KING'S College LONDON
University of London

Health, Safety and Environmental Protection Office
SAFETY DESIGN STANDARD
SDS03 v.01 (2012)

LABORATORY

1 INTRODUCTION:

When planning a new or refurbished laboratory (or suite of laboratories) King's College London (hereto referred to as "the College") requires and expects the Design Team, in particular the Designers, to consider and provide laboratories that are fit for purpose. The end users must provide information on the range of activities that are typically expected to be done within the laboratories and the types and numbers of equipment to be used and estimated maximum occupancy.

This document outlines the minimum Safety Design Standards to which any proposed laboratory must comply. In the event that documents referred to within this document are superseded, the most recent versions must be referred to.

Any laboratory design should be adaptable, to accommodate future changes: an adaptable 'smart' (modular & prefabricated) design which is capable of being disassembled at the end of its useful life and the components reused or recycled is recommended.

In line with the College's Energy & Carbon Management Policy all new laboratories must achieve the Higher Education BREEAM standard of 'excellent' and all laboratory refurbishments must achieve 'very good'.

1.1 TYPES OF LABORATORIES

Within this document the term "laboratory" encompasses rooms and/or enclosed spaces where scientific experiments or procedures are conducted (using materials, equipment and/or substances that may present a hazard to human or animal health or to the environment). It also includes any rooms where biological research is to be conducted.

The design requirements for ALL laboratories are given in Section 4. More specialist laboratory requirements dependent on the type of activities to be conducted therein are given in Sections 5-9.

Where there are different requirements in multi-disciplinary laboratories standards relating to the more stringent requirement must be used.

Any queries regarding this standard should be sent to safety@kcl.ac.uk.

1.2 VARIANCE REQUEST

Variance requests from the criteria contained within this design standard must be submitted as early as possible in writing to the HSEPO, and any subsequent variance approvals/ denials will be in writing. Such requests shall include the nature and proposed location of the variance, justification and details of proposed changes.

2 TABLE OF CONTENTS

3 REFERENCES:

External

- BS 2646-2: 1990, Autoclaves for sterilization in laboratories. Guide to planning and installation.
- BS:EN 12347:1998, Biotechnology. Performance criteria for steam sterilizers and autoclaves.
- BS:EN 13150:2001, Workbenches for laboratories – Dimensions, safety requirements and test methods.
- BS:EN 14056:2003, Laboratory furniture, Recommendations for design and installation.
- BS 4247 - Surface Materials for use in Radioactive Areas.
- BS:EN 14175-2, Fume cupboards — Part 2: Safety and performance requirements.
- BS:EN 14175-5:2006, Fume cupboards – Part 5: Recommendations for installation and maintenance.
- BS 5499 series, 2000-2006, Safety Signs and Symbols.
- BS:ISO 7010:2011,Graphical symbols. Safety colours and safety signs. Registered safety signs.
- BS 5726:2005, Microbiological safety cabinets – Information to be supplied by the purchaser to the vendor and to the installer, and siting and use of cabinets – Recommendations and guidance.
- BS:EN 12469:2000, Biotechnology. Performance criteria for microbiological safety cabinets.
- EN 13792:2002 Colour Coding Of Taps And Valves For Use In Laboratories.
- BS:EN 61010-1:2001 IEC 61010-1:2001 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements.
- BS 5266:1999-2008, Code of Practice for emergency lighting.
- BS:EN 50172:2004, Emergency escape lighting systems.
- The management, design and operation of microbiological containment laboratories, Advisory Committee on Dangerous Pathogens, HSE Books, 2001.
- Biological agents: Managing the risks in laboratories and healthcare premises, Advisory Committee on Dangerous Pathogens, HSE Books, 2005.
- Health (Safety Signs and Signals)Regulations 1996.
- Chemicals (Hazard Information and Packaging for Supply) Regulations 2009.
- Lighting at Work, HSG38, HSE Books, 1997.
- CIBSE Code for Lighting, 2009.
- Seating at Work, HSG57, HSE Books 1997.
- Code of Practice for the housing and care of animals used in scientific procedures, Home Office, 1989.
- Code of Practice for the housing and card of animals in designated breeding and supplying establishments, Home Office, 1989.
- AURPO Guidance Note 6 Working with Ionising Radiations in Research and Teaching.
- AURPO Guidance Note 7 Safe Use of Lasers in Education and Research.
- Medicines and Healthcare Products Regulatory Agency: Safety Guidelines for Magnetic Resonance Equipment in Clinical Use 2007
- International Electrochemical Commission: Medical electrical equipment – particular requirements for the safety of magnetic resonance equipment for medical diagnosis 2010

Internal

- College Energy & Carbon Management Policy.
- College Safety Design Standard 02(2009): Liquid Nitrogen Storage Facilities for Portable Containers.
- Laser Safety Management Procedure (SPR017-01-HSEPO)
- Responsibilities and Arrangements for Ionising Radiation Management (SPR001-03_HSEPO)
- Responsibilities and Arrangements for the Safe Use of Biological Agents (SPR003-01-HSEPO)
- Responsibilities and Arrangements in respect of Genetic Modifications (SPR016-01-HSEPO)
- Safety Responsibilities and Arrangements in respect of the Management of Contractors (SPR008-01-HSEPO)

4 REQUIREMENTS FOR ALL LABORATORIES AND LABORATORY SUITES:

The following are requirements for all laboratories. Subsequent sections provide specific requirements for the appropriate discipline. Note that in all laboratories there must be consideration of the final usage and the traffic routes of personnel through the laboratory and corridor areas between laboratories to ensure safe passage through the working areas. Flexibility for future adaptation must be considered, e.g. modular laboratory design.

Dangerous chemicals are those as defined under the Chemicals (Hazard Information & Packaging for Supply) Regulations. For the purposes of this document where the term 'dangerous chemicals' is referenced, consideration should also be given to any intermediate products, wastes and other by-products of chemical reactions or combustion.

4.1 LOBBY AREAS

The following features must be sited near the entrance to the laboratory in an open "lobby-like" area:

4.1.1 Light switches

Light switches must be located near the entrance to the laboratory and must be labelled with the lights that they control.

4.1.2 Hand washing facilities

Dedicated hand washing sinks must be provided at or near the entrance to the laboratory, where appropriate for the activities being conducted. The sinks must be of a suitable size to allow hands to fit easily under the taps and labelled "For hand washing only." The taps for these must allow hands-free operation. Liquid soap and paper towel dispensers must be provided.

4.1.3 Laboratory coat hooks

Laboratory coat hooks must be provided to enable all the expected number of laboratory personnel and visitors to be able to hang their lab coats. Separate provisions for non-laboratory clothing must be provided in a convenient location for laboratory users outside of the laboratory area.

4.1.4 Emergency shower (if required)

An emergency shower with suitable drainage must be provided if the laboratory is expected to require one. These should only provided where the chemicals and processes likely to be handled in the laboratory dictate their installation. The location should be appropriate for the hazards and where they occur, i.e. within a laboratory or beside or near a chemical store. A floor drain must be situated directly below the emergency shower. In most cases the chemicals and quantities being handled do not warrant the provision of emergency showers.

4.1.5 Spill kits

If dangerous chemicals, biological or radioactive materials are to be used within a laboratory then accommodation for a suitable number of appropriately sized, compatible spill kits (able to control 200% of the largest container) must be located near each entrance to the laboratory with clear signage to indicate their location.

4.1.6 Wall space

Clear space inside and adjacent to the laboratory entrances must have a minimum of 600 mm beside the door to allow for light switches, thermostats and, where deemed appropriate, fire extinguishers and any emergency shutdown for electricity, gases and compressed air supplies to the room.

4.2 EYE WASH STATIONS

The activities within the laboratory and the risk assessments thereof will determine the type of eye wash station provided.

Plumbed eye wash installations are not recommended for most laboratories unless direct drainage is provided and a regime of regular flushing will be enforced by the users.

Bottled eye wash stations must be of the double disposable bottle type as opposed to single.

4.3 SPACE, EQUIPMENT LOCATION AND FLOOR LOADING

The space allocated within laboratory areas must be appropriate to the tasks that are to be performed within them. Consideration must be given as to what equipment will be installed and, for very heavy

items, to the floor loading. In all cases equipment must be installed to enable operator and maintenance access.

Personnel working within laboratory areas must be able to work and move unimpeded by each other and by fixed equipment. As a minimum there must be a 1200 mm passageway between benches, or 1700 mm passageway between back-to-back working benches. Work surface area for each worker must be more than 1200 mm across (recommended to be at least 1500 mm) and 600 mm deep, excluding bench space for laboratory equipment.

Particle emitting equipment, such as autoclaves steam cleaners and dishwashers, must not be located directly below fire detection sensors.

4.4 FLOORS

Floors must be sealed and covered with an impervious surface such as a continuous sheet of PVC or linoleum at least 2.5 mm thick. The covering must be impervious to water, resistant to acids, alkalis, solvents and disinfectants, easy to clean and compatible with any chemicals likely to be used in the laboratory.

The covering should be coved to the walls to a height of about 150 mm contiguous with the floor surface. All edges at the walls should be sealed or welded to prevent seepage of spilled materials.

Supported coving should be used to facilitate easier cleaning and prevent contaminants from seeping into floor level service voids behind false walls.

If service voids are likely to become contaminated then they will also need impervious surfaces.

Joints between flooring sheets are not recommended, but where necessary the joints are to be welded and inspected to ensure the absence of a seepage path for contamination

4.4.1 Floor drains

Floor drains must be installed to allow for the weekly flushing of safety showers (if installed).

4.5 WALLS AND CEILINGS

Walls and ceilings must be smooth and painted with a hard gloss, acrylic emulsion or high quality waterproof vinyl.

Joints must be sealed or filled with silicone type materials. Service penetrations in walls and ceilings should be sealed and coved.

Sealing between the bench upstand and the wall should be silicon based to allow for the different surface characteristics and movement.

4.6 SECURITY

Entrances to laboratory areas must be restricted to authorised personnel only. This may be achieved by secured access to either the whole building or areas containing laboratories.

4.7 DOORS AND WINDOWS: LOCATION, DESIGN AND HANDLES

Doors must have vision panels in them except when activities specify otherwise, i.e. in dark rooms.

Push plates must be provided on doors that open outwards. Handles must be of a type to enable them to be easily cleaned. Doors must open with a single operation.

Door stops must be considered to ensure equipment and fittings are not damaged.

Doors must be lockable to ensure a good level of security but must open without a key on the escape side.

Ground floor or accessible windows must be secured to prevent unauthorised entry.

4.8 USE OF WOOD

Exposed wooden surfaces are not to be used in any laboratory area, including door frames and window beading. If any wood is used it should be sustainably sourced.

4.9 WORK SURFACES

Work surfaces must be smooth, hard and non-absorbent.

The surfaces must be compatible with any chemicals likely to be used in the laboratory and must be impervious to water, resistant to acids, alkalis, solvents and disinfectants and easy to clean and a drip strip must be cut on the undersurface.

Work surface front corners may be rounded for ergonomic reasons but rounded work bench front edges should be avoided to prevent spills following the contours onto the under surfaces. Where possible, joins must be biscuit jointed, clamped underneath and sealed with a non-silicon sealant such as epoxy resin.

Work benches must be strong enough to withstand the weight of equipment to be placed on them with enough support to prevent bowing.

Work surfaces must be an appropriate height to enable laboratory users to sit or stand comfortably whilst working.

4.10 SHELVING

Shelving must have surfaces as for work benches.

Shelves must not be more that 1800 mm from floor level.

Any shelving on the workbench spine must have shelf backs installed.

Vertical storage carousels should be considered instead within consumable stores.

4.11 SEATED WORKSTATIONS

Where it is anticipated that workers will sit at their workstation there must be sufficient room under the work surface to accommodate the workers' knees and legs. Seating must be appropriate for the tasks being undertaken in the laboratory. Seats must be height adjustable and made of non-porous wipeable material. Lockable castors may be required dependent on the laboratory usage and seat height.

4.12 SERVICES DISTRIBUTION IN FURNITURE

Sufficient electrical plug sockets and communication ports for all the equipment planned must be provided in each laboratory. Sockets and ports must either be in dado rails a minimum of 150 mm above the work bench surface, in “spine zones” in the middle of work benches or in droppers from an above ceiling service matrix. Under bench fridges and freezers must be provided with sockets under bench sockets. In all cases, positions must be placed to prevent penetration by liquids and avoid trailing cables.

4.13 ENERGY EFFICIENCY

The most energy efficient electrical laboratory equipment appropriate to the work to be carried out should be used unless operational requirements dictate otherwise.

4.14 HIGH VOLTAGE/CURRENT EQUIPMENT

For laboratories containing high voltage or high current devices an emergency "Power Off" button to cut the electrical service in case of emergency should be located in the vicinity of the equipment it controls at an easily accessible point within the laboratory and/or in the “lobby-like” area. The power-off control must be clearly labelled specifying the equipment that it controls.

4.15 WATER TAPS AND SINKS

Hot, cold /mixer and deionised water must be provided as considered appropriate by the end-users. Tall taps with spigots for hoses should be used unless specifically required otherwise.

Laboratory sinks must be stainless steel or resin, as appropriate, and must be separate from the work surface. An easy to decontaminate rear splash plate of non-absorbent, easy to clean material, i.e. Perspex or stainless steel, should extend at least 300mm up the wall behind the sink.

Any laboratory areas which may use amalgam must have amalgam separators fitted to the respective sinks. Operating and maintenance instructions must be passed on to the end users.

4.16 GAS SUPPLY AND MANIFOLDS

Laboratory gases should preferably be generated within the laboratory rather than supplied from cylinders. Where gases cannot be generated they should be piped into the laboratory from an external cylinder store unless it is not reasonably practicable to do so. Piped gases must be provided with supply knock-off valves.

Where it is necessary to use gas cylinders inside the lab they must be suitably supported and fitted with a manifold. (Reference must be made to the College's Laboratory Gas Design Standard SDS02 for all installations involving laboratory gases).

Plumbed service fixtures shall be laboratory grade with handles colour coded and labelled by type of service in accordance with EN 13792.

4.17 LIGHTING

The use of natural light must be maximised. In addition appropriate lighting dependent on the work activities must be provided (refer to HSG38 and CIBSE Code for Lighting). A minimum requirement is 750 lux at work surfaces. Sufficient emergency lighting must be provided. In dark rooms, low lux red lighting may be appropriate. Light switches must be provided with labels indicating what each switch controls. The most energy efficient lighting at the time of design, appropriate to the work to be carried out, must be used. Photosensing technologies should be used where appropriate, with manual overrides.

Emergency lighting must conform to BS5266.

4.18 HANDLES ON STORAGE CUPBOARDS

Handles on drawers and storage cupboards must be easy to clean and not have sharp edges.

4.19 VENTILATION

There must be sufficient supply of fresh air with a through-flow in all rooms: 5-10 complete changes of air per hour dependant on the expected activities to be preformed within.

4.20 FUME CUPBOARDS AND OTHER LOCAL EXHAUST VENTILATION

Fume cupboards must be externally ventilated where practicable – recirculating fume cupboards are not recommended. Where recirculating fume cupboards are unavoidable there must safe unobstructed access for the regular changing of filters. Note that re-circulating fume cupboards must not be used where volatile radioactive materials will be used, see Section 7.2.3.

'Plug in' fume hoods, with integral variable air volume control should be used where appropriate to the work to be carried out.

Down draft tables must always be externally ventilated and filtered if to be used for animal handling purposes.

Ductwork for exhaust fumes must be separate from general building air supply and extract. Exhausts must not be located in the vicinity of air intakes.

Fume cupboards must be sited to minimise disturbances to fume cupboard airflow from surrounding equipment, fittings and passing personnel. Refer to BS EN 14175-5:2006 for further information.

During a fire alarm, the fume cupboard must continue to run.

4.21 FRIDGE/FREEZER SPACE AND LOCATION

Sufficient numbers of fridges and freezers must be considered for the storage requirements of the users. Only intrinsically safe refrigerators can be installed in areas in which flammable liquids will be used. These should be located so that they do not inhibit the movement of personnel past them when the doors are open. Where there are larger numbers of fridges and -20 °C freezers, air conditioning or air handling to remove excess heated air above the units may be required to prevent excessive temperature rises.

Where -80 °C freezers are required, an existing dedicated freezer farm with sufficient space must be used, or an additional dedicated freezer farm with capacity for future expansion must be designed in.

If liquid carbon dioxide or nitrogen is required for emergency back up in the event of refrigerant loss, reference must be made to the College's Laboratory Gas Design Standard SDS02/2009 for all installations involving laboratory gases.

Uninterruptable Power Supply or generator produced electricity may be required for -80 °C freezers dependent upon freezer contents.

4.22 STORAGE OF CHEMICALS / DANGEROUS CHEMICALS

Sufficient reagent racks and/or shelving must be installed in each laboratory for at least the projected weekly usage of chemicals. Reagent racks or shelving must comply with the requirements for working surfaces (Section 4.9), have a 25 mm retaining lip and not be more than 1500 mm from the floor. Storage for chemicals cannot be located over sinks, above or near any floor drains or in entrance lobbies.

The following categories of dangerous chemicals must be stored in individual dangerous chemical storage cabinets; and a sufficient number of dangerous substances storage cabinets must be installed in each laboratory to ensure their segregation (if they are proposed to be used):

- Flammables (maximum size of flammable storage must be 50 litres per laboratory) (cannot be secured to walls). Note that this limit is separate to the small quantities used in laboratory experiments. If large quantities (≥25 litres) of flammables are used within equipment or an experimental set up than a variance request must be sent to the HSEPO together with a COSHH and/or DSEAR assessment by the end user.
- Oxidisers.
- Corrosives (with either separate storage areas for acids and alkalis, or completely separate cabinets).
- Toxics/ Poisons (must be secured to wall/ floor).
- Organic peroxides.
- Gas canisters.

All laboratory dangerous chemical storage cabinets must meet the requirements of BS EN 144701:2004, including the following requirements.

- The cabinet must not be located in an area likely to flood, such as directly below mains water pipes. The structure of the store must prevent water ingress.
- Any means of escape in the event of an emergency must not be jeopardised by the location of the cabinet.
- Access to emergency equipment, such as fire extinguishers, must not be jeopardised by the location of the cabinet.
- The cabinet must not be located near any ventilation inlets or outlets.
- The cabinets must be vented if they will contain noxious or malodorous materials to a safe location outside the building; or to a local externally vented fume hood duct, if the duct is suitably fire resistant, through a flame arrestor.
- The cabinet must be suitably earthed.
- The cabinet must be fire rated for 30 minutes, if located under a fume hood or in a basement area it must be fire rated for 90 minutes.

Additional storage of chemicals should be provided by a dedicated Chemical Store (a Safety Design Standard for Chemical Stores is currently being drafted). If there is a requirement for the storage of more than 50 litres of flammable solvents in any specific laboratory this must be discussed and agreed in writing with the HSEP Office.

4.23 CONSUMABLES STORAGE

Separate local store rooms for laboratory consumables are recommended to minimise storage requirements in labs and maximise benchtop workspace. Consideration must be made for the frequency and intensity of laboratory activities to be conducted.

The installation of vertical storage carousels should be considered.

4.24 WASTE POINTS

Dedicated floor and work top space must be set aside for the collection of segregated laboratory waste. If waste autoclaves are to be used there must be sufficient space to hold materials that have been autoclaved (see Section 5.7).

4.25 SIGNAGE

Relevant signs, indicating hazards which will be present and local mandatory requirements, must be placed at an appropriate height on entry doors to laboratories or suites of laboratories and on storage cupboard doors. Refer to BS: ISO 7010. A4 document cases for the provision of emergency information must be placed by entrance doorways.

A laboratory drawing must be provided in a format that can be used by the laboratory occupants to indicate locations of any dangerous substances storage cabinets, cylinder storage, fire extinguishers, spill kits, etc. for incorporation into local and building emergency plans.

4.26 FIRE DETECTORS

The type of fire detector must be suitable for the activities being conducted in the laboratory, e.g.. steam, droplet or particle releasing equipment such as dishwashers or autoclaves.

4.27 HANDOVER INFORMATION

The Operations and Maintenance (O&M) manual detailing the required information, including building plans, air handling unit information, ventilation, hazard zoning, etc., must be passed to the users on completion to enable user maintenance of the laboratory.

5 BIOLOGICAL LABORATORIES

5.1 CONTAINMENT LEVELS 1 AND 2 (CL1/CL2)

All biological laboratories must be designed to a minimum of Containment Level 2 standards (as described in the Management, Design & Operation of Microbiological Laboratories) to meet likely future usage requirements. All laboratories operating at CL2 must display a Biohazard sign on doors into the laboratory or suite.

5.2 CONTAINMENT LEVELS 3 AND 4 (CL3/CL4)

When a CL3 or CL4 laboratory is proposed advice must be sought at the earliest stage from the College Biological Safety Officer as these laboratories must be designed from the outset to suit the biological agents being handled.

5.3 SECURITY

Access to laboratory suites must be restricted to authorised personnel only. This may be achieved using card swipe, proximity readers or key code access systems. Specified laboratories such as those designated for use with Specified Animal Pathogens or the use of substances covered by the Anti-terrorism Crime & Security Act may require additional access controls. In such cases advice must be sought from the College Biological Safety Officer.

5.4 WINDOWS

All windows must be kept closed by laboratory users to ensure containment. However, where smoke ventilation in the event of fire or other emergency is deemed necessary, arrangements must be made to enable the windows to be opened.

5.5 AIR HANDLING

Where there is mechanical ventilation, there must be a net inward airflow. The laboratories must be maintained at air pressure negative to atmosphere/standard temperature and pressure (STP) where the end-users' risk assessment(s) for the work activities require it. Contact the College Biological Safety Officer for further advice.

5.6 MICROBIOLOGICAL SAFETY CABINETS, LOCATION AND AIR CONDITIONING

MSCs must be sited to minimise disturbances to cabinet airflow from surrounding equipment, fittings and passing personnel. Refer to BS 5726:2005 for further details. Where workers are to carry out their tasks in a seated position there must be sufficient space beneath the MSC to accommodate worker's knees and it must be at a height to enable this.

External exhaust ducting may be necessary based upon the materials to be handled by the end user and is preferable when the use of the materials require the MSCs to be fumigated. If negative pressure is required within the laboratory, such MSCs may be used to maintain the pressure differential through bypass extract airflow if room thimbles are not to be used. Ducting must be separate to general building supply and extract and fume cupboard ducting.

A MSC or fume hood must not be installed within 3000 mm of an autoclave.

5.7 AUTOCLAVES

Waste autoclaves must be sited within the building, preferably in a room dedicated for waste treatment with sufficient space to hold materials that has been autoclaved (for bagging as offensive waste), see Section 4.24. The chamber volume must be of an appropriate size to contain the expected daily amount of autoclaved waste.

Sterilisation autoclaves may be located in the same room if required or in an appropriate laboratory with suitable ventilation. Autoclaves must not be sited near or opposite MSCs.

Pulsed heating and pre- and post-cycle vacuum chamber extraction should be considered to reduce cycle times and ensure steam penetration.

Autoclaves must be provided with a canopy hood, slotted exhaust, or other suitable means of local exhaust. In addition, dedicated autoclave rooms must have a minimum of 10 air changes per hour.

5.8 LABORATORY STORAGE OF CLINICAL WASTE

All separate clinical and non-clinical waste streams must be identified to ensure appropriate segregation.

Adequate storage space and waste receptacles must be provided for the following and must not be located in the laboratory aisles:

- Mixed recycling, including by all hand wash sinks
- Yellow bagged clinical waste
- Orange bagged clinical waste
- Clinical waste for autoclaving
- Pipette tip boxes
- Cleaned glass
- Bench top storage of sharps bins (orange, yellow, purple)

Space for appropriate clinical waste bins must be provided near all laboratory work areas, especially MSC's.

If supplied, laboratory clinical waste bins must be:

- Lidded (of the appropriate colour and labelled)
- Hard sided,
- Foot operated (hands free)
- Fire retardant.

5.9 PHLEBOTOMY ROOMS

Where donation of blood samples is expected, there must be designated room(s) provided for phlebotomy. These must be of adequate size to allow free access around the donor during the procedure.

The rooms should be private to limit interruption during the procedure.

Flooring should be as for a laboratory, intact, washable non-slip surface with coved edges and no carpets

Furnishings and equipment should be kept to a minimum to facilitate effective cleaning and prevent dust build up. Work surfaces should be intact, seamless and easily washable. Open shelving is not recommended.

There must be ventilation to ensure the comfort of operator and patient, Air movement induced by any form of mechanical ventilation must flow from 'clean' to 'dirty' areas, i.e. air must not be drawn into a phlebotomy room from a laboratory.

Hand washing basins with hot and cold running water must be provided in the room.

6 BIOLOGICAL SERVICES UNITS (BSU)

BSUs must comply with the Animals (Scientific Procedures) Act, 1996 or superseding legislation. Animal holding rooms and procedure rooms must be designed to the same requirements as Containment Level 2 biological laboratories (see Section 5 and The Management, Design & Operations of Microbiological Laboratories, 2001) with additional requirements for security, airflow and air extraction and drainage. Rooms and suites designed for behavioural studies and satellite rooms (i.e. rooms outside main BSU areas where animals are handled) may require lower containment standards. Contact the College Biological Safety Officer or Biological Services Unit Director for further information.

6.1 SECURITY

Access to laboratory suites and/or specified laboratories must be restricted to authorised personnel only. This may be achieved using card swipe or proximity readers. Key code locks cannot be used.

Specific requirements to secure the animals from escape must be made.

6.2 CHANGING AND REST FACILITIES

Separate changing, welfare and rest facilities must be provided for personnel working in BSUs. These rooms must be located near the entrance to the unit and in a separate area away from animal and procedure rooms and associated storage areas.

6.3 HANDWASH FACILITIES

Dedicated hand washing sinks must be provided at or near the entrance to BSUs and by the doors to procedure and holding rooms. The taps for these must allow hands-free operation.

6.4 AIRFLOW AND AIR EXTRACTION

Airflow should be inward to the facility. Within cage rooms the airflow must be downwards and away from operators. Extract air should be coarse filtered and vented externally. Inlet air may require HEPA filtering: the end users must be consulted for sterility requirements.

6.5 DRAINAGE

Floor drains are not generally required, only for “wet rooms” such as rooms with pools or with water tanks within. If fitted, drains must be flush-fitted with the floor and water must not pool around them.

7 RADIATION LABORATORIES

7.1 DESIGNATED RADIATION LABORATORIES

Designated Areas can usually be accommodated within a general laboratory facility. The requirements for a Designated Area are minimal and it is expected that any General Laboratory (see Section 4) would fulfil them, with the additional recommendations below. It is however advised that any laboratories designed to contain radiation areas be designed to at least the level of Supervised Area, to allow for growth of research work.

7.1.1 Designated Areas

Designated areas must consist of a dedicated area of bench set aside for radioactive work and be clearly delineated. There must be sufficient depth of bench to allow for work in plastic or metal drip trays or use of benchkote covering if using liquid radionuclides.

7.2 SUPERVISED RADIATION LABORATORIES

Supervised radiation laboratories are separate facilities demarked by the boundaries of the laboratory room enclosed with a door, as work requiring such registration must not be carried out within a dedicated area of bench in a general laboratory.

The design standard for Supervised Areas must include the recommendations provided by the General Laboratory (see Section 4) in addition to the following requirements.

7.2.1 Work Benches

All gaps and joints must be sealed with a silicone type material. Account may need to be taken of the problems involved in decontaminating certain materials used for bench surfaces: advice can be sought from the Radiation Protection Officer, who will discuss with the College Radiation Protection Adviser.

The bench tops must be coved at the rear against walls, i.e. have an upstand. Gaps must be sealed with a silicone type material.

Benches must be substantial enough to take the weight of any shielding or shielded pieces of equipment such as Liquid Scintillation Counters. Typically lead shielding could require a load of ~100kg over a 0.25m^2 area of bench.

Where the design of work surfaces is in an island format there must be a splash guard of non-absorbent, easy to clean material, i.e. Perspex or stainless steel, around 300mm, between the two sides to prevent cross contamination.

7.2.2 Designated Disposal Sinks and Drainage Pipes (if required)

Sinks for the disposal of radioactively contaminated aqueous waste must be constructed of suitable material: separately moulded epoxy resin sinks are preferred over stainless steel. Ideally an easy to decontaminate rear splash plate of non-absorbent, easy to clean material, i.e. Perspex or stainless steel, should extend at least 300mm up the wall behind the sink. Side splash guards, of a height of between 150mm height at up to 50mm from the sink edge, or 300mm at up to 100mm from the sink edge, should be installed to the side of the sink, where there is not at least 500 mm of drain board present.

Drainage systems must include a small diameter U-bend or small catch pot. Space must be allowed for a suitable container to be positioned directly under the U-bend or small labelled catch pot, to contain any potential future leaks from these and must be accessible for regular inspection.

The drain must be connected as directly as possible to the main foul water sewer leaving the premises with minimal pipe run exposed within the laboratory. The discharge route must be mapped and recorded for future reference in case of maintenance on the system and pipes must be labelled with the ionising radiation hazard tape.

Pipes must be:

- well-supported along a suspended run;
- down-sloped to prevent accumulations of radioactivity;
- made accessible by the use of demountable panels for periodic inspection or maintenance where practicable.

A separate non-designated sink for washing and preparation purposes should be provided.

7.2.3 Fume cupboards, Ventilation and Containment

Laboratories where volatile radioactive materials may be used must be provided with appropriate containment such as an externally ventilated fume cupboard. Recirculating ventilation systems are inappropriate.

Fume cupboards used for volatile radioactive materials must vent externally to areas of safe location, as identified by appropriate risk assessment, through a separate vent extract duct from other ventilation ducts. Exhausts must not be in the vicinity of air intakes. Sufficient access must be available to inspect and maintain the fume cupboard extracts.

During a fire alarm activation period, the fume cupboard's extract system must continue running.

Fume cupboards need to be strong enough to take the weight of any lead shielding. Typically lead shielding could require a load of ~100 kg over a 0.25 m^2 area.

General dilution ventilation (air circulation) must be provided by mechanical ventilation in all radioactive laboratories, which should provide for a net inward air flow

7.2.4 Radioactive Material Storage

Adequate storage space must be provided to keep essential equipment. It is also recommended that a designated area for the storage of equipment awaiting decontamination is provided.

Adequate space for the location of lockable refrigerators and freezers for the storage of radioactive and other materials must be provided.

7.2.5 General Area

In addition to the 'lobby-like' area described in 4.1, provision must be made to hang clean and dirty lab coats separately to avoid cross contamination.

An overshoe barrier may be required, dependent on the use of the laboratory: seek advice from the College Radiation Protection Officer

A corded telephone must be provided, ideally sited close by the hand wash facilities at the entrance to the laboratory.

7.2.6 Security

Some specific laboratories may require additional access controls, advice must be sought from the College Radiation Protection Officer.

7.3 RADIATION CONTROLLED LABORATORIES

7.3.1 Introduction

The design of each Controlled Area must be discussed with the Radiation Protection Officer, who will discuss with the College Radiation Protection Advisor to ensure that all the necessary considerations have been covered, as design requirements are specific to the proposed use.

7.3.2 Access Control & Security

Access to Controlled Areas must be restricted to authorised individuals only. This can be achieved by the use of Proximity or swipe card controlled access locks, or by key access to small numbers of users. Some Controlled Areas may also require computer recorded access logs.

Intruder alarm systems may be required for some Controlled Areas, which may include remote monitoring as defined by PD6662 and DD243 security standards.

It is recommended that the area around the Controlled Area, especially all entry points, be covered by CCTV cameras with recorded output and preferably monitored by security.

Some Controlled Areas also require the surrounding area to have access control to prevent members of the public or other non-authorised persons from approaching the Controlled Area.

Further advice on these general points, is available from the College Radiation Protection Officer.

8 LASER CONTROLLED LABORATORIES

For high power non-enclosed lasers (as defined in the College's Laser Safety Management Procedure), the surrounding area must be defined as a Laser Controlled Area, with the following recommendations designed into the facility.

8.1 FLOORS, WALLS AND CEILING

The surfaces of the room must be covered with a non-reflective material or finish to minimise the hazard of stray beams.

8.2 DOORS AND WINDOWS

Windows and vision panels must be covered with an opaque material to prevent stray beams passing through the window into the uncontrolled area outside.

Where practicable the entrance doors to Laser Controlled Areas must be connected to an interlock system to activate either emergency shutdown of the laser or shutter activation on entry to the room.

If a defeatable interlock system is installed, or connection to the interlock system is not practicable, then a walled or curtained entryway enclosure composed of material sufficiently fire-resistant to prevent combustion when hit by the laser beam must be installed. The walled or curtained enclosure must be arranged such that it fully protects the doorway from stray beams that might otherwise be transmitted towards the door.

The door to the laboratory shall be equipped with a self-closing device and be secured at all times. The door may be locked with a standard key lock, but a proximity or swipe card entry system is preferred, or a cipher lock with key override so that the code may be easily changed as necessary. The security system must allow for emergency access or egress.

8.3 BENCHES

Most Laser Controlled Areas would require the use and inclusion of specialist optical tables, negating the need for most benching. However the surfaces of benching or tables must be covered with a non-reflective material or finish.

8.4 GENERAL AREA

The entrance to the Laser Controlled Area should have sufficient space to display warning signs, clearly marked with the word "Laser", with the Laser Radiation symbol and any other information necessary (contact person, laser details, etc).

An illuminated "Laser On" warning sign must be placed prominently at each entrance that is automatically activated (where practicable) when the laser tube is energised.

A protective eyewear station inside the lab near the main entrance, and outside the curtained enclosure if present, must be provided so that personnel can don such equipment before proceeding into the area of Laser hazard.

An integral interlock system must be fitted to the room to allow for the activation of either emergency laser shutdown or shutter activation, requiring manual reset once activated. Triggers for the interlock system must include one or more of the following:

- entrance door opening for non-defeatable interlock systems
- unsuccessful bypass of defeatable interlock systems
- manual emergency stop buttons within the area
- localised power failure

8.4.1 Security

Access to laboratory suites must be restricted to authorised personnel only. This may be achieved using card swipe, proximity readers or key code access systems, in addition to the interlock system.

9 MAGNETIC RESONANCE LABORATORIES

9.1 INTRODUCTION

All areas intended for the use of Magnetic Resonance Imaging or Nuclear Magnetic Resonance equipment must consider the risks associated with high magnetic fields.

The design of Magnetic Resonance Laboratories must be discussed with the Radiation Protection Officer, who will discuss with the College Magnetic Resonance Safety Advisor to ensure that all the necessary considerations have been covered.

The area enclosing the 0.5 mT field line must be defined as a Magnetic Field Controlled Area, with the following basic recommendations designed into the facility.

9.2 FLOORS, WALLS AND CEILING

Sufficient space within the area is required to encompass the strong magnetic field lines from the proposed equipment, the perimeter of which is dependent upon the magnetic field strength of the equipment.

Appropriate conductive materials to act as the Faraday cage must be constructed in or on to the boundaries of the Magnetic Field Controlled Area.

Sufficient space within the area is also required to safely hold the pressure from the cryogenic gas volume that would be liberated by an emergency quench of the magnet. The design must allow for any liberated cryogenic gas to vent directly to atmosphere and must be separate from any general building air supply and extract. Where practicable the laboratory will be located adjacent to an external wall.

9.3 DOORS AND WINDOWS

Consideration must be given to the fitting of doors and windows to the area such that they can withstand the potentially explosive cryogenic gas expansion that would be created by the liberated cryogenic gas volume from an emergency quench of the magnet, or are designed specifically to aid venting of the liberated gas volume through appropriate safe routes out of the room (see Section 9.2).

The entrance to the Magnetic Field Controlled Area must prevent unauthorised or inadvertent access.

9.4 GENERAL AREA

All fittings and equipment for use within the area must be composed of non-magnetic materials. As well as affecting image quality and equipment performance, magnetic materials can become lethal projectiles within the strong magnetic field.

An emergency quench button must be provided to initiate an emergency quench of the magnet. This button should be of a type that allows for deliberate use only, as the activation of an emergency quench will destroy the magnet.

Power supply to the lighting within a Magnetic Field Controlled area must be DC power, not AC. Electromagnetic interference produced by AC lighting can affect image quality and equipment performance.

The power that is being fed to lighting fixtures must be clean and regulated. It is additionally often preferred that the personnel are able to dim the lights from within the room itself.

9.4.1 Security

Access to laboratory suites must be restricted to authorised personnel only. This may be achieved using card swipe, proximity readers or key code access systems.