UNIVERSITY OF EDINBURGH
GENERIC RISK ASSESSMENT - RADIATION

RP/RA2 - LABORATORY TRACER WORK USING TRITIATED MATERIAL

Foreword

This is a generic risk assessment for use by persons involved in or effected by the application of radiation outlined in the Scope section below. It must be read together with the relevant completed and countersigned Proposed Scheme of Work form PSoW/US6. Together they make up the risk assessment of each application for each person working with radiation in the University. The specific control measures for each application are recorded in the relevant Local Rules.

Where risks are recognised with an application that are not included in this assessment the University Radiation Protection Adviser must be informed.

Note that this assessment refers only to the risk arising from radiation. There might be other risks arising from this work and these must be properly assessed using the University's risk assessment approach. Guidance can be obtained from the Health and Safety Department.

Scope

This risk assessment concerns work using typical amounts of unsealed tritium in the laboratory for the purposes of tracing or quantifying chemical or biological pathways or reactions. It applies only to tritiated material[1] and in a liquid form.

Work with gaseous forms of this radionuclide is excluded from this assessment, except for very small amounts of gas, vapour or aerosol formed as part of the experiment or determination. Laboratory tracer work with other categories of radionuclides have their own generic risk assessments.

Hazards

- Uptake into the body by ingestion, inhalation or absorption of small amounts of radioactivity, resulting in irradiation of the internal organs, possibly for long periods of time.
- Uptake into the body by ingestion, inhalation or absorption of large amounts of radioactivity as a result of an accident, resulting in irradiation of the internal organs, possibly for long periods of time.

Persons likely to be exposed to the hazard: University staff, research staff, students and other workers. Pregnant women and persons less than 18 years old would be at particular risk.

Risk before the implementation of control measures:

Category of Person	High	Medium	Low
University staff, research staff, students and other workers	○	◉	○
Members of the public	○	○	◉
Persons particularly at risk: pregnant women and young persons	○	◉	○

Tritium is extremely mobile, and there is a significant risk of the release of airborne contamination, as elemental tritium or tritiated water vapour. This increases the risk of exposure from inhalation.

[1] i.e. hydrogen-3 acquired and maintained in a non-elemental form.

Reasonably foreseeable accidents:

Type of Incident	Possible Effects
Known spillage of the tritiated material	Ingestion, inhalation or absorption of significant quantities of radioactive material
Unknown leakage of the tritiated material	Ingestion, inhalation or absorption of small quantities of radioactive material
Accident resulting in a cut to the skin	Absorption of significant quantities of radioactive material
Breach of containment or failure of extract ventilation	Inhalation of small quantities of radioactive material
Flooding	Ingestion, inhalation or absorption of small quantities of radioactive material
Fire	Ingestion or inhalation of small quantities of radioactive material
Loss of radioactive material	Ingestion, inhalation or absorption of small quantities of radioactive material by members of the public

Justification and Optimisation

It is assumed that the use of unsealed radioactive material is needed to fulfil the desired work. The amount of activity should however be minimised, and a justification made for the choice of tritium.

Control Measures

Technical

- The surfaces of all laboratories or parts of laboratories that are used for tracer work must be designed and installed to minimise the risk of radioactive contamination, including its long term build-up, and permit easy decontamination.
- Sinks, waste traps and pipework must be designed and installed to minimise the risk of contamination, including its long term build-up, and permit easy decontamination.
- There must be a separate hand basin for personal washing, supplied with hot and cold running water.
- Disposable towels, soap and nail brushes must be available at each hand basin.
- Disposable paper tissues must be readily available.
- Laboratories must be provided with a good standard of general ventilation. As a guide, the air-change rate should be at least 5 h^{-1}.
- Suitable and sufficient fume cupboards must be provided. They must be designed and installed so as to minimise the risk of contamination, including its long term build-up, and permit easy decontamination.
- Controlled area laboratories must have adequate facilities for storing personal protective clothing.
- There must be adequate storage facilities for the tritiated material, including space for refrigerators.
- Each laboratory or part thereof used for the work must be clearly marked in accordance with the Health and Safety (Safety Signs and Signals) Regulations.
- Each must also have a notice at the entrance that specifies its designation, the permitted radionuclides and corresponding maximum activity values, and a list of the authorised workers who may use the area.
- The tritiated material must be stored in a segregated and secure area that is clearly marked in accordance with the Health and Safety (Safety Signs and Signals) Regulations. It is acceptable for small amounts to be stored in a refrigerator or other location shared with non-radioactive material, but they must still be clearly segregated and marked.
- There must be suitable and sufficient immediate storage facilities within the laboratory for

the tritiated waste. The storage must be segregated into the appropriate waste streams and clearly marked. Sinks used for the disposal of aqueously miscible tritium waste must be clearly marked as such.

- If waste facilities outside of the laboratory are used, they must be secure, clearly segregated from other non-active material, and appropriately marked. The inner surfaces of the store must be designed and installed to minimise the risk of radioactive contamination, including its long term build-up, and permit easy decontamination.
- All laboratory facilities must be adequately inspected and maintained so far as is necessary to ensure their continuing safe use.
- Appropriate means of monitoring should be available for all areas where tritiated material is used. This will normally mean a liquid scintillation counter. The monitoring instrumentation must kept in good condition, including free from contamination. It must be tested at annual intervals.

Procedural

- Only those persons who have been authorised by the University Radiation Protection Adviser must be allowed to work with the radioactive material.
- Work to which this assessment applies must only be carried out within a segregated and designated laboratory area, except when:
    - transporting material in between such areas; or
    - using specialist equipment not available within a designated laboratory area.
- Careful consideration must be given when establishing an experimental procedure to the probability of the generation and release of elemental tritium or volatile tritiated material. If necessary, an initial experiment using small quantities of tritium should be carried out to identify and quantify such generation[2].
- Any operation likely to produce small quantities of tritiated gas, vapour or aerosol must be carried out in a fume cabinet or other suitable extracted enclosure.
- When the activities being handled are in excess of the relevant limits specified in Guidance Note GN1 – Controlled and Supervised Areas, the laboratory areas must be designated as shown in the Guidance Note.
- If persons are routinely working with activity values less than the stock solution, they do not need to be classified. However, if their work involves handling the stock solution activities all the time, then they might need to be classified and must contact the University RPA for further information.
- Where workers are not classified but work is carried out in a Controlled Area as described in the previous paragraph, then the following restrictions must be imposed:
    - undergraduates are not permitted to undertake the work;
    - entry to the Controlled Area must be in accordance with a written arrangement, which must be incorporated into the Local Rules;
    - all visitors to the Controlled Area must be accompanied; and
    - persons must only work in the area, once it is known that they are pregnant, in compliance with special control measures.
- Personal dose monitoring of unclassified workers is not normally necessary. Occasional personal monitoring by the measurement of tritium-in-urine should be undertaken to identify any procedures that are giving rise to higher than normal doses. Classified workers must undergo personal dosimetry monitoring.
- All work to which this assessment applies must be in line with prepared Local Rules.
- All persons must wear appropriate protective clothing when handling or in the immediate vicinity of the tritiated material. Confinement of laboratory coats to the designated areas is unnecessary except when contaminated or when working routinely with activities equal to or in excess of those requiring a Controlled Area. Two pairs of disposable gloves must be worn to reduce the risk of breakthrough by tritiated material. All personal protective

[2] If there is the possibility of the release of elemental or volatile tritiated material, it will be also be necessary to compare any potential atmospheric discharge against the appropriate Radioactive Substances Act authorisation.

equipment, save disposable equipment, must be adequately maintained, including any appropriate washing.
- Working and hygiene procedures must be such as to minimise the risk of personal or other contamination, whether by normal working practices or in case of accident.
- In view of the difficulty in monitoring for tritium contamination, workers must wash their hands each time they leave the laboratory.
- All apparatus used for handling the tritiated material must be labelled to warn of the presence of the material so far as is reasonably practicable. Batch labelling may be used.
- Movement of the tritiated material around or in between laboratories must be minimised. Where it is taken outside of the laboratory, double containment must be used to reduce the risk of spillage. Transport of radioactive material outside of the University premises must be in accordance with the Radioactive Materials (Road Transport) Regulations.
- Workers must monitor for contamination all appropriate surfaces of designated laboratories before leaving the laboratory, and immediately after spillages. Records of the monitoring checks must be kept.
- Surface contamination must be removed as soon as practicable.
- The tritiated material must be stored in a secure refrigerator - not a freezer unless the experiment requires it - at all times and within a designated area. The material should be kept in glass containers in preference to plastic.
- The frost/condensate in the storage refrigerator must be monitored for tritium contamination at regular intervals. Where tritiated material is continuously stored, monthly intervals should be used.
- The opening of containers used for the long term storage of tritiated material should be carried out in a fume cupboard or other suitable extracted enclosure.
- There must be arrangements in place to ensure that tritiated material is both delivered to and transferred within the premises safely.
- The whereabouts of the tritiated material must be known at all times. Records must be kept of the activity on site, the consumption, the fraction disposed of to each of the permitted waste streams, and the identification of the persons undertaking the work to which the record relates.
- Plans must be drawn up and included in the Local Rules for procedures in case of the accidents listed above.

Behavioural

- All persons handling unsealed radioactive material must be trained in the correct and safe method.
- All female workers must be instructed in the need to inform their line manager or the Occupational Health Department as soon as they are aware that they are pregnant.
- A Radiation Protection Supervisor must be appointed to provide suitable supervision of all work with unsealed radioactive material. He/she must be trained in the measures required to ensure compliance with the controls outlined in this risk assessment and with the Local Rules.
- All relevant workers must be trained in the action to be taken in order to implement the contingency plans made.

Dose constraint

No special dose constraint is required for work to which this risk assessment applies.

Dose Investigation level

The majority of the workers to which this risk assessment applies should not receive a dose in excess of the limit for non-classified persons. The dose investigation level for these workers is therefore set at 6 mSv per annum. In the case of the small number of classified workers, the work will be non-routine, and it is therefore likely that personal doses will not initially be predictable. The

initial investigation dose level for these workers is therefore set at 15 mSv per annum.

Risk after the implementation of control measures:

Category of Person	High	Medium	Low
University staff, research staff, students and other workers	○	○	⊙
Members of the public	○	○	⊙
Persons particularly at risk: pregnant women and young persons	○	○	⊙