Recommended facilities for laboratories used with open sources of radioactive material

This Safety Note summarises the minimum standards that should be applied to (1) any upgrade or redesign of laboratories used for open source work and (2) that applies to all existing open-source facilities.

Introduction

The purpose of this Note is to provide guidance on the standards which are expected to apply to facilities where open-sources of radiation are used or stored. This guidance is neither prescriptive nor exclusive, and there may be other appropriate means of compliance in specific circumstances.

These standards are intended to meet the safety and environmental principles which apply to the use of open-sources of radioactivity at the University. These are based on Environment Agency recommendations and the requirements that all relevant parts of the premises are constructed, maintained and used in such a manner that they do not readily become contaminated, and that any contamination which does occur can easily be removed.

Where there is any apparent conflict of the standards to be adopted, the overriding principle should be that surfaces liable to contamination by radioactive material should be easy to clean and decontaminate: the main criterion to be met is that “the floor, ceiling walls, furniture and fittings in any part of the premises where a registered substance is used are maintained in such a condition that they can easily be cleaned.” Where hazardous biological agents are also used, the recommendations for Microbiological Containment laboratories should also be taken into account.

Please note: Compliance with these standards should not necessarily be regarded as satisfying the demands or expectations of individual EA Inspectors, who may have additional observations to make concerning the facilities that are present in specific circumstances.
The benchmark for the standards given in this Note is a new radiochemical laboratory. Inspectors are expected to have regard to the criterion of reasonable practicability when assessing the suitability of existing facilities or where there is only minor usage (e.g. one-off radioimmunoassay kits).

Part 1: Recommendations for new radiation facilities or laboratory up-grades

**Note:** ALL surfaces should be impervious to water, and resistant to the effects of acids, alkalis, solvents and disinfectants. In some cases, materials may specifically bind certain types of ions and so even though the surface may comply with the recommendations for chemical resistance, the chemical nature of the isotopes in use will have to be taken into account.

| Floors | The floor should be covered with an impervious surface such as a **continuous** sheet of PVC or linoleum at least 2.5 mm thick. The floor must be easy to decontaminate, as such a smooth finish flooring is recommended. Joints between sheets are not recommended, but may be permitted if the joints are welded and regularly inspected to ensure the absence of a seepage path for contamination. All edges at the walls should be sealed or welded to prevent seepage of spilled materials. The floor covering should be coved to the wall to a height of about 15 cm contiguous with the floor surface, but a coved skirting which seals the gap between the floor and the wall may be acceptable for areas in which only a small amount of open source work is done. Any non-slip sealant material used to facilitate cleaning may be applied provided that spilled materials can be easily removed during the decontamination procedure. As an alternative to a sheet material covering, an epoxy resin coating may provide an acceptable finish on smooth concrete. |
| Walls and Ceilings | The walls and ceilings should be smooth and painted with a hard gloss or high quality **waterproof** (acrylic) emulsion to facilitate cleaning. (BS 4247 Part 2). For higher grade laboratories, an oil-based eggshell or stain finish paint or an impervious two-pack isocyanate resin coating may be required. Joints should be sealed or filled with silicone type materials to facilitate cleaning (or removal in the event that decontamination cannot be achieved). Service penetrations in walls and ceilings should be sealed and coved. Suspended ceilings may potentially cause problems due to penetration of contamination. |
| **Wash-hand basin and Changing facilities** | Wash hand basins should have non-hand-touch type taps. Elbow-operated taps are acceptable, but for higher grade labs, optical-sensor operation is recommended. The hand wash basin should always be located near the main exit from the laboratory, to act as a prompt for occupants to wash their hands before they leave.  
Hand-drying facilities (paper towel dispenser) and hand soap should always be provided.  
As a minimum, hanging space for lab-coats should be provided near the laboratory entrance.  
For higher grade labs, a lobby/ changing area should be provided, so that outdoor clothing is stored separately from lab coats. |
| **Doors and Windows** | Wooden surfaces should be covered with plastic laminate material or painted with a good quality polyurethane gloss paint or varnish.  
Doors should be lockable to ensure safe keeping or to restrict access in the event of major spillage of the materials.  
Doors leading off public places and which are frequently opened should additionally be secured by use of a key-pad lock or swipe-card system.  
Where opening windows are fitted, care should be taken that no persons immediately outside the building could be affected by any release of radioactivity. |
| **Benches and cupboards** | Working surfaces should be smooth, hard and non-absorbent and have necessary heat and chemical resistant properties.  
The benchtops should be coved (upstand) at the rear against walls. Gaps should be sealed with a silicone type material. Some bench top designs have a raised front lip which can help prevent a spillage running off the bench on to the floor.  
**NOTE:** Depending on the type and quantity or radioactive materials used, account may need to be taken of the problems involved in decontaminating certain materials used for bench surfaces. For example: `Corian` apparently locks onto iodine (e.g. I-125) in several chemical forms; Melamine fixes sodium ions (e.g.Na-22) under some conditions; stainless steels may bind phosphate (e.g.P-32) or chromium (e.g. Cr-51) firmly and may be very difficult to decontaminate.  
The use of wood surfaces, including under benches or for cupboards should be avoided on all **new** laboratory designs. Exposed wood should be painted with a good quality hard gloss paint or polyurethane varnish or laminated. |
| **Waste Disposal Sinks and Drainage Pipes** | Sinks for the disposal of radioactive aqueous liquids should be constructed of suitable material: for most applications, good quality stainless steel is preferred (note phosphate ions may bind strongly on to stainless steel, and this may cause problems in laboratories where P-32 is used in quantity). |
| Waste Disposal Sinks and Drainage Pipes (cont) | Where possible, combined sinks and draining boards should be used, with a sink depth of greater than 20 cm, rounded front edges and coved (upstand) at the rear against walls. All gaps and joins should be sealed with silicon sealant.

An easily decontaminable rear splash plate should extend a reasonable distance up the wall behind the sink. A side splash guard (sink side) is considered university standard.

Small diameter U-shaped traps should be used, instead of large traps or catch pots, so as to avoid accumulations of radioactive sediments.

The drain should be connected as directly as possible to the main foul water sewer leaving the premises. Holding tanks are generally undesirable in terms of sedimentation, but may be used by some laboratories for other reasons - such as confirming compliance with chemical discharge consent conditions. The discharge route should be mapped and recorded for future reference in case of maintenance on the system. Drainage system materials should take into account the possible build up of contamination on surfaces.

**NOTE:** All drainpipe materials may retain specific radionuclides. The most generally useful type - 'Vulcathe' fixes iodine very strongly - which may be significant where the radiiodines have to be disposed of through drains of this material.

Drainage pipes for radioactive effluent should be labelled with the ionising radiation symbol up to a point at which their contents are diluted substantially with frequently - flowing, non-radioactive effluents.

Pipes should be well-supported along a suspended run, should be down-sloped to prevent accumulations of radioactivity, and, where reasonably practicable, should be made accessible - for example by the use of demountable panels.

| Ventilation and Containment | General dilution ventilation (air circulation) should be provided in all radioactive laboratories. Where small quantities of radioactive materials are used, this may be provided using an extractor fan mounted in a window or a wall.

Where larger quantities of radioactive materials are used, a guiding principle for effective control of contamination is that air movement should be maintained from less-contaminated areas to more-contaminated areas. This may be achieved for example by extracting from a general laboratory area through a fume cupboard to a discharge stack.

If a fume cupboard is to be used for open-source work (for example, for dispensing or manipulation of large quantities or to allow for discharge of radioactive gaseous waste products), the ductwork from the fume cupboard must be appropriately labelled ["Radioactive"]). The discharge must go directly to the open air, and must discharge at a minimum height of 3 metres above the roof line / the position of any air intakes to the building. Re-circulating or scrubber fume cupboards should not be used. |
<table>
<thead>
<tr>
<th><strong>Ventilation &amp; Containment (cont)</strong></th>
<th>Where work includes the use of hazardous biological agents a Class I - III microbiological safety cabinet may be used (with discharge conditions described above). Internal and external surfaces of workstations should be smooth, hard and non-absorbent and have the necessary heat and chemical resistant properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radioactive Storage Facilities (including Waste)</strong></td>
<td>Adequate storage space should be available to keep essential equipment in order to minimise the clutering of equipment near working areas, and reduce the risk of spreading contamination. All refrigerators / freezers, and radioactive materials within them, should be easily identified (labelled) and should be lockable. Waste disposal bins in the laboratory (used for storing solid waste awaiting disposal) should be constructed of robust plastic, and preferably should be foot-operated. Adequate separate and secure storage facilities should be available for radioactive waste. The storage space must be kept locked when not occupied and may need to be under surveillance.</td>
</tr>
<tr>
<td><strong>Other Facilities</strong></td>
<td><strong>Tacky mats</strong> may usefully be installed in laboratory doorways, to prevent the spread of contamination. Monitoring of these mats may give early warning of a contamination problem. <strong>Warning signs</strong>, clearly and legibly marked with the word 'Radioactive', with the Ionising Radiation symbol (BS3510: 1968 or ISO 36 1) and any other information necessary (contact person, telephone number, etc), should be placed on doors. <strong>Stools and chairs</strong> should either be non-upholstered, or be upholstered in a non-absorbent material covered with an impervious surface that is easy to clean. Wooden stools must not be used. <strong>Adequate lighting</strong> should be provided throughout the laboratory, particularly to enable operators to see spillage easily. <strong>Emergency showers</strong> are not normally recommended in laboratories handling relatively small amounts of radioactivity as they can spread contamination. <strong>Laboratories for large-scale tritium usage</strong> - particular considerations apply to facilities who handle tritium in quantity. It is the usual practice for a facility handling large amounts of tritium (multi-GBq quantities) to be separate from other buildings to prevent the spread of radioactivity beyond the controlled area, and to allow any escape to be diluted by the outside atmosphere.</td>
</tr>
</tbody>
</table>
Part 2: Minimum requirements for existing radiation-facilities

This part of the guidance is designed as a checklist for facilities refurbished prior to 2005 in order to check compliance with “the floor, ceiling walls, furniture and fittings in any part of the premises where a registered substance is used are maintained in such a condition that they can easily be cleaned.”

| Floors | • The floor should be in a good state of repair with no cuts or breaches.  
• Joints should be inspected to ensure the absence of a seepage path for contamination.  
• All edges at the walls should be sealed or welded to prevent seepage of spilled materials. |
|---|---|
| Walls and Ceilings | • The wall surface is smooth and paintwork intact with no holes or cracks in the paintwork.  
• No wood or absorbent material used e.g. for notice boards.  
• All joints sealed or filled with silicone type materials to facilitate cleaning.  
• Service penetrations in walls and ceilings should be sealed and coved. |
| Wash-hand basin and Changing facilities | • Wash hand basins should have non-hand-touch type taps.  
• Hand-drying facilities (paper towel dispenser) and hand soap are provided.  
• Hanging space for lab-coats should be provided near the laboratory entrance. |
| Doors and Windows | • All plastic laminate material or paint undamaged.  
• Laboratory doors lockable, additional security for (frequently opened) doors leading off public places. |
| Benches and cupboards | • Working surfaces smooth, hard and un-damaged (including edges).  
• Gaps sealed with a silicone type material.  
• Where wood surfaces exist (e.g. including under benches or cupboard edges) they should be painted with a good quality hard gloss paint or polyurethane varnish and inspected frequently. |
| Waste Disposal Sinks and Drainage Pipes | • Sinks for the disposal of radioactive aqueous liquids are intact and not-rusty.  
• (very) small bottle traps.  
• All gaps and joins should be sealed with silicon sealant.  
• Drainage pipes for radioactive effluent are undamaged, are adequately supported and clearly labelled with the ionising radiation symbol (up to a point at which their contents are diluted substantially with frequently - flowing, non-radioactive effluents). |
### Ventilation and Containment
- Laboratories have adequate ventilation.
- Where small quantities of radioactive materials are used, this may be provided using an extractor fan mounted in a window or a wall.
- Where larger quantities of radioactive materials are used, a guiding principle for effective control of contamination is that air movement should be maintained from less-contaminated areas to more-contaminated areas. This may be achieved for example by extracting from a general laboratory area through a fume cupboard to a discharge stack.
- If a fume cupboard is to be used for open-source work the ductwork from the fume cupboard must be appropriately labelled ["Radioactive"]. The discharge must go directly to the open air, and must discharge at a minimum height of 3 metres above the roof line / the position of any air intakes to the building. Recirculating or scrubber fume cupboards should not be used.
- Internal and external surfaces of workstations should be smooth, hard and non-absorbent.

### Radioactive Storage Facilities (including Waste)
- All refrigerators / freezers, and radioactive materials within them, should be easily identified (labelled) and should be lockable. All surfaces undamaged.
- Waste disposal bins in the laboratory (used for storing solid waste awaiting disposal) should be constructed of robust plastic, and preferably should be foot-operated.
- Adequate separate and secure storage facilities should be available for radioactive waste. The storage space must be kept locked when not occupied and may need to be under surveillance.

### Other Facilities
- **Warning signs**, clearly and legibly marked with the word "Radioactive", with the Ionising Radiation symbol (BS3510: 1968 or ISO 36 1) and any other information necessary (contact person, telephone number, etc), should be placed on doors.
- **Stools and chairs** should either be non-upholstered, or be upholstered in a non-absorbent material covered with an impervious surface that is easy to clean. Wooden stools must not be used.
- **Adequate lighting** should be provided throughout the laboratory, particularly to enable operators to see spillage easily.

---

Dr Gretta Roberts  
Health & Safety Services  
October 2011