



UNIVERSITY OF AUCKLAND RADIATION SAFETY PLAN

Version 3 – August 2006

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UNIVERSITY OF AUCKLAND POLICY

Policy Statement

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 purchase or acquisition of radionuclides (both sealed and unsealed) material above exempt levels and irradiating equipment by University of Auckland staff will only be undertaken by holders of a current license issued by the National Radiation Laboratory (NRL).
3. The University reaffirms the primary responsibility of license holders and staff to ensure safe use, storage, transport and disposal of radionuclides. License holders must meet the statutory requirements of the Radiation Protection Act, its associated Regulations and Safe Codes of Practice promulgated by the National Radiation Laboratory.
4. License holders must ensure that they are able to provide adequate supervision and instruction of staff and students using radionuclides. The license holder will also ensure that risk of incurring exposure from any isotopic source is kept As Low As Reasonably Achievable (ALARA)
5. The University will assist the license holders and the NRL to monitor work with radionuclides to ensure that ALARA principals are adopted. The University will also assist license holders by providing training on safe use of radionuclides and irradiating equipment.
6. 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:
 1. Internal auditing and reporting systems.
 2. Radiation safety training
 3. Systems for document retention
 4. Management oversight of radionuclide work
7. 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 license holders to ensure that all users of radionuclides are aware and follow statutory obligations, IAEA protocols, National Radiation Laboratory Codes of Safe Practice and the University of Auckland Radiation Protection Plan.

Responsibilities

A. University/Faculty Administration

1. In conjunction with license holders, 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 they will receive reports from the Hazards and Containment Manager.
2. Will inform the Deputy Vice Chancellor (Research) of any Corrective Action Report (see section 6.2) with significant health and safety implications.
3. Will direct the Hazards and Containment Manager and the University Health and Safety Coordinator to disseminate information and ensure all license holders are fully informed of all developments with regard to policy.
4. Will provide appropriate courses in the safe handling of radioactive materials/irradiating equipment.
5. Where license holders 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 license

holders (see Section 4.1). It will be the responsibility of license holders to deposit records with the Health and Safety office.

6. Faculties may support the provision of appropriate facilities for shared use of radionuclides (such as Category C laboratories).

B. Deans and Heads of Department

1. In consultation with license holders, 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. To this end they will receive reports from the Hazards and Containment Manager.
2. Deans will authorise applications for licenses and license renewal conditional on agreed compliance with statutory obligations and the Radiation Protection Plan.

C. University of Auckland Health and Safety Coordinator

The University of Auckland Health and Safety Coordinator 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 and Safety Coordinator receives copies of any reports, audits and recommendations concerning the use of radionuclides and irradiating equipment.

In the event of accidental radiation exposure, the Health and Safety 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. License Holders

License holders are responsible for:

1. The safe use, storage and disposal of unsealed radionuclide or irradiating equipment purchased or otherwise obtained under their respective licenses. License holders will follow the relevant NRL Code of Safe Practice
2. Ensuring that adequate records of purchase, transfer, use and disposal specified in Sections 3.8 to 3.10 are maintained and available for inspection by the Hazards and Containment Manager and the NRL. Documentation will include a Standard Use Protocol as specified in Appendix 7.
3. Ensuring that the safe receipt, use, storage and disposal of radionuclides and irradiating equipment is in accordance with University of Auckland policy and is in compliance with the Radiation Protection Act and associated Regulations and NRL policy (which includes the NRL Safe Codes of Practice). The guiding principal will be to ensure that all exposures are kept As Low As Reasonably Achievable (ALARA).
4. Ensuring that all staff and students attend training provided by the Centre for Professional Development (CPD) before commencing work with radionuclides. If this is not practical, the license holder will ensure that the new staff/student will attend the course as soon as possible. In such cases the license holder will be responsible for ensuring that, in the interim, the untrained staff/student is made aware of the hazards, is trained adequately to ensure safe handling of the radionuclide concerned and is given specific instructions on how to handle the radionuclide.
5. 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.
6. Ensuring that the Hazards and Containment Manager is notified of the purchase of isotopic sealed sources (above exempt levels) or irradiating equipment. License holders must also notify the

Hazards and Containment Manager of any transfers or disposal of the above radionuclide or equipment.

7. 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 NRL and notification to the Hazards and Containment Manager.
8. Ensuring a copy of the Radiation Protection Act and the Safe Code of Practice is readily available to all staff/students under their supervision.
9. Ensuring adequate monitoring procedures are established and documented.
10. Ensuring that adequate survey meters (where applicable) are available for monitoring work and work areas in which radionuclides are held and used.
11. Ensuring that adequate safety equipment is available for the safe use of radionuclides.
12. Ensuring that there is no transfer of radionuclides to unauthorised individuals.
13. Ensuring that exposure of employees is maintained as low as reasonably achievable (ALARA).
14. Distributing, collecting and collating results of personnel monitoring devices for any staff where recommended or required by the NRL Safe Code of Practice
15. Ensuring that any exposure of female staff/students is kept well within the NRL guidelines for ionising radiation.
16. 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 NRL within 24 hours. License holders must inform the Health and Safety Coordinator and Head of Department at the same time.
17. Ensuring that radiation emission data and/or calculated doses that staff are likely to be 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 as defined by the NRL will be used in accordance with the NRL Safe Code of Practice. Users of exempt quantities of radionuclide will be responsible for:

1. The safe use, storage and disposal of exempt unsealed radionuclide or irradiating equipment. The relevant NRL Safe Code of Practice will be followed.
2. Documentation of radionuclide purchase will include a Standard Use Protocol as specified in Appendix 7.
3. Ensuring the safe receipt, use, storage and disposal of radionuclides and irradiating equipment is in accordance with the NRL Safe Codes of Practice and the University of Auckland Radiation Protection Plan.
4. Ensuring that ALARA principles are followed at all times.
5. Ensuring that all staff and students attend training provided by CPD before commencing work with radionuclides. If this is not practical, the license holder will ensure that the new staff/student will attend the course as soon as possible. In such cases the license holder will be responsible for ensuring that, in the interim, the untrained staff/student is made aware of the hazards, is trained adequately to ensure safe handling of the radionuclide concerned and is given specific instructions on how to handle the radionuclide.
6. Ensuring adequate monitoring procedures are established and documented.

7. Ensuring that adequate survey meters are available for monitoring work and work areas in which radionuclides are held and used.
8. Ensuring that adequate safety equipment is available for the safe use of radionuclides.
9. Ensuring that the exposure of employees is maintained as low as reasonably achievable (ALARA).
10. Ensuring that any exposure of female staff/students is kept well within the NRL 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 Protection Act and associated Regulations, NRL policy (which includes the NRL Safe Codes of Practice) and this Radiation Protection 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 Licence Holder. Where exempt quantities of radionuclide are used, directives issued by the University will be followed.

G. Hazards and Containment Manager

Will work with Faculty Administrations and License Holders 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 with particular reference to safe practice in Category C laboratories.
2. Providing routine training classes of personnel on all aspects of radionuclide use, storage and disposal via CPD programs.
3. Oversees the purchasing/processing of transfer of sealed sources of radionuclide/irradiating equipment.
4. Maintains inventory of sealed sources and handheld survey meters
5. Undertaking periodic audits of all facilities and irradiating equipment. Audits will ensure adequate documentation is in place. The Hazards and Containment Manager will report to and make recommendations to Registry and license holders in the University.
6. Ensuring radiation disposal facilities are maintained in a safe and secure manner for University license holders.
7. Ensuring license holders and all radionuclide and irradiating machine users are kept informed of University and NRL policy directives.
8. Ensuring Faculty Administrations and Directors of Institutes are kept fully informed of all reports, audits and recommendations.

1. INTRODUCTION

1.1 THE UNIVERSITY OF AUCKLAND

- The University of Auckland is responsible for delivering research-based teaching at graduate and postgraduate level.
- The University is also charged with fostering research, which is primarily publicly funded and contestable. The results of most of this research are released into the public arena.

1.2 ADMINISTRATIVE STRUCTURE OF THE UNIVERSITY OF AUCKLAND

- The academic operation of each Faculty is managed by Deans of Faculties through the respective Heads of Department. Faculty Registrars oversee the physical and financial resources of the Faculty for the Deans. Core services such as property maintenance and custodial services are separately managed by Facilities Managers.
- License holders approved by the National Radiation Laboratory to import and use radio-isotopic sources and/or irradiating equipment are accountable to Heads of Department and the Dean of Faculty in which they are employed.
- Deans of Faculties are responsible to the Vice Chancellor and Council.
- The Vice Chancellor, through the Deans and Heads of Department will ensure that the University's responsibilities with regard to irradiating equipment, sealed and unsealed radioradionuclide sources are met by the establishment of reporting and auditing systems.
- As line managers for their respective areas, Heads of Department and Faculty Administration will be an integral part of the management of safe use of radionuclides and ionising radiation , ensuring that license holders are aware and follow both University policy and National Radiation Laboratory guidelines.
- The Hazards and Containment Manager in conjunction with license holders will conduct internal audits of radionuclide and ionising radiation use. The results of these audits will be reported to the University of Auckland Health and Safety Coordinator, Institute Directors, Heads of Department and Deans of Faculty.

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

2.1 USE OF RADIONUCLIDES AND IRRADIATING EQUIPMENT IN THE UNIVERSITY OF AUCKLAND

- (i) The Hazards and Containment Manager (HCM) *shall* ensure an accurate record of:
 - a.) all current licence holders in the University of Auckland
 - b.) the location of experimental work involving radionuclides

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

2.2 LICENSE APPLICATION AND RENEWAL

- (i) All applications to the NRL for new licenses or license amendment *shall* require authorisation from the Dean of Faculty.
- (ii) Authorisation of the license application *shall* be conditional on agreement to comply with statutory obligations and the requirements of this Radiation Protection Plan.
- (iii) Where a licensee will be on extended leave (longer than 4 weeks and less than 3 months), that licensee must apply to the NRL to appoint a 'Person in Charge'. Copies of the application *shall* be lodged with the Hazards and Containment Manager.
- (iv) Where a licensee will be on leave longer than 3 months, another member of staff *shall* apply to the NRL to become a licensee for that area.

2.3 PURCHASE OF SEALED 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 also accepts responsibility for any radionuclide source or irradiating equipment in the event that a license holder fails to renew their license. The following notification provisions are designed to reduce these risks:

- (i) Purchase or transfer of sealed sources of radionuclide or irradiating equipment *shall* be notified to the Hazards and Containment Manager by the licensee.
- (ii) Transfer of B or C quantities of unsealed sources of radionuclide *shall* be notified to the Hazards and Containment Manager by the licensee.
- (ii) Notification *shall* be within 10 working days of receipt of goods. Failure to comply will be brought to the attention of the Head of Department.

2.4 PURCHASE OF UNSEALED SOURCES

- (i) Accurate records of purchase of all sealed and unsealed sources shall be maintained by License holder or user of exempt sources as detailed in Section 4.

2.5 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 A, 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.
- (v) All warning labels *shall* be removed or rendered unreadable before disposal of packaging.

2.6 TRANSFER/RECEIPT OF EQUIPMENT WITH SEALED RADIONUCLIDE SOURCES

- (i) Transfer of equipment containing radionuclide source onto University premises *shall* be notified to the Hazards and Containment Manager within 5 working days of transfer.

3. USE OF IONISING RADIATION IN NON CLINICAL RESEARCH AND TEACHING

3.1 SAFE CODE OF PRACTICE

- (i) All staff and students working with sealed and unsealed sources of radionuclides or irradiating equipment *shall* observe their statutory obligations under the Radiation Protection Act and its associated Regulations as described in the relevant NRL Safe Code of Practice.
- (ii) All license holders *shall* observe the requirements of this University Radiation Protection Plan.
- (iii) Staff and students handling radionuclides or irradiating equipment *shall* have ready access to a copy of the relevant Acts, Regulations and applicable NRL Codes of Safe Practice.

3.2 LABORATORY FACILITIES

- (i) The design of laboratory facilities in which sealed and unsealed sources are handled *shall* meet the requirements section 5.1 of the ERMA approved HSNO Code of Practice for University/CRI Exempt Laboratories (HSNO COP 1/1).
- (ii) Unsealed sources of radionuclide *shall* be handled in dedicated areas designed to ensure containment of any spill and *should* have appropriate shielding. These dedicated areas may be established on a temporary basis for the purposes of experimentation. A system of monitoring contamination in the dedicated area *shall* be established.
- (iii) 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.

3.3 SAFETY PRACTICES

- (i) The basic safety procedures within laboratories in which unsealed sources are handled *shall* meet the requirements of section 4 of the ERMA approved HSNO Code of Practice for University/CRI Exempt Laboratories (HSNO COP 1/1).

3.4 TRAINING

- (i) All Staff/Students working with sealed and unsealed sources of radionuclides *shall* attend the University of Auckland Safe Use of Radionuclides course held by the Centre for Professional Development (the syllabus is detailed in Appendix 2).

- (ii) Training *shall* be conducted prior to handling of sealed and unsealed radionuclide in quantities qualifying as Categories B and C (see Appendix 1).
- (iii) Training *should* be conducted prior to commencing work with other quantities of radionuclide. If training is not possible prior to handling radionuclide the laboratory personnel *shall* attend the next available training session. In such cases, the supervisor *shall* ensure that detailed instructions are given to the untrained user to ensure adequate supervision.
- (iv) All users of irradiating equipment are required to have core knowledge in radiation safety. This core knowledge can be obtained by undertaking a self-directed learning program such as the one available on the Health and Safety website.
- (v) In the case of irradiating equipment with sealed sources laboratory personnel *shall* attend the CPD training course.
- (vi) Records of attendance at CPD course *shall* be maintained by the Hazards and Containment Manager and will be available for audit purposes.
- (vii) Records related to core knowledge in radiation safety in x-ray equipment *shall* be kept by license holder

3.5 DECLARED PREGNANCY POLICY

- (i) The licensee 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.
- (ii) Reasonable efforts *shall* be taken by the licensee and female staff member (which include documented instruction) to maintain effective dose to an a minimum.

3.6 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 licensee *shall* contact the Hazards and Containment Manager.
- (ii) The licensee *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 NRL, 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 areas where less than Category C use of unsealed nuclide is used. License holders *shall* document all surveys taken to determine that the areas are

safe to return to normal laboratory use. Licensees *shall* retain the results of these surveys on file.

3.7 USE OF RADIONUCLIDE 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 radiolabelled solutions.

4. OPERATIONAL DOCUMENTATION

4.1 OPERATIONAL DOCUMENTATION (IRRADIATING EQUIPMENT)

License holders for irradiation equipment and equipment with sealed sources *shall* document the following:

1. Operating Procedures for the use of the Equipment. (Local Rules)

- (i) License holders *shall* document procedures for the safe operation of a particular piece of equipment. These shall be deemed to be Local Rules
- (ii) License holders *shall* ensure staff and students are aware and comply with these procedures/Local Rules.
- (iii) Specific instructions *shall* be given to ensure only trained license holders or suitably licensed staff undertake repair of these machines.
- (iv) All Local Rules will detail actions in the event of an emergency.

2. Record of training on use of the Equipment

- (i) License Holders *shall* ensure that every staff member and students who operates equipment capable of delivering ionising radiation knows and understands 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.
- (ii) All users are also required to have core knowledge in radiation safety. This core knowledge can be obtained by undertaking a self-directed learning program available on the Health and Safety website in the case of x-ray equipment. In the case of irradiating equipment with sealed sources laboratory personnel *should* attend the CPD training course. In either case, verification of understanding of the principles of radiation safety and appropriate statutory obligations will be verified by sitting a written test and achieving a pass mark of 60%.
- (iii) The License holders *shall* have a record that the staff and student displays the required competency and understanding of Local Rules to safely operate that equipment

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

- (i) Logs for all irradiating equipment and sealed sources of radionuclide detailing use of equipment will be kept beside each machine.

3. Equipment Maintenance

- (i) Where equipment maintenance is carried out by a person possessing a license to maintain analytical X-ray equipment as per clause 2.4.1 NRL C17), the responsibility for the maintenance licensee will cease once machine has been repaired, safely recommissioned and documentation of verification completed.(see below). Safe Use of the machine then becomes the responsibility of the Use licensee.

(ii) Record of Equipment Maintenance

- (iii) License holders will pay particular attention to the ability of maintenance personnel to bypass safety interlocks and remove shielding. In such cases, license holders will document verification that interlocks have been reinstated, shielding has been reinstated safely and dose rates are within acceptable limits.
- (iv) Maintenance licenses will keep use the prescribed form to record verification that interlocks are functioning, shielding has been properly reinstated and dose rates are within acceptable limits

4. Monitoring Protocols

- (i) If dose rates are not monitored at regular intervals, then irradiation equipment leakage and scatter will be measured annually or after any alteration to the machine.

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

4.2 OPERATIONAL DOCUMENTATION (SEALED SOURCES)

License holders of sealed sources will undertake an inventory of all sealed sources under the control of License holder detailing:

1. radionuclide
2. activity (with reference date)
3. any unique identifier (serial number)
4. exempt status
5. date of wipe test (license holder will conduct wipe tests for sources above exempt quantities). This will not apply to sources where it is unsafe to perform direct wipe tests.

Training

For those persons who are not license holders and who supervise the handling of licensable sealed sources, verification of understanding of the principles of radiation safety and the appropriate statutory obligations will achieved by sitting a written test and achieving a pass mark of 60%.

All records will be kept for a minimum of 10 years (see Section 4.1)

4.3 OPERATIONAL DOCUMENT (EXEMPT AND REGULATED QUANTITIES OF UNSEALED SOURCES)

License holders for unsealed sources will document the following:

1. Records of radionuclide purchase

(i) Records of purchase of unsealed sources *shall* be kept. Purchase records *shall* detail:

1. Radionuclide and its chemical form
2. Activity
3. Purchase date

(ii) Readily accessible accounting records may suffice. License holders must be able to have records of purchase of radionuclide available for inspection by the NRL.

Note: unsealed sources above quantities specified for Category B and C laboratories (see Appendix 1) records of individual usage must be kept (see subsection 2 below).

(iii) The license holder *shall* keep a record of any transfer of radionuclide notified to the NRL.

2. Operating Procedures for the use of the Radionuclide in Exempt and A Categories

(i) For radionuclide use in exempt and A Categories O (see Appendix 1), license holders *shall* provide protocols outlining typical experiments for each radionuclide (see Appendix 7).

(ii) These protocols *should* outline how the radionuclide is used, typical radionuclide incorporation rates and the percentage of radionuclide in solid and liquid waste generated.

3. Operating Procedures for the use of the Radionuclide in Categories B and C.

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

(ii) License holders *shall* also provide protocols outlining typical experiments for each radionuclide (see Appendix 7).

(iii) These protocols *should* outline how the radionuclide is used, typical radionuclide incorporation rates and the percentage of radionuclide in solid and liquid waste generated

4. Record of those personnel using radionuclide

(i) License Holders *shall* ensure that the name of every staff member and student who use radionuclides is recorded.

- (ii) License Holders *shall* ensure that these persons attend the CPD Radiation Safety Course and are supervised adequately or given specific instruction.

5. Monitoring Protocols

- (i) The method and frequency of monitoring contamination of work surfaces and equipment for each radionuclide *shall* be documented in the protocol (see Appendix 7).
- (ii) Periodic wipe tests *shall* be conducted where low energy beta emitting radionuclides are used.
- (iii) Protocols *shall* include acceptable limits for contaminated equipment and how contaminated equipment will be stored or surfaces decontaminated.

4.4 INVENTORY OF IRRADIATING EQUIPMENT AND EQUIPMENT CONTAINING SEALED SOURCES OF RADIONUCLIDE.

- (i) The Hazards and Containment Manager *shall* maintain an accurate register of irradiating equipment or equipment containing sealed sources of radionuclides.

5. OCCUPATION HYGIENE AND MONITORING

5.1 PERSONNEL MONITORING

- (i) Laboratory personnel handling 125-I or 131-I in a volatile form (i.e. performing radioiodinations) **shall** have a thyroid scan once a week or after each occasion radioactive iodine is used, whichever 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 and used in a reproducible geometry.
- (ii) Calibrated thyroid scans **shall** be performed by Nuclear Physics Department, Auckland Hospital.
- (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 handling more than 1.5 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.
- (v) Once permission has been 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.

5.2 DOSE MONITORING

- (i) The Hazards and Containment Manager **shall** monitor doses received in the course of typical experiments involving sealed and unsealed sources. Results **shall** be published on the University Health and Safety Website.
- (ii) Dose levels **shall** be measured around x-ray diffraction equipment at least every 6 months. The measurements **shall** be documented.
- (iii) Measurements **shall** be taken for procedures where alignment of beams in x-ray diffraction equipment is undertaken by University staff.

5.3 RADIATION DOSE LIMITS

Notwithstanding the statutory requirement to maintain dose limits within those limits specified in ICRP 60, the University will adopt ALARA principles. Limits for persons exposed to radiation as a normal condition of employment **should** be maintained at 1/3 limits specified in ICRP 60.

Effective dose to body	6mSv
Equivalent dose to skin	150mSv
Equivalent dose to eye	50mSv
Equivalent dose to hands or feet	150mSv
Equivalent dose to abdomen of pregnant women	0.6mSv

5.4 CONTAMINATION MONITORING

- (i) Wipe tests shall be undertaken on a 3 monthly basis to monitor use of unsealed low energy beta emitters. Records shall be undertaken by the Hazards and Containment Manager.
- (ii) 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.

5.5 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.
- (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.
- (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.

Survey equipment that fails to meet acceptable standards *shall* be withdrawn from service for repair.

6. AUDITS AND DOCUMENTATION

6.1 INTERNAL AUDIT

- (i) The over-riding consideration in conducting any audit *shall* involve facilitation with licensees to ensure safe working practices are adopted.
- (ii) After notifying the Head of Department and license holders, the following audits *shall* be carried out by the HCM:
 - a. Audit of documentation for each license holder (see Sections 3.8 to 3.10)
 - b. Environmental surveys of exposure levels and tests for contamination.
 - c. User training will be verified.
 - d. Comparison of survey meters.
 - e. Audit of work areas – including signage.

Note: Examples of audit documents are given in Appendices 5 and 6.

- (iii) The frequency of audit *shall* be at least once every 12 months but will ultimately depend on use/purchase of radionuclide.
- (iv) As a result of audit, the University Radiation Protection Plan *shall* be reviewed to ensure currency and adequacy.
- (v) License Holders and Head of Department *shall* be advised of the outcome of the audit.

6.2 REQUESTS FOR CORRECTIVE ACTIONS

- (i) Where internal or NRL audits result in corrective action requests, the Head of Department *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.

6.3 AUDIT REPORTS

- (i) A copy of the audit reports *shall* be retained in the Health and Safety Office for inspection.
- (ii) A summary of the reports will be presented to the Deans of the relevant Faculty and OESHAC.

6.4 TRAINING RECORDS

- (i) All training records *shall* be kept by CPD and reviewed to ensure that all staff and students using unsealed isotopic sources and irradiating equipment using sealed sources are adequately trained in basic radiation safety.
- (ii) Authorised staff and students using irradiating apparatus *shall* have specific training delivered that is pertinent to basic x-ray safety.
- (iii) In addition, the Hazards and Containment Manager *shall* ensure the following:
 - a) Undergraduate students using radionuclides are issued with adequate instruction.
 - b) An awareness program for maintenance staff is established.

6.5 RETENTION OF RECORDS

- (i) Licensees *shall* retain all records relating to sealed and unsealed radionuclides or irradiating apparatus for 10 years.
- (ii) Where a license holder 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 license holder to ensure that such records are deposited with the Hazards and Containment Manager.

6.6 RADIATION PROTECTION PLAN

- (i) The Radiation Protection Plan *shall* be issued with date and version number.
- (ii) A copy *shall* be lodged with the Health and Safety Office.
- (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 license holders are consulted before any changes or amendments are made to the Radiation Protection Plan

7. DISPOSAL

7.1 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.

7.2 DISPOSAL OF UNSEALED RADIOISOTOPIC SOURCES

Solid Waste

- (i) Where radionuclide has a half-life of less than 90 days, waste *shall* be allowed to decay to levels specified by the relevant National Radiation Laboratory Safe Code of Practice. To enable reasonably accurate calculation of the time allowed to decay isotopic waste, licensees *shall* keep good approximation of isotopic activities disposed. No allowance will be made for decay prior to storage of waste to decay. A sample form for this purpose is presented in Appendix 4.
- (ii) Designated decay facilities *shall* be used for storage for the purposes of decay.
- (iii) Detachable labels *shall* be used for waste containers stored in decay facilities.
- (iv) For radionuclides with half life longer than 90 days, waste *shall* be disposed of in accordance with National Radiation Laboratory Safe Code of Practice.
- (v) License holders are strongly advised to allow a margin of safety of at least 10 in their calculations.

Liquid Waste

- (i) Where radionuclide has a half-life of less than 90 days, waste *shall* be allowed to decay to levels specified for sewer by the National Radiation Laboratory Safe Code of Practice before disposal to sink.
- (ii) Designated decay facilities *shall* be used for storage.

- (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, licensees *shall* keep good approximation of isotopic activities disposed. No allowance will be made for decay prior to storage of waste to decay. A sample form for this purpose is presented in Appendix 4.
- (v) For radionuclides with half-life longer than 90 days, waste *shall* be disposed of in accordance with National Radiation Laboratory Safe Code of Practice, with the exception that allowable levels for disposal at sink *shall* be those specified for sewer by the Safe Code of Practise.
- (vi) License holders are strongly advised to allow a margin of safety of at least 10 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.

7.3 RECORDS OF DISPOSAL

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

7.4 RADIONUCLIDE DECAY FACILITIES

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

8. CONTINGENCY PLANS

8.1 ACCIDENTS/INCIDENTS

- (i) The Hazards and Containment Manager and the Health and Safety Coordinator *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 license holders, license holders *shall* be notified immediately.
- (iii) Accident/incident reports *shall* be reported on the University report form and forwarded to Health and Safety Office.
- (iv) Where the accident/incident involves significant exposures (as detailed in the relevant NRL Safe Code of Practice) the license holder *shall* inform the National Radiation Laboratory within 24 hours. The license holder 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 license holder and the Health and Safety Office.

8.2 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 License holder *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.

8.3 ACTION LEVELS

- (iii) Where the accident results in a potential exposure level greater than 10% of the dose detailed below or results in ingestion of radionuclide of more than one-twentieth of the ALI (annual limit of intake), license holders *shall* immediately inform the Health and Safety Office and their Faculty Manager (via Head of Department).
- (iv) 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), license holders *shall* immediately inform the National Radiation Laboratory, Health and Safety Office and their Faculty Manager (via Head of Department).

Note: the ICRP equivalent dose limits for pregnant women are lower than other staff members.

Effective dose to body	6mSv
Equivalent dose to skin	150mSv
Equivalent dose to eye	50mSv
Equivalent dose to hands or feet	150mSv
Equivalent dose to abdomen of pregnant women	0.6mSv

8.4 SPILL

Procedures to be followed in the event of a spill *shall* be kept in each laboratory.

8.5 PROCEDURES IN THE EVENT OF AN EMERGENCY

a. Unsealed sources

Procedures in the event of an emergency *shall* kept in each 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.

8.6 EMERGENCY PLANS

Emergency Plans will identify location on floor plans of unsealed and sources of radionuclide and irradiating equipment in the University of Auckland.

8.7 RISK MANAGEMENT PLAN

- (i) The Hazards and Containment Manager will assess the risks posed by use and storage of radionuclides and irradiating apparatus for the University of Auckland.
- (ii) The Hazards and Containment Manager will develop and update a contingency plan to manage these risks in the event of an emergency.

9. USE OF IONISING RADIATION IN CLINICAL RESEARCH

9.1 USE OF RADIATION IN CLINICAL RESEARCH

- (iv) License holders *shall* comply with the relevant NRL Code of Safe Practice for clinical practice.
- (v) License holders *shall* be subject to regular NRL audit and inspection.
- (vi) License holders *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 licensee.
- (vii) 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.
- (viii) License holders *shall* employ a licensed radiographer where directed to do so by the NRL or by a NRL Code of Practice
- (ix) Hazards and Containment Manager *shall* receive a copy of all correspondence with the NRL.

APPENDIX 1: Activity Categories

Radionuclide	O limit	A Limit	B Limit	C Limit
H-3	1 GBq (30 mCi)	10 GBq (300 mCi)	100 GBq (3 Ci)	1 TBq (30 Ci)
C-14	10 MBq (300 uCi)	1 GBq (30 mCi)	10 GBq (300 mCi)	100 GBq (3 Ci)
P-32	30 kBq (1 uCi)	100 MBq (3m Ci)	1 GBq (30 mCi)	10 GBq (300 mCi)
P-33	30 MBq (1 mCi)	100 MBq (3m Ci)	1 GBq (30 mCi)	10 GBq (300 mCi)
S-35	30 MBq (1 mCi)	100 MBq (3 mCi)	1 GBq (30 mCi)	10 GBq (300 mCi)
I-125	3 MBq (100 uCi)	10 MBq (300 uCi)	100 MBq (3 mCi)	1 GBq (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: SYLLABUS FOR RADIATION SAFETY COURSE

The training programme consists of one three hour workshop sponsored by CPD which covers the following topics:

A. BACKGROUND THEORY

1. Nuclear decay
2. Interaction with matter and living tissue
3. Dose and its measurement
4. ICRP threshold limits and their application to radiation safety

B. SAFE HANDLING OF RADIONUCLIDES

1. Basic principles of ALARA
2. Basic principles of Radiation Safety
3. Legal Obligations and University Policy
4. Transport
5. Sealed Sources
6. Disposal
7. Protocols for emergencies.



APPENDIX 5: INTERNAL AUDIT CHECKLIST – UNSEALED RADIONUCLIDES

License Holder:

Department:

Room Number:

Radionuclides Used:	Activities:

Documentation

Current License	<input type="checkbox"/>	Code of Practice readily available	<input type="checkbox"/>
Records of purchase	<input type="checkbox"/>	Records of use (if applicable)	<input type="checkbox"/>

Laboratory Facilities

Prominent warning signs on doors	<input type="checkbox"/>	Surfaces impervious	<input type="checkbox"/>
Washbasins/soap/towels	<input type="checkbox"/>	Fume Hood available	<input type="checkbox"/>

Hot Area

Clearly defined	<input type="checkbox"/>	Adequate signage	<input type="checkbox"/>
Free of Clutter	<input type="checkbox"/>	Adequate containment – trays etc	<input type="checkbox"/>
User Log (if applicable)	<input type="checkbox"/>		

Shielding

Correct shielding	<input type="checkbox"/>	Adequate Shielding	<input type="checkbox"/>
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Storage Areas

Fridges/Storage areas labelled	<input type="checkbox"/>	Containers labelled	<input type="checkbox"/>
Activities present match records	<input type="checkbox"/>		

Survey instrument

Make: _____ Model: _____
Correct type Battery charged
Included in annual survey

Inventories (Category B and C Activities only)

Adequate inventories Accurate

Personnel Monitoring (125-I and 131-I only)

Thyroid monitoring Records kept

Contamination Check

Contamination detected Location: _____

Work Practices

Laboratory coats in use Waste not accumulating
Provision for spills

Training

Staff – CPD course Emergency protocol

Comments:

Audit performed by: _____ Date: _____

Follow up Audit (where necessary)
To check items:

Performed by: _____ Date: _____



APPENDIX 6: INTERNAL AUDIT CHECKLIST – ANALYTICAL IRRADIATING EQUIPMENT

License Holder:

Department:

Room Number:

Type of equipment

Activity of Source:

Make:

Model:

Energy of Emission:

Documentation

Current License

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

Equipment

Equipment labelling

Equipment warning lights functioning

Interlocks functioning

Dosimetry readings

Dose < 25 Gy @ 5 cm

Perimeter and typical dosimetry checks last taken

Pocket dosimeters in use:

Date of last calibration:

Work Practices

User instructions and/or SoP SoP for maintenance

Training

Up-to-date

Emergency:

Accidents/incidents Emergency protocol

Person responsible for shutdown

Comments:

Audit performed by: _____ Date: _____

Follow up Audit (where necessary)

To check items:

Performed by: _____ Date: _____



APPENDIX 7: UNIVERSITY OF AUCKLAND Protocol for Unsealed Radioactive Material

Laboratory:

Principal Investigator:

1. Radionuclide and Use

Radionuclide:

Chemical form:

Category of activity of primary vial (Exempt, A, B or C)

Brief description of experiment:

Typical Activity used:

Range of activity used:

Amount incorporated in Experiment (approx % and activity):

2. Storage

Location of primary vial storage:

3. Waste

Approx. total activity of waste generated by experiment:

Solid waste

Approx. total activity sent to solid waste:

How and where is solid waste disposed?

Is waste disposed by decay?

Liquid waste

Approx. total activity sent to liquid waste:

How and where is liquid waste disposed?

Is waste disposed by decay?

Approx. total activity discharged to sewer:

Location of 'hot sink':

4. Monitoring Regime

Type of Monitoring:

If wipe test specify locations:

Monitoring performed by whom:

Frequency:

Level of unacceptable contamination: