RSU INF 2021-02
RADIATION LABORATORY DESIGN GUIDANCE NOTE
(OCTOBER 2021)

University of Manchester
Radiation Safety Unit

The University of Manchester

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Two alchemists, Hans Weiditz (c. 1500)

BASIC LABORATORY REQUIREMENTS

Preliminary considerations

1) **Dry chemistry / wet chemistry / high temperature chemistry (molten salts).** The 'client' (i.e. the Director of Institute or Head of School or Dean of Faculty whomever holds responsibility for the facility and for directing the design) must determine whether the laboratory flooring, finishes, furnishings and fittings are appropriate for the proposed use. In general wet chemistry areas are relatively simpler and less expensive to construct than those for use in dry chemistry applications where, irrespective of the use of fume cupboards and glove boxes, the presence of dusts may present complications for safety and hygiene. Hot chemistry and the handling of molten salts may require greater attention to be paid to the potential for fire risk and / or heat damage.

2) **Identify.** The client must specify the use of the facility and identify where hazardous materials are to be used. Moreover, the nature of any strong acids (e.g. nitric, acetic, sulphuric, chromic), strong or caustic bases, and solvents, along with proposed volumes and duration of use should be specified. Are other hazardous materials, including radioactive materials, likely to be stored outside fire-proof safes e.g. actinides may be 'preloaded' into glove boxes for storage and use, will Schlenk lines be permanently installed in fume cupboards, will uranium recycling rigs be permanently installed in glove boxes and only

periodically decontaminated, will molten salts furnaces be in semi-permanent use?

3) **Specify.** It is vitally important that the laboratory design be properly optimised for the radioactive materials being manipulated and the areas in which individual tasks will be carried out. A clear and unambiguous lead is required from the client as it is likely that much of the value engineering of the project will take place in this area. The client needs to be clear on where a 'minimum' specification is acceptable, on what aspects of the design are essential, and on what is subject to negotiation. The client must have clear negotiation criteria based on the science and not upon political factors.

Floor coverings

4) **Covering.** Floor coverings need to be homogeneous, non-permeable, non-absorbent, non-staining, moisture proof and durable. It is particularly important that and spilt radioactive materials and corrosive chemicals do not penetrate the flooring. Consideration must be given to laboratories where cryogenic materials (e.g. liquid nitrogen) are handled as these may cause vinyl to crack and deteriorate.

5) **Chemical resistance.** It is imperative that the client advises on the chemicals the floor might come into contact so that the correct tolerance of covering can be selected. Obvious specifications the laboratory should advise upon are strong acids (e.g. nitric, acetic, sulphuric, chromic), strong or caustic bases, and solvents, and also the likely time a floor finish might be expected to come into contact with a spillage; test data should be consulted.

6) **Cleaning regime.** The likely cleaning regime(s) must be considered, for example 'standard' cleaning chemicals, steam cleaning, the potential for formaldehyde sterilisation, waxing / polishing and buffing (e.g. the use of removable polishes may be considered as radioactive spillages may be removed by stripping / re-waxing).

7) **Seamless finishes.** Vinyl sheet and ceramic tile finishes will have joints that will become points of weakness; failures of joints and absorbent grouts will allow the penetration of contamination. Jointed tiles and welded replacement patches tend to fail at the joints and specifically at the corners of joints. Seamless finishes and resin floors do not have this issue and long wide roles of vinyl are a compromise.

8) **Electrostatic dissipative.** In higher risk alpha-handling laboratories where actinide chemistry / dry powder is carried out on laboratories should ideally have electrostatic dissipative (ESD) resin floors specified. The type of flooring should be specified (e.g. epoxy resin & gloss, water based polyurethane resin, trowel applied polyurethane resin self-sealing screed). The electrical conductivity leakage resistance should comply with BS2050:1978: an earthing system is a prerequisite of ESD flooring.

It is recommended that floor coverings comprise a 6 mm trowel-applied polyurethane resin screed with electrostatic dissipation to BS2050 are used, and it is noted that a 9 mm screed will withstand steam cleaning and resist liquid spillages to 100°C; an example being Pumadur TG69.

9) **Non-slip finishes.** The flooring must be non-slip. However, in laboratories on research ships where there is a greater risk of slipping and tripping under adverse weather conditions it may be thought necessary for the floor covering to incorporate a gritty finish. Consideration, through the risk assessment, should be given to how such a finish is incorporated into the flooring material and whether this will enable contamination to pass through the flooring barrier and contaminate the fabric of the vessel.

10) **Penetrations.** The flooring must not be penetrated by screws, fixings, service pipes, etc. such as to secure furniture. Ideally floor mounted cupboards etc. should be either a) mounted on plinths or similar that are covered with a flooring material that is integral with the floor, b) free standing secured to the walls or c) mobile.

Floor skirting / coving

11) The flooring must be coved to the wall to a minimum height of 150 mmm to create a bunded area.

12) There are no issues with gaps or the potential for deterioration of seems where the flooring and integral coving is polyurethane resin, and which is poured or trowelled to a height of 150 - 250 mm up the walls, and also where they terminate with a transition or capping strip.

13) A vinyl flooring can be coved and either glued or glued and secured to the walls. All joints must be welded. Consideration should be given to mechanically securing the coving to the wall using a transition strip or threshold. Sit-on coving should not be used.

14) Cove formers may be used to form floor-wall junctions for single piece vinyl floor coverings. There must be no air pockets or spaces between the vinyl and the wall / floor as these may ‘pop’ or crack.

Walls and ceilings

15) **Purpose.** The purpose of the wall covering is, as for the flooring, to provide a permanent resistant barrier to contamination and prevent contaminating materials from becoming incorporate into the fabric of the building.

16) **Preparation.** Walls and ceilings should be smooth, intact and any areas of poor plasterwork must be made good, all gaps must be sealed with a suitable hard bonding sealant. Bare brick / stone / concrete walls are not acceptable.

17) **Surface covering.** The walls and ceilings should generally be smooth and as a minimum painted with oil-based paints such as eggshell, hard gloss, or high-quality waterproof vinyl

emulsion to facilitate cleaning without causing damage. Painting with vinyl emulsion is not acceptable. The use of stippled surfaces or a paint finish applied to unplastered concrete blocks is not acceptable.

18) **Chemical resistance.** The client should determine what chemicals and reagents are likely to be used and what degree of chemical resistance is appropriate both to laboratory reagents and reaction products and also to the cleaning materials likely to be used and cleaning regime followed. The decontamination of small areas such as might be affected by spillages should be considered.

19) **Vinyl.** Vinyl wall coverings, utilising appropriate corner cove formers, may be used where a fully washable surface is needed.

20) **Joints.** Joints should be sealed or filled with silicone type materials to facilitate cleaning (or removal in the event that decontamination cannot be achieved). The grouting material must be chemically resistant. Service penetrations in walls and ceilings should be sealed and coved, and must also be continuous with the wall covering.

21) **Suspended ceilings.** Suspended ceilings will cause dust fall in laboratories and may cause disruptions to air flow. They are also impossible to decontaminate and so must not be used where it is likely that radioactive dusts, powders, volatile materials are to be used. Neither should they be used where it is necessary to control air-flow.

Doors and windows

22) **Daylight and solar capacity.** Windows should take account of the likely solar gain and heat loss from the laboratory, and also the need for shading and visible transmittance. Windows should be non-opening.

23) **Construction.** Windows must be of seamless moulded construction with no ledges, edge lipping's or voids that might harbour contamination, dusts, or moisture. The construction materials must be resistant to water, caustic / corrosive chemical attack, and in some cases (e.g. actinide laboratories) intensive cleaning regimes.

24) **Security**. Barriers, reinforced walls and doors & sets that give access to a facility should meet an appropriate security standard as specified in the 'Red Book' (www.redbooklive.com/).

- High security facilities for actinide, fissile or high activity laboratories must be fitted with doors and sets that meet LPS 1175 SR4, and where appropriate fitted supplementary doors meeting LPS1175 SR2.
- Walls must similarly be reinforced to LPS1175 4.

25) These links are not necessarily endorsed by RSU, but serve to give examples of suppliers

and further information.

- www.bregroup.com/products/lpcb/
- www.meesons.com
- www.meesons.com/what-is-the-difference-between-lps-1175-and-en1627-302011
- www.securitydoorsdirect.co.uk/lps-1175-level-4/
- sunraydoors.co.uk/security-rated-doors-levels-1-6-lps-1175

26) It is expected that project managers, designers and architects will discuss security matters with Security Services www.estates.manchester.ac.uk/services/security/. RSU will ensure the Counter Terrorism and Security Adviser from Greater Manchester Police is notified and involved at the appropriate time.

Benches, fittings and wall coverings

27) **Material.** All work surfaces must be impervious to aqueous solutions and offer a high degree of resistance to strong acids, alkalis, solvents, chelating agents, detergents and disinfectants. Care must be taken in the selection of surfaces as certain bench materials preferentially bind specific ions (e.g., Corian[1] fixes iodine, laminates fix sodium, and stainless-steel fixes phosphorous, chromium and calcium ions). The optimisation of the bench surface should be undertaken carefully after discussions with the laboratory and Health & Safety Coordinators / Advisers. In general Trespa[2] (or equivalent) is a good standard of material. However surfaces such as Corian are generally regarded as being a better if more expensive finish. An advantage of Corian is that back stands, jointed sections, lips, sinks, etc. can be moulded (prior to installation), to form continuous joint free surfaces.

28) **Flat, lipped or dished.** The client must specify the nature and extent of benches after consideration of the activities they intend to undertake. A flat bench on which drip trays are used is often a better solution. Lipped benches are installed where it is thought necessary to provide a bund to prevent spilt liquids spreading, however, thought should be given to whether the lip will present difficulties to siting equipment, workstations, drip trays, etc. At one time dished benches or Trespa benches fitted with height profile wedged bunds were considered useful for preventing spillages from bench to floor, however there is little evidence to support their effectiveness.

[1] Corian is a resin-based homogeneous material that is cast in a single piece (including back stand, lips and sink). The advantage is that it is seamless and highly resistant to wear and tear.

[2] Trespa is a solid laminate that is reasonably resistant to wear and tear, but which is produced in single sheets: corners, back stand, lips, etc. need to be joined or bonded after fitting.

Lipped Corian® bench and integral sink

29) **Active / support benches.** A mix of specific 'active' workbenches where experimental materials are handled, and (flat-edged lower grade) 'support' benches on which equipment is housed could be considered, as can the use of different coloured benches to clearly differentiate the purpose and function of various areas. It is suggested that active benches are coloured to enable them to visually stand out from other work areas.

30) **Back stands.** 150 mm back stands must be fitted to all bench tops apart from island benches, where their fitting must at least be considered.

31) **Sealing gaps.** All gaps in benches, and between benches and walls, sinks, etc. must be sealed with a chemically resistant non-absorbent chemically resistant sealant. The client should specify the nature of the chemicals being handled and whether there may be any material conflicts.

32) **Absorbent materials.** Exposed wood, including under benches and under bench cupboards are not appropriate. However, if painted with a good quality hard gloss paint or polyurethane varnish or laminated such surfaces may provide a temporary solution pending laboratory refurbishment. The use of wood surfaces and similarly absorbent materials must not be used in new laboratory designs.

33) **Alternative siting.** An alternative siting plan is discussed towards the end of this document.

Electrical supply – dado trunking

34) There should be a sufficient number of sockets to accommodate all the equipment required on bench tops with a separate socket for each item. In most cases the power should be supplied above benches via a dado type trunk (with the base of the rail) fixed at least 15 cm above the top of the bench or above the top of a back stand. Power trunking or sockets must not be affixed directly to the bench.

35) Sockets are acceptable below benches for fridges etc, however, isolator switches must be fitted to the dado trunk or in similar suitable locations.

36) Sockets must not be sited where they can get splashed with water (e.g. close by sinks) or suffer chemical spillage.

37) The electricity supply should be fitted with a residual current device (RCD) in an easily accessible location.

Waste Disposal Sinks and Drainage Pipes

38) **Materials.** Sinks and drainage runs used for the disposal of radioactively aqueous liquid waste should be constructed of suitable material, and the material will be selected after consideration of the nature of the waste, for example 1) will it be corrosive, acidic / strongly basic, 2) the radioisotopes likely to be in the waste, and will these complex / adsorb onto the sink 3) the chemical nature of the waste such as other ions, e.g. phosphate and calcium ions may bind strongly on to stainless steel, which may cause problems in laboratories where ^{32}P is used in quantity. The materials, for sinks in particular, must be resistant to the detergents used for cleaning. The client will need to specify an appropriate material.

39) The most generally useful type of drainpipe material for radiation laboratories is **'vulcathene'**. However, it must be borne in mind that all materials will absorb ions to a greater or lesser extent, for example, vulcathene tends to fix iodine very strongly[3], and this

[3] Prior to iodine work, vulcathene drainpipe runs can be pre-flushed with concentrated molasses, which lines

could prove to be significant where large quantities of radioiodine have to be disposed of through drains of this material. Borosilicate glass may be used if the design requires this and polypropylene is unacceptable. A problem with glass is its fragility and the difficulties in making permanent tight unions. Glass must not be used if there is likely to be any movement or flex in the sinks and benches.

40) Drainage system materials should consider the possible build-up of contamination on surfaces.

41) **Drainage pipes.** For drainage runs polypropylene is the material of choice but

42) **Sinks.** One of the best solutions for sinks would be to use an integral Corian (Figure 1) or similar resin sink. Stainless steel is acceptable, but a quality grade must be selected as cheaper stainless steels are highly susceptible to corrosion. Ceramic is acceptable. Sinks must be permanently fixed and sealed to the bench and there must be no gaps between the sink and the bench, also, flexible joints and inappropriate sealants are not permitted.

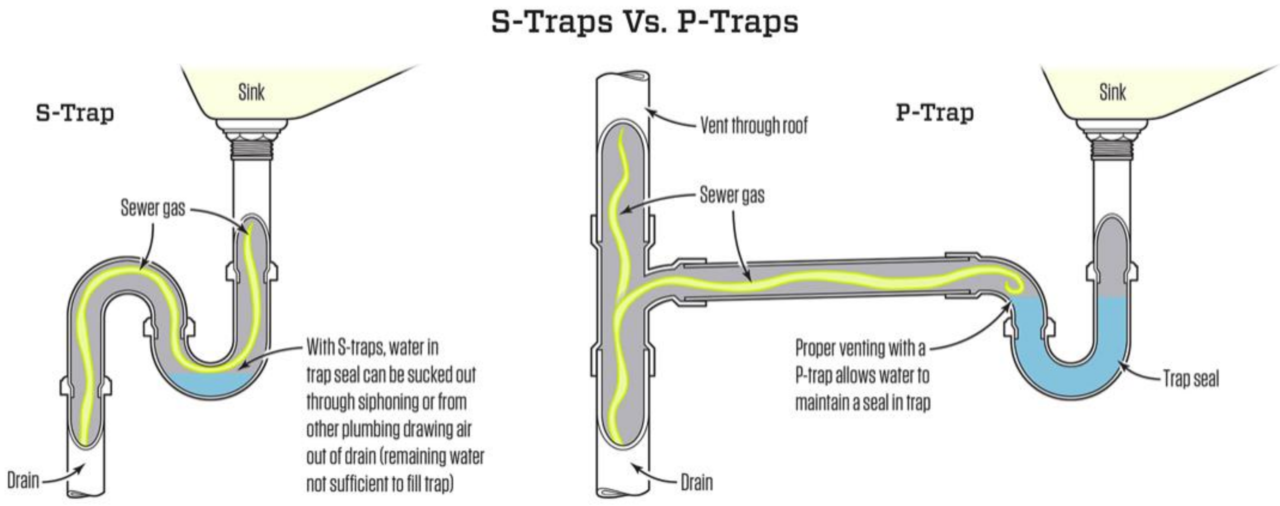
43) **Designated radioactive waste disposal sinks.** For sinks likely to be used as radioactive waste disposal sinks (designated sinks) consideration must be given to fitting easily cleanable rear splash plates that extend a reasonable distance up the wall behind the sink. Side splashguards may also be useful.

44) **Sinks in fume cupboards.** In most cases the siting of designated sinks in fume cupboards is not appropriate. Fume cupboard sinks must not be used for radioactive waste disposal unless agree with the Radiation Safety Unit.

45) **Access.** It must be possible to gain easy access to all drainage points, traps, joints leading from sinks so that they can be inspected and cleaned. Drainage points must not be hidden / enclosed behind facias, cupboards or other features. Environment Agency inspectors are particularly interested in there being good access to spaces beneath fume cupboards and / or store cupboards being easily removable.

46) **Sink traps.** Traps connecting sinks to drainage runs should ideally be ‘P Type’ traps and **must not** incorporate bottle traps or catch pots of any description.

the pipe and preferentially absorbs iodine ions.



47) **Siting the drainage run.** The drain should be connected as directly as reasonably practicable with the main trade waste / foul water sewer leaving the premises. For 'higher risk' facilities the best solution is to connect all the radioactive waste disposal sinks to a single dedicated fall pipe that should be combined with the sewer at ground level or close by. It is acceptable for other drainage runs be connected into this outfall at ground level or at a similar point. The purpose is to ease future maintenance; a single run is easier to isolate for maintenance or in the event of an incident. This waste run is then combined with other drainage wastes before leaving the premises so that adequate dilution takes place.

48) **Discharge route, marking and plans.** Pipe runs 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 - and subject to periodic inspection so as to assure their integrity.

49) Discharge from radioactive waste runs need not be via a dedicated (unique) fall pipes, but designated sinks should be as close as possible to the building outflow. Other drainage systems may feed into radioactive drainage runs as dilution from other inputs aids dilution of radioactive wastes. The discharge route should be mapped and recorded for future reference in case of maintenance on the system. Also, sinks and drainage systems used for the disposal of aqueous radioactive waste 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. This is to alert maintenance staff and thus prevent unauthorised disposal of any contaminated pipes removed during maintenance work.

50) Radioactive waste discharge runs must be marked with trefoils and appropriate signage.

51) **Holding tanks.** Unless agreed with the Radiation Safety Unit, waste holding tanks must not be used as they facilitate the accumulation of sediments, which may themselves become further contaminated, and are prone to holding chlorine-releasing disinfectants.

Hand-wash Basin

52) All Supervised and Controlled Areas must be provided with a hand wash station comprising a suitable basin fitted with extended lever elbow or knee operated taps, liquid soap and paper towel dispensers. This must be sited near the exit from the laboratory.

53) The basin must never be used for the disposal of radioactive substances (other than traces from the washing of hands).

Changing facilities

54) As a minimum, somewhere to hang lab coats should be provided near the entrance to the facility. In many cases it will necessary to provide a lobby/changing area to the laboratory.

55) For 'higher risk' areas a step barrier should be incorporated to a lobby. In general the 'clean side' (outside) of the lobby will have pegs for personal coats and personal storage lockers and storage beneath the counter / barrier for laboratory shoes. On the 'dirty side' (inside) will be pegs for lab coats. The barrier may be permanent or hinged to allow for wheel chair access or heavy equipment to be carried inside on trolleys.

56) Monitoring stations and hand wash areas will be on the dirty side of the barrier.

57) **Mobility allowances.** Regarding wheel chair access, this will be the subject of separate assessments, but as a general point it would be expected that the mobility user will have a chair permanently located on the 'dirty side'. The changing facility and lobby should be sufficiently spacious to allow for reasonable movement and wheel chair access to laboratories

Telephone

58) A telephone should be provided, ideally being sited close by the hand wash facilities.

Fume cupboards, ventilation and containment

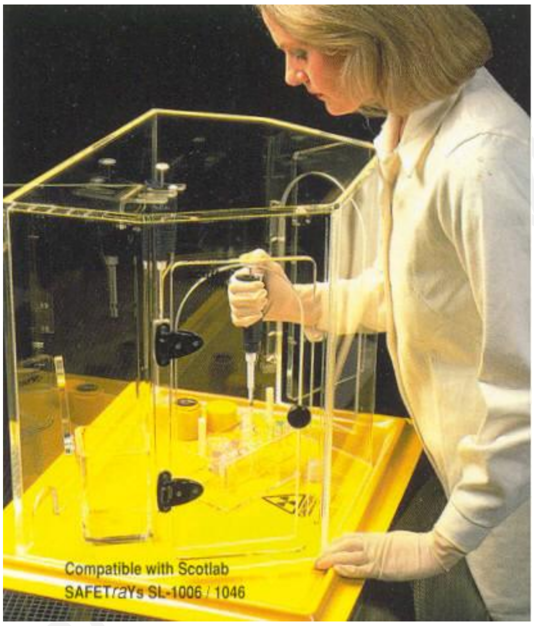
59) **Higher risk laboratories.** In higher risk laboratories designed for the handling of fissile materials and actinides the ventilation systems will be purpose designed to accommodate the necessary fume hoods / cupboards and glove boxes, and so no detailed guidance is provided herein.

60) **Construction materials.** Fume cupboard design must take account of the physical and chemical materials being used, and the nature of the activities being undertaken in the cupboard. Particular consideration must be given to:

- the quality of any stainless steel used;

- the use of ceramic fume cupboards where corrosive materials are to be used;
- the integrity of any welds or seams;
- the placement of equipment that may disturb the airflow;
- aerofoil sills and the potential for spillages to leave the containment provided by the fume cupboard;
- the use of hydrofluoric and perchloric acid;
- HEPA filtration, which removes particulates but not gases or vapours;
- recirculating fume cupboards.

61) **Dispensing and preparation.** The dispensing or preparation of radioactive materials that may cause airborne contamination should be carried out under conditions to prevent dispersal of the substances. The common options are the provision of fume cupboards (possibly with filtration or scrubbers), mobile fume hoods with appropriate filtrations and / or glove boxes. For low risk materials dispense may be carried out in a 'Betacab®' (Figure 2), although this option must be discussed with the Radiation Safety Unit before use.



Workstation comprising a beta cab and drip tray

62) **Volatile materials.** Volatile radioactive materials should never be used in the open laboratory, only in appropriate externally ventilated or filtered containment. Recirculating ventilation systems are inappropriate for volatile radioactive materials.

63) **Handling gamma-emitting radionuclides.** If a fume cupboard is to be used for containment when working with substantial quantities of a gamma emitting radionuclides then it may be necessary to install a plinth to support a considerable amount of lead shielding (possibly up

to 1,000 kg). In addition, when handling gamma-emitting or energetic beta emitting radionuclides consideration should be given to lining the walls of the fume cupboard with 3mm lead.

64) **Ambient air flow.** Careful consideration should be given to laboratory ventilation and the provision for air change. Generally, airflow should move from less hazardous to more-hazardous areas of a laboratory before being extracted or discharged from the room, possibly through air filtration systems. It should be noted that the balancing of an extract ventilation system having a number of ducts, dampers and inlet points, to achieve design airflow rates, requires considerable skill and expertise. Alterations to damper settings by unskilled operators are therefore generally to be deprecated.

65) Radiation and laboratories must have either no pressure gradient between the laboratory and the corridor/outside area, or it must be held at constant negative pressure of (typically) 5 to 20 Pascals, i.e. inward airflow. What is strictly forbidden is for the room to become positively pressurised with respect to the surrounding areas.

66) When considering fume cupboards or cabinets for radiation areas, attention should be given to the chemical (resistance) and physics properties of both the internal and external surfaces, which should be smooth, hard, non-absorbent and have the necessary heat and chemical resistant properties. Surfaces must also be easy to decontaminate.

Seating

67) Stools and chairs should be either non-upholstered or upholstered in non-absorbent material

Write-up areas

68) Write-up areas are not permitted in radiation facilities.

Power

69) **Power Supply.** Electricity conduits, trunks and a sufficient number of plug sockets to power laboratory equipment should be wall mounted and set at a minimum height of 200 mm above the back stand (Figure 3). Sockets should be a minimum of 300 mm from the nearest sink: the requirement used to be siting at a distance of 1500 mm, however this was revised as sinks no longer have to be earth-bonded, and pipes work is more commonly plastic. Provision should be made for under-bench equipment such as refrigerators and freezers. A clearance distance of 900 mm should be provided between the floor and the lowest point of the bench so as to allow fridges etc. to be sited underneath. If it is necessary to fit safes or lockable storage cabinets beneath benches sufficient clearance must be allowed.

A workstation sited on a Corian® bench, a suitable laboratory chair, the position of the electrical trunking, and a single sheet laminate floor covering coved to the walls

70) **Alternative siting of benches.** An alternative laboratory layout is to site the benches at a distance of 100 mm from the walls thus leaving a gap between the back stand and the wall to allow trailing leads and plug sockets to pass. This means that only a single power dado rail need be installed and that power cables etc. can pass beneath benches from above. The back stands will be sufficient to retain any spillages on the bench tops. If this option is selected it is important not to enclose the rear of the benches as access will be needed to connect equipment and also to facilitate cleaning.

Storage

71) **General storage.** Adequate storage space should be available to keep essential equipment in order to minimise the cluttering of equipment near working areas, and reduce the risk of spreading contamination. It may be desirable to have an area set aside for the storage of equipment awaiting decontamination. Storage cupboards should ideally be constructed of non-absorbent materials.

72) **Sources.** Small quantities of materials, weighing's and aliquots may be kept in under bench cupboards although these cupboards should be lockable and must be clearly labelled.

Laminated under-bench storage cupboards mounted on castors to facilitate cleaning

Refrigerators and freezers

73) **Cold storage.** Refrigerators and freezers are commonly used for the storage of radioactive sources, stock solutions and samples. All refrigerators / freezers[4] and the materials within them, should be easily signed and labelled / identifiable.

74) **Secure keeping.** Refrigerators and freezers used to store radioactive materials should be lockable and kept locked unless they are under continual surveillance or sited in locked laboratories.

Waste storage and disposal

75) **Laboratory bins.** Waste disposal bins in the laboratory should be constructed of a material that is robust, and must provide an acceptable level of shielding[5]. The lid should be closed when not in use and the contents in the bag sealed or secured before removing them from the bin.

76) **Sharps.** All sharps, bottles, tubes, broken glass pipettes etc. should be placed in sharps containers to ensure safe handling of the materials. Bins located outside the control of the user must be secured to prevent misuse of the contents.

77) **Secure keeping.** Radiation waste must be kept secure at all times and must never be left unattended between the laboratory and the disposal area.

Waste policy (see the Health and Safety Policy & Radiation Safety Arrangements Chapter)

78) **Black bin waste.** Small quantities of Very Low-Level Waste (VLLW) such as tissues, wipes and small quantities of solid materials are disposed of along with 'normal' laboratory waste.

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[4] Refrigerators / freezers should be regularly defrosted. It should be noted that volatile radionuclides, in particular tritium, might accumulate in the ice: it is good practice for the user to check this periodically.

[5] If the waste contains hard beta emitters, the bins will need to be shielded by 1cm Perspex, or lead if the waste contains gamma-emitting radionuclides.

79) **Aqueous waste.** Aqueous waste is disposed of to designated waste sinks (usually) in Radiation Supervised Areas.

80) **Solid waste.** Waste that is likely to have concentrations of radioactive materials greater than VLLW limits is retained in laboratories pending transfer to the Radiation Safety Unit.

Hazard Warning Signs and Signals

81) Clearly and legibly marked hazard warning signs may need to be posted on laboratory doors or just inside laboratory areas where they will be immediately visible to anyone entering the laboratory. Signage may need to be provided for storage rooms / cupboards, equipment, refrigerators, working areas, drainage pipes, sinks, sewers, exhausts as appropriate. However, care should be taken not to draw attention to areas by unnecessary signage in publicly accessible areas.

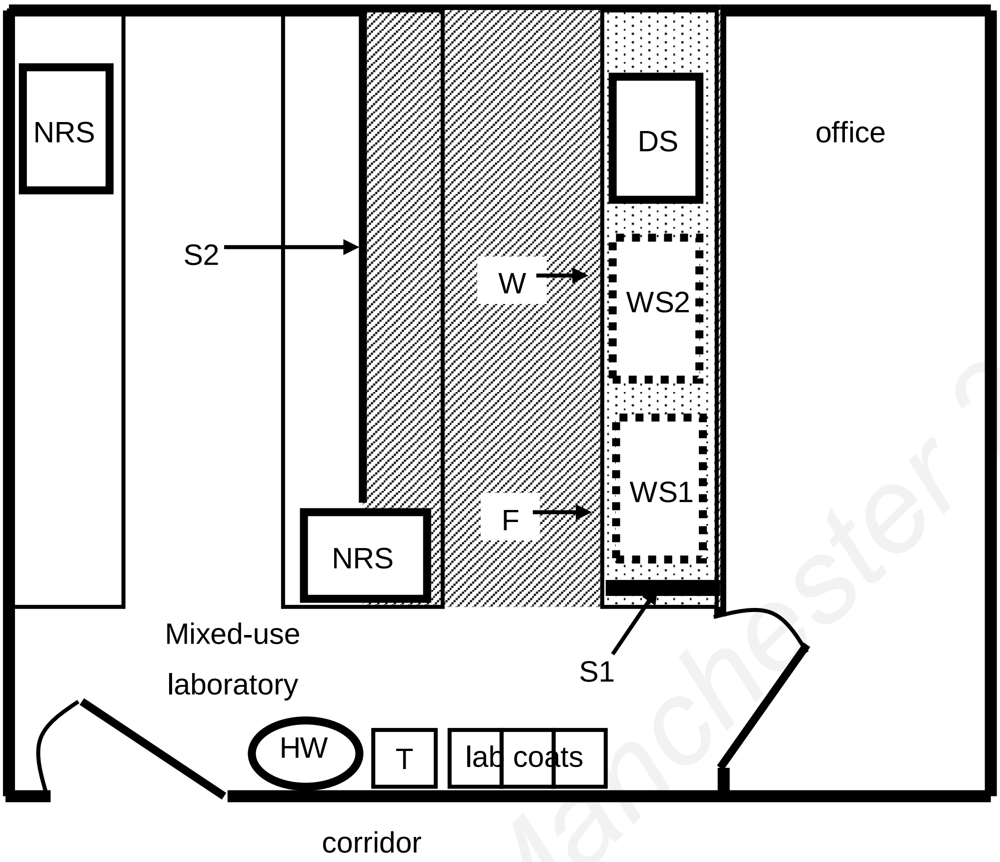
82) All signs should comply with the requirement of the Health and safety (Safety Signs and Signals) Regulations 1996, i.e. signs should be clear, unambiguous, indicate the hazard and level of risk, and state where the hazard is to be located. Signs are available at www.staffnet.manchester.ac.uk/rsu/ionising-radiation.

Radiation Workstations

83) Unsealed radioactive materials should be handled on a designated workstation or similar (e.g. a designated glove box), and so radiation laboratories should be designed with a mind for the number of workstations required therein. A workstation is typically delineated by taping an appropriately sized piece of Benchkote® (absorbent side uppermost) to an 'active' bench using 'radioactive' labelled tape. A drip tray within which the work will be done is sited on the Benchkote®; the drip tray will be used in conjunction with disposable liners of absorbent paper (towels or Benchkote®).

84) Shielding will need to be used where appropriate to reduce radiation dose rates at all accessible points. This means that if two workstations are situated side-by-side, it is likely that a Perspex screen will be needed between the workstations. Screens may also be needed at the ends of workbenches.

APPENDIX 1 A SUPERVISED RADIATION AREA WITHIN A MULTI-PURPOSE LAB



Key

DS = designated sink for aqueous radioactive waste disposal.

NRS = sinks which must not be used for radiation work or radioactive waste disposal.

HW = hand washbasin, soap dispenser, paper towel holder.

WS = workstation.

T = telephone.

W = shielded radioactive waste storage bins, etc. beneath bench/sink adjacent to solid wall

F = fridge/freezer used for storing source, stocks, samples etc. beneath bench

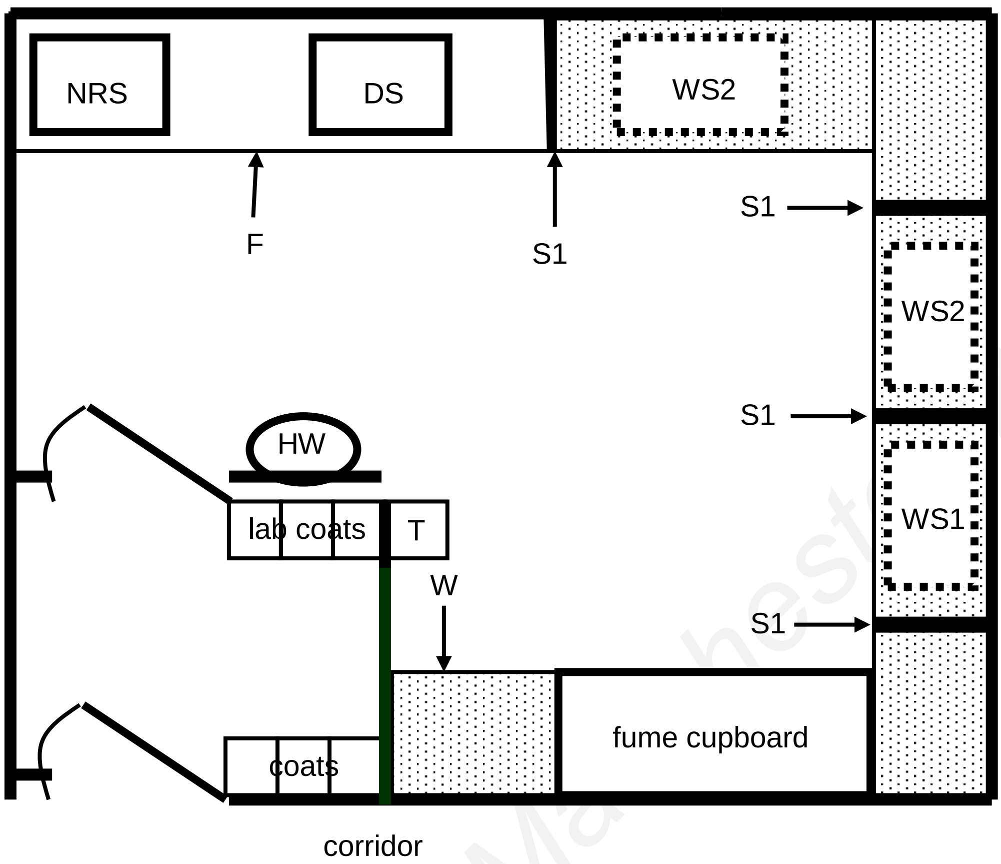
S1 = fixed 10mm thick Perspex screen shield.

S2 = 3mm Perspex/acrylic shield to partition island bench.

= 'Corian' bench, lipped at exposed edges, edges adjoining walls combine integral back stand (15 cm high), integral designated sink.

= section of lab to be designated as a Supervised Area.

APPENDIX 2 THE MAIN FEATURES OF A SUPERVISED RADIATION AREA



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STATUTORY FRAMEWORK

Basic requirements and implementation / oversight

85) **Ionising Radiations Regulations 2017.** The principle factors influencing design and commissioning are the need to **optimise** a facility or laboratory, where form and function are balanced against cost and socio-economic benefit, and primarily, to ensure a design assessment process is followed and commissioning **Critical Examinations** are carried out to 'prove' the design is safe and secure. There is no 'sign off' of plans by the HSE. Should they inspect and find matters they deem to be non-compliant the HSE may pursue enforcement action (www.hse.gov.uk/enforce/enforcementguide/index.htm). There is a duty under the IRR17 to appoint an Radiation Protection Adviser (RPA) to advise on compliance with the regulations and in particular on design plans. It is the employer's responsibility to ensure that the RPA is competent to offer advice. There is no statutory requirement for the RPA to 'sign off' plans'.

86) **Construction (Design and Maintenance) Regulations 2015.** The CDM15 places significant duties on designers and also on who is considered to be a designer. A Principal Designer, who would normally be a contractor, must be appointed and an institute should usually appoint a person in-house with the responsibility of liaising with the Principal Designer.

87) **Environmental Permitting Regulations.** Environment Agency inspectors will not give 'approval' to a facility at the planning or any other stages or 'sign off' plans. However, inspectors will make decisions on whether a facility is 'safe and proper', i.e. fit for purpose, and may cancel / revoke or limit licences on that basis. The emphasis is on the 'radiation employer' to get it right.

88) **CTSA.** Counter Terrorism and Security Advisers work alongside Environment Agency inspectors on projects that may have security implications. CTSA advice must be sought at an early stage of the design and further communications maintained. This design guide only briefly touches on such matters and only with respect to materials in the public domain. All parties should maintain confidentiality over designs and plans, and restrict relevant information on a 'need to know' basis. A CTSA will not 'sign off' plans, but will act alongside an Environment Agency inspector to determine whether and security measures are appropriate.

89) **Other statutory considerations.** Equal opportunities legislation requires an employer to take account of providing reasonable access to facilities. For example, whilst it may not be reasonable to provide equipment such as glove boxes at varying heights on account of the costs of such high specification equipment and other safety reasons, where reasonable practicable, it should be possible to ensure there is sufficient access to provide height

adjustable equipment to enable e.g. a less-abled person, good access to such facilities. Therefore the design should take account of space and manoeuvrability issues.

Legislation

- Health and Safety Executive. Work with Ionising Radiation [Ionising Radiations Regulations 2017, Approved Code of Practice and Guidance]. ISBN 978 0 7176 6662 1. www.hse.gov.uk/pubns/books/l121.htm
- Health and Safety Executive. Managing Health and Safety in Construction [Construction (Design and Maintenance) Regulations 2015]. ISBN 978 0 7176 6626 3. http://www.hse.gov.uk/pubns/priced/l153.pdf
- The Environmental Permitting (England and Wales) Regulations 2016 www.legislation.gov.uk/uksi/2016/1154/contents/made (www.legislation.gov.uk/uksi/2016/1154/schedule/23/made)
- The Anti-Terrorism, Crime and Security Act 2015 www.legislation.gov.uk/ukpga/2015/6/contents/enacted (www.gov.uk/guidance/secure-hazardous-materials-to-help-prevent-terrorism#radioactive-materials)

Guidance

- Association of University Radiation Protection Officers. AURPO Guidance on Working with Ionising Radiations in Research and Teaching. AURPO (2010 update). https://aurpo.org.uk/publications/guidance/
- Environment Agency. Guidance on Standards for Radiochemical Laboratories in Non-nuclear Premises. Environment Agency Doc 374_04 2008 (Chapter 10).
- International Commission on Radiological Protection. ICRP 25. The Handling, Storage, Use and Disposal of Unsealed Radionuclides in Hospitals and Medical Research Establishments'. Annals of the ICRP **1** (2). Pergamon Press (1977). ISBN 0 08 021510 6. www.icrp.org/publication.asp?id=ICRP%20Publication%2025
- Natural Environment Research Council. NERC Guidance on Design of Safe Laboratories version 1.5 (2015). www.nerc.ac.uk/about/policy/safety/procedures/guidance-laboratories/
- Environment Agency guidance on permits and compliance. www.gov.uk/government/collections/radioactive-substances-regulation-for-nuclear-sites
- Pacific Northwest National Laboratory. Design of the Laboratory-Scale Plutonium Oxide Processing Unit in the Radiochemical Processing Laboratory. PPNNL-24205. U.S. Department of Energy (2015).
- AWE. Design Safety Principles: Radiation Protection Aspects Of Active Area Design. MER-420-000123 AEA (2015).

- Office for Nuclear Regulation. Nuclear Safety Technical Assessment Guide: Radiological Protection NS-TAST-GD-038. ONR (2020). www.onr.org.uk/operational/tech_asst_guides/ns-tast-gd-038.pdf
- National Counter Terrorism Security Office. Counter Terrorism Advise for Hazardous Sites. NaCTSO V11 17/07/14. www.cia.org.uk/Portals/0/Documents/Publications/NaCTSO%20Security%20advice%20for%20Hazardous%20Sites%20-%20August14.pdf?ver=2017-01-09-143759-797

British Standards (including withdrawn)

- British Standard BS 3202-1. Laboratory Furniture and Fittings. British Standards Institute (1991 – withdrawn).
- British Standard BS 4247-2. Surface Materials for use in Radioactive Areas. Part 2: Guide to the Selection of Materials (1982 – withdrawn).
- British Standard EN ISO 20553:2017. Radiation Protection. Monitoring of Workers Occupationally Exposed to a Risk of Internal Contamination with Radioactive Material.

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6th October 2021