Ionising Radiation Regulations 1999

LOCAL RULES

These rules apply to the following areas:-
Biomedical Physics cell culture lab (B6/7)

Issue date April 2012

Review date April 2014

Note If you are reading this document after the review date please check with your RPS that you have the latest version
1. Radiation protection supervisor is: Tim Smith

2. Designated areas:

<table>
<thead>
<tr>
<th>Controlled radiation areas</th>
<th>Supervised radiation areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Room B6/7 Biomedical Physics</td>
</tr>
</tbody>
</table>

3. Unsealed Radionuclides used

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Half Life</th>
<th>Emissions</th>
<th>Contamination monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>18F</td>
<td>110min</td>
<td>Positron, gamma</td>
<td>EP15</td>
</tr>
<tr>
<td>3H</td>
<td>5y</td>
<td>beta</td>
<td>Scintillation counter</td>
</tr>
<tr>
<td>111In</td>
<td>2.8d</td>
<td>gamma</td>
<td>EP15</td>
</tr>
<tr>
<td>99mTc</td>
<td>6h</td>
<td>gamma</td>
<td>EP15</td>
</tr>
</tbody>
</table>

3.1 Holding and aqueous discharge limits

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Holding limit</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18F</td>
<td>100MBq</td>
<td>90MBq</td>
<td></td>
</tr>
<tr>
<td>3H</td>
<td>540MBq</td>
<td>540MBq</td>
<td></td>
</tr>
<tr>
<td>111In</td>
<td>15MBq</td>
<td>15MBq</td>
<td></td>
</tr>
<tr>
<td>99mTc</td>
<td>100Mbq</td>
<td>90 MBq</td>
<td></td>
</tr>
<tr>
<td>14C</td>
<td>75</td>
<td>75 MBq</td>
<td></td>
</tr>
</tbody>
</table>

4. General Lab arrangements

These rules must be posted in each laboratory radioactive materials are handled. A prior risk assessment must be carried out before commencing new work activities and recorded using form on the iso-inventory system.

Access to the lab
- Access to radiation areas should be restricted to those who have been trained and are...
directly involved in the experiment unless authorised unless they are under the close supervision of the RPS.

General

- Experiments should be carefully planned and should only take place if no other equivalent experiment which does not involve radioactive substances exists.

- Consideration should be always be given to using the least hazardous radionuclide for example P-33 should be used in preference to P-32.

- Experiments involving radioactive materials should only be carried out by suitably trained staff/students. Any new member of staff or student wishing to undertake work with unsealed radioactive substances must first have completed the basic radiation safety course. Additionally the principle investigator/RPS should ensure that all staff or students working on the experiment are proficient in basic laboratory techniques before they start manipulation of radioactive substances unsupervised. It is important that all staff involved in this work are suitably trained in carrying out contamination monitoring.

lab procedures

- Observe all the basic laboratory safety procedures:
  - There must be No eating, drinking or applying cosmetics in the laboratory
  - Never use your mouth to pipette
  - If you see a colleague doing something dangerous, point it out to him/ her immediately and if necessary report it to the RPS
  - Work must not be carried out by a person with an undressed cut or abrasion below the wrist

- Lab coats or other suitable protective clothing should be worn at all times when entering a supervised area. Disposable gloves and protective eyeglasses should be worn whenever unsealed sources are being handled or manipulated.

- Work should be carried out over trays wherever possible.

- All apparatus being used with radioactive materials must be labelled using “radioactive” warning tape. The tape must be removed when the apparatus has been washed and found to be clear of contamination.

- Radioactive substances must only be removed from controlled or supervised areas in closed uncontaminated containers.

- Radionuclides emitting penetrating radiations must be adequately shielded. Lead shielding must be used for gamma emitters and perspex shielding for beta emitters.

- Containers for radioactive materials other than Carbon - 14 and tritium should not be directly held in the unprotected hand. (Note: the outside of containers of Carbon-14 and H-3 can become contaminated so it is good practice to wear gloves when handling them). Tweezers should be used for handling sealed radioactive sources.

- Contamination must be contained without delay and you must be familiar with the contingency procedures given in section 14

- Keep time manipulating radioactive substances to a minimum.
• Place any waste items in the appropriate bin as described in section 13

• Keep all radioactive materials in labelled containers and stored in designated fridge. In general, fridges that are used to store radioactive materials should not be used to stored non-active items. If it is necessary to use a fridge for active and non active items there should be clear demarcation and additional containment for the active items.

• At the end of a work session always tidy up and perform a contamination check of the bench, see section 10. If significant contamination is found then follow the contingency procedure.

• Always check your gloves, hands and laboratory coat for radioactive contamination before leaving the laboratory, see below.

• Wash your hands using the hand wash sink before leaving the laboratory.

• In case of emergency remain calm and follow the contingency procedures.

5. Local arrangements and procedures

Sources are manipulated on the tray within the lead enclosure within lab B6. Protein/precursor labelling: the activity is transferred to reaction tube containing precursor molecules and incubated on the tray or in the adjacent water bath. When centrifuging down samples use centrifuge adjacent to the lead enclosure keep outside 1M of centrifuge (check dose rate at this distance with the mini 900 ratemeter). Non-incorporated activity from washes (centrifugation washes) are disposed of down the sink in B7 and washed down by running tap at moderate rate for 5min.

Cell incubations: Flasks of cells (upto 20) are incubated with tracer (upto 10MBq total activity) is dissolved in 7ml of medium solution on the tray within the lead enclosure and 0.3ml added to each flask. Flasks incubated in incubator in lab B7 for requisite time - check dose rate at 1M keep outside area until processing cells). Processing cells involves pouring media down sink and washes 3X with PBS each time pouring wash down wash down sink. By this stage as only about 5% of incubation activity incorporates, 95% (so 9.5MBq) will be in liquid waste.

Preparation of liposomes containing 99mTc or 18F: 2MBq of either 99mTc or 18F are added to a phospholipid mixture in total volume of 1ml. The solution is loaded into a syringe which is attached to a second syringe via a sealed union. The solution is then pumped through the grid to the second syringe. This procedure is repeated 10-20x - total time<5min). The solution is then unloaded into a centrifugal filter and centrifuged at 12000g for 15mins and the filtrate placed into a microfuge tube. PBS is added to the liposomes held on the filter and the centrifugation repeated up to 20X and the filtrate collected and stored behind lead blocks until experiment end. The liposomes are collected from the filter. The filter is store until all activity has decayed. The syringes are washed under the tap in the designated sink and checked for remaining activity – further washing as required. The liposomes will be administered to cells as described above for tracers. After counting activity in all the washes the contents will be disposed of down the designated sink. About 10% of the activity will be in the liposomes which will also be disposed of via liquid waste (designated sink).

6. Pregnant and breast feeding females

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

7. Personal Monitoring

If you are issued with a personal dose monitor you must wear it and it is your responsibility to look after it. These badges should be worn at hip or waist level. For work with certain isotopes, additional dosimeters may have to be worn on the fingers or at neck level. If your loose your dosimeter or it is damaged (or goes through a washing machine) tell your RPS without delay and arrangements will be made to issue a replacement. You should stop working with radioactive materials until a replacement monitor has arrived.

Finger and badge dosimeters are taken over to Lutz Schweiger in the PET unit at the beginning of each month and exchanged for dosimeters for that month.

8. Dose investigation levels

The following dose investigation levels apply.

<table>
<thead>
<tr>
<th>Investigation level (over the wear period of the dosimeter)</th>
<th>Effective whole body dose (mSv)</th>
<th>Equivalent dose to the skin (averaged over &lt;100cm²) (mSv)</th>
<th>Equivalent dose to lens of the eye. (mSv)</th>
<th>Equivalent dose Hands, forearms, feet and ankles (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>7.5</td>
<td>2</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

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

If one of these levels is exceeded an immediate investigation should take place to establish why the level has been exceeded and any preventative actions that are required.

9. Contamination monitoring

After completing each series of manipulations check gloves, labcoat, exposed clothing and shoes with monitor. Check area around lead enclosure, incubator and sink with monitor if using 18F, 111In or 99mTc or take swabs using dampened pieces of paper tissue, placing into vials containing scintillation fluid and counting on the beta-counter.

10. Ordering radioactive materials

Sealed sources must not be ordered

Unsealed sources are ordered after entering details onto iso-inventory system. Upon receipt details are entered onto iso-inventory system. The source is unpacked to the level of the lead pot or plastic housing and the source number written on the housing.

11. Storing radioactive materials

The sources are stored either in the polystyrene box marked ‘Radioactive’ in the locked fridge in B7 or the freezer inside the sealable plastic tub.
12. Disposing of radioactive waste

Cell incubations with up to 10MBq of 18F, maximum that will incorporate will be 5% so rest is disposed down sink. Remaining 0.5MBq (more usually less than 0.4MBq) will be collected into 20 vials, counted and then dissolved overnight in NaOH in Room B6 after which all activity will have decayed.

Experiments involving 111In – 10MBq collected from the ARI Radiopharmacy 2MBq will be utilised for labelling proteins, nanoparticles, tracer precursors. Wash volumes kept to less than 10ml total volume after centrifugation and placed in original source vial and returned to Radiopharmacy. Labelled tracer incubated with cells (as for 18F above) and about 90% washed away and disposed of down sink as liquid waste. Solid waste (the remainder) kept within lead enclosure for 2 weeks to decay.

Experiments with 3H: procedures as above but from cell experiments the 5-10% of 1MBq will be added to scintillation fluid and counted. These will then be washed out in the sink in B7 utilised for radioactive disposal, activity checked by swabbing washed tubes and adding swab to a scintillation tube and counting. If not above background tubes disposed in biological waste bags. Disposals in the designated sink will be recorded in the iso-inventory. Items allowed to decay to be recorded and source status et to ‘Dead’ and disposal date recorded

Aqueous Liquid Waste

This may be disposed of only via the approved sinks in the radioactive laboratories and with the following precautions:

- The radioactive waste should be poured carefully and directly into the waste outlet.
- The total activity of waste discharged per month must not exceed the maximum permitted under the terms of the Authorisation Certificate for the school given in section 3. Liquid waste disposals should be logged onto the iso-inventory system before disposal is made to ensure limits are not breached.

Solid waste

Solid waste should be disposed of according to the following diagram.
Solid or Scint waste

Put waste in numbered waste to appropriate bag in lab

**LLW Solid waste**
Includes empty vials, pipette tips, contaminated gloves and other experimental materials

Seal bag when full

Attached green label

Transfer to waste store

**LLW Scint waste**
Mainly liquid scintillation vials plus any other items containing contaminated scintillation fluid.

Seal bag when full

Attach yellow label

Transfer to waste store

**VLLW**
Solid waste below the thresholds given in table 7.1 or that will below the thresholds within 12 months. Must NOT include sharps bins or any other waste that would not normally be put in normal refuse

Seal bag when full

Attach orange label

Transfer to waste store

Add in any information about which bins should be used for each category of waste and location of spare bags, who can seal bags etc.

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

RADIATION SPILLAGE

1. Immediately alert personnel working near the area of the radiation spill and if possible alert RPS. If in doubt contact radiation protection service for help and advice. Any personnel not required to deal with the spillage should remove them selves from the area after checking them selves for contamination.

2. Put on lab coat, over shoes and gloves

3. Do not allow anyone to walk through the spillage and spread the contamination. If possible isolate and cordon off the area.

4. Use a contamination monitor to locate areas of contamination on the work bench, floor and workers.

5. **If a worker has become contaminated deal with them first** (although it would be prudent to cover the spillage with absorbent material such as paper towels to prevent it from spreading.)

   - If a member of worker believes they are contaminated they should always attempt to locate the contaminated area and decontaminate just that area. Only if large areas of the body are contaminated should staff resort to a full body shower.

   - **Contamination of the skin, hands, arms.** If significant contamination is found on the hands staff should remove and discard gloves and re-monitor their bare hands. If still contaminated then the hands should be washed using a suitable detergent and then re-monitored and if necessary a soft brush should be used. Care should be taken not to break the skin. Other areas of exposed skin should be washed in a similar manner and re-monitored. The RPS should make a suitable report of any incident, including an estimation of dose, and submit it to the RPA.

   - **Contamination in the eyes.** If a member of staff suspects that radioactivity has splashed into their eyes, they should use an eye bath. Another member of staff should then take a reading using the contamination monitor. If contamination persists then contact the RPA. The RPS should make an appropriate report any incident, including an estimation of the dose, and submit it to the RPA.

   - **Contamination on clothing.** If contamination is found on a lab coat or other clothing it should be removed, bagged and either disposed of or be allowed to decay.

6. Cover the spillage with absorbent material such as paper towels to prevent it from spreading.

7. Remove as much contamination as possible by absorbing the spill on paper towels. Contaminated towels should be disposed of as radioactive waste.

8. Ensure that any glass that has broken is placed in a sharps bin and label as radioactive.

9. Any residual contamination should be clean using a detergent, when mopping up always work form the outside in.
10. Monitor the area to ensure that all the activity has been removed.

11. If the area has been cleared of radioactivity, remove the tapes and signs.

12. Remove apron, shoes, gloves and place in the black plastic bag monitor and dispose as radioactive waste if necessary

13. Monitor hands, clothes and feet to ensure that they are not active.

14. If clothes or shoes become contaminated, remove them and bag them. If mildly contaminated they should be washed as normal before they are worn again.