than one Operator? Yes/No

If one Operator, name of XRD Operator:

If more than one Operator, is there a log of training Yes/No

List of all users ☐

All users trained ☐

Training method:

Maintenance

Has there been any maintenance in the last 12 months?

Maintenance logged ☐

Service agent for machine Yes/No
Name:

UoA staff are licensed to repair ☐
Name:

Sign off procedures before recommissioning ☐

Evidence of perimeter dose rate before recommissioning ☐

Emergency:

Is there a Person responsible for shutdown? ☐

Location of emergency shutdown switch known or is the switch is clearly labelled? ☐

Comments:

Verification performed by: _____ Date: _____

APPENDIX 8: DEXA SCANNER and qCT

Responsible Principal Investigator:

Department: **Room Number:**

Make: **Model:**

Documentation

Operated only by User licensees ☐
Supervising clinician:
Current Ethics approvals available ☐
System to log machine use ☐
List of all users and their training record ☐
Operating Procedures ☐
QA and Phantom record system ☐
Evidence of review of phantom scans ☐

Are children likely to be scanned?

Is there awareness of use of paediatric made?

Procedures

Prominent warning signs on doors ☐
Warning signs for pregnant women ☐
Access to area with equipment controlled by lock or swipe card ☐

Dosimetry readings

Date of Scatter survey undertaken:
Room layout or screening appropriate for machine ☐

Maintenance

Regular maintenance undertaken and logged ☐

Licensed Service agent for machine Yes/No

Name:
Written documentation of safe re-instatement ☐

Comments:

Verification performed by: _____ Date: _____

APPENDIX 9: FLUOROSCOPE

Responsible Principal Investigator:

Department: **Room Number:**

Make: **Model:**

Documentation

Only operated only by Cardiologist or a suitably qualified MRT ☐

Operator dose monitored by:

Log of use ☐

Written instructions for others present ☐

Warning signage when in operation ☐

Annual certification of Fluoroscope:

Undertaken by:

Date:

Annual certification of lead aprons, gloves and thyroid screens ☐

Adequate shielding in walls ☐

Adequate warning signage ☐

Comments:

Verification performed by: _____ Date: _____

APPENDIX 10: NEUTRON SOURCE

Responsible Principal Investigator:

Department: **Room Number:**

Source:

Documentation

Only operated only by Use licensee ☐

Log of use ☐

Verification of dose to patient and operator ☐

Environmental survey at dose at various locations in the facility ☐

Adequate warning signage ☐

Room locked when not in use ☐

Comments:

Verification performed by: _____ Date: _____

APPENDIX 11: INTERNAL VERIFICATION CHECKLIST – IRRADIATING EQUIPMENT (Linear accelerator, 137Cs and Cobalt 60 sources)

Responsible Principal Investigator:

Department: **Room Number:**

Type of equipment **Activity of Source:**

Make: **Model:**

Documentation

List of Use Licensees ☐ Code of Practice readily available ☐

Maintenance Log Present ☐ Log of use ☐

Laboratory Facilities

Prominent warning signs on doors ☐ Room locked when not in use ☐

Log of key holders ☐

Methods of security:

Equipment

Equipment labelling ☐

Equipment warning lights and interlocks functioning ☐

Date of last check:

Dosimetry readings

Perimeter and typical dosimetry checks last taken:

Environmental survey last taken:

ORS Film Badges or Instadose ☐ Film badges cover all users ☐

Frequency of renewal:

Length of time records retained: Location of file:

Pocket dosimeters in use ☐ Date of last check:

Work Practices

User instructions and/or SoP ☐ SoP for maintenance ☐

Training

Up-to-date ☐ ☐

Covers Radiation Safety principles ☐

Emergency:

Accidents/incidents ☐ Emergency protocol ☐

Person responsible for shutdown ☐ Emergency contacts ☐

Comments:

Verification performed by: _____ Date: _____

Follow up Verification (where necessary)
To check items:
Performed by: _____ Date: _____

APPENDIX 12: UNIVERSITY OF AUCKLAND

Protocol for Personal Dosimetry

- Personal dosimeters ***shall*** be issued by Responsible Principal Investigator responsible for irradiating apparatus or high activity radionuclide source.

- The Responsible Principal Investigator shall keep a record all staff and students issued with film badges and TLDs

- Personal dosimeters may be film badges or thermo-luminescence dosimeters (TLDs) issued by an ORS approved provider or microprocessor dosimeters that record cumulative dose at each occasion the dosimeter is used.

- Responsible Principal Investigator ***shall*** issue instructions on correct use and correct position that dosimetry device is to be worn.

- Responsible Principal Investigator ***shall*** ensure all personal dosimeters, film badges or TLDs are renewed or read at least every 3 months.

- In the case of separate microprocessor dosimeters, the Responsible Principal Investigator ***shall*** ensure all readings are recorded in a logbook or database.

- Separate microprocessor dosimeters are used in addition to dosimeters the microprocessor dosimeters ***shall*** be checked every year.

- The Responsible Principal Investigator ***shall*** retain all records of all personal dosimeter, film badge or TLD results for all staff and students issued with all personal dosimeters, film badges or TLDs.

- The Responsible Principal Investigator ***shall*** review results and ensure that dose exceeding 100microSieverts is reported to the HCM immediately.

- The Responsible Principal Investigator ***shall*** record all lost or non-returned all personal dosimeters, film badges or TLDs. The Responsible Principal Investigator ***shall*** ensure a new monitoring device is obtained prior to the individual continuing work with radionuclide or apparatus.

- The HCM ***shall*** verify compliance with the above procedure at time of internal verification.

ATTACHMENTS

Training Procedures for Unsealed Isotopes

Note that Training documents are available via Canvas Web Portal and students' understanding is verified by quiz undertaken in Canvas

Note also that procedures related to Uranyl acetate disposal and wipe tests are also available on the same Canvas portal