Safe Management of Work with Ionising Radiation

Health and Safety Policy, Guidance and Arrangements for Queen Mary University of London (QMUL)

Prepared by the QMUL Health & Safety Directorate
Approved by the QMUL Radiation Protection Safety Committee
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1. Executive Summary

This Health and Safety Policy document establishes the framework for the risk assessment, the risk controls and the protective measures to be adopted and implemented for working safely with Ionising Radiation by Queen Mary University of London (QMUL) staff and students on QMUL Premises; and also for others who may be affected by QMUL activities. The objective of the Policy is to eliminate or where not reasonable practicable, reduce the arising risks to a negligible level by justification of use, and utilising the best available techniques to minimise the effects to humans and the environment via the use, holdings and disposal of ionising radiation, and to ensure compliance with the Regulations governing work with Ionising Radiation, primarily the Environmental Permitting Regulations 2010 (as amended) and the Ionising Radiation Regulations 1999.

The Policy defines safe working requirements for Ionising Radiation in the context of QMUL's activities; identifies the roles and responsibilities for Heads/Managers/Supervisors of Schools / Institutes / Directorates conducting work with Ionising Radiation, for QMUL staff, students and others who may be affected, and notes the key legal and compliance (including notifications to the regulatory authorities) requirements specified in the relevant legislation and guidance.

Guidance on practical measures (including ionising radiation protective measures, safe working procedures, accidents and emergencies, inspections, training, supervision and competencies) for QMUL and resources for the risk assessment of Ionising Radiation activities are provided or linked. The Policy document has been issued following approval by the QMUL Radiation Protection Safety Committee.

2. Queen Mary University of London – Objective and Statement of Policy on Safe Working with Ionising Radiation

The Objective of the Policy is to ensure the health, safety and welfare of employees (staff), students and others who may be affected by the risks, the protection of the environment and to ensure compliance with the Regulations governing work with Ionising Radiation.

The Policy of Queen Mary University of London (QMUL) is to ensure that the risks arising from working with Ionising Radiation are eliminated or reduced to '**A**s **L**ow **A**s **R**easonably **P**racticable' (ALARP).

It is QMUL Policy that the procedures for risk assessment (including **justified** use of ionising radiation) and safety management (including facilities and infrastructure, and waste inactivation and safe disposal) set out in current legislation noted below and in the other statutory guidance, shall be in place **before** commencing the work (activity).

These must maintained throughout the duration of the activity until complete inactivation (via decay, safe disposal or other **B**est **A**vailable **T**echniques, BAT) of all ionising radioactive materials involved, to ensure that risks from the Ionising Radiation activity to staff, students and others and the environment are minimised to as low as reasonably achievable.

Reference to 'radiation' throughout this document hereafter, unless otherwise stated, means 'ionising radiation'.

3. Legislation applicable for Ionising Radiation Work

This Policy, its attached appendices and associated Campus Ionising Radiation Local Rules sets out the framework to achieve compliance with the legal requirements in United Kingdom legislation (implementing European Union Directives), and to describe how QMUL manages radiological protection. This is a dynamic Policy document maintained by the Health and Safety Directorate of QMUL, is subject to scheduled and non-scheduled modifications, with approval by the statutory adviser/s and management group on ionising radiation for QMUL, and gives effect to all guidance and procedures concerning radiological protection provided at QMUL.

The principal United Kingdom legislation applying to work at QMUL are the Ionising Radiations Regulations 1999 (IRR99) [1], and the Environmental Permitting Regulations 2010 (EPR 2010) [2] (as amended). Applying the requirements of the legislation ensures that exposures to staff and students using sources of radiation on QMUL premises, and those who might be affected by their activities (including members of the public), kept '**A**s **L**ow **A**s **R**easonably **A**chievable' (ALARA). All permitted work with Ionising radiation is justified to minimize the effects on staff, students and others, including the environment.

The Ionising Radiation (Medical Exposures) Regulations 2000 (IR(MER) 2000) (as amended) [3], the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPIR 2001) [4], The Justification of Practices Involving Ionising Radiation Regulations 2004 [5] and The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended) [6] may apply during certain radiological procedures or activities. Legislation applicable to other types of radiation sources apply, details are obtainable from the QMUL Health and Safety Directorate.

The document also describes how QMUL will adopt the most effective measures for the storage, use and disposal of radioactive wastes, using the principles of **B**est **A**vailable **T**echnology (BAT) in accordance with relevant legislation [5] and guidance [7].

It also notes measures for the effective security of radioactive sources and materials conditional with Environmental Agency permits or authorisations and as specified by the UK Police National Counter Terrorism and Security Office (NaCTSO) [8].

The general requirements of the Health and Safety at Work *etc* Act 1974 [9], and where applicable, certain provisions in the Management of Health and Safety at Work Regulations 1999 [10], and the Control of Substances Hazardous to Health Regulations (2002) [11] apply when work involving Ionising Radiation occurs.

4. Scope and Application of the Policy

This Policy applies to all QMUL staff, students and others (e.g. contractors, academic visitors) who are to conduct activities with Ionising Radiation and to all others who may be affected by QMUL's activities involving Ionising Radiation.

5. Overview of QMUL Roles and Responsibilities for Ionising Radiation Protection

The ultimate responsibility for ensuring the governance of ionising radiation protection rests with the Council of Queen Mary University of London QMUL) (hereafter referred to as 'the Council').

The Principal of QMUL takes overall responsibility for the executive implementation, compliance and management of health and safety, including ionising radiation protection. The Principal, assisted by the Director of the QMUL Health and Safety Directorate, provides the Council an annual report on overall health and safety performance at QMUL. Local area responsibility for health and safety are devolved to the Heads of QMUL Schools / Institutes / Directorates. The QMUL Executive Senior Management, Council and Organisational structure is available at [12].

Within the health and safety management framework, the Principal delegates specific responsibility for health and safety management at QMUL to its Health and Safety Advisory Group (HSAG). The HSAG has established a specialist sub-group, the 'Radiation Protection Safety Committee' (RPSC) to manage and monitor radiation protection for work with ionising radiation.

Oversight of day to day practices, advice, implementation and adherence to national regulations and QMUL policy are undertaken by the QMUL appointed statutory roles of Radiation Protection Adviser (RPA), Radioactive Waste Adviser (RWA), local area Radiation Protection Supervisor (RPS), and coordinating role for QMUL, the Radiation Protection Officer (RPO). All these appointed roles constitute the RPSC.

The QMUL line management and advisory / administrative functions for work with Ionising Radiation is provided in **Appendix 1**.

The Terms of Reference of the QMUL Radiation Protection Safety Committee is provided in **Appendix 2**.

A flowchart noting key points of the QMUL Radiation Protection Management System and key personnel is provided in **Appendix 3**.

6. Specific Roles and Responsibilities of QMUL Staff for Radiation Protection

(i) The Principal

The Principal has overall executive responsibility for ionising radiation protection for QMUL and will appoint a suitable RPA upon advice from the Director of the QMUL Health and Safety Directorate.

(ii) Heads of QMUL Schools / Institutes / Directorates (S/I/D)

The Head of an S/I/D is responsible for all aspects of radiation safety in his/her School / Institute / Directorate, including ensuring there is adequate funding and resources to

implement the requirements of the QMUL Radiation Management Policy and Campus Local Rules that apply to their local facilities.

In consultation with the QMUL RPO, the Head of an S/I/D must appoint in writing suitably qualified Radiation Protection Supervisor/s and, if necessary, deputies using the QMUL RPS appointment form [13].

The Head of an S/I/D must ensure that appropriate radiation project approval (including the risk assessment and justification for the radiation activity) is made in conjunction with the local RPS and sent to the QMUL RPO for approval **BEFORE** any activity commences, using the QMUL Radiation Project Approval form [13].

If it is required for specified radiation sources, the appropriate notification document to the Regulatory Authority detailing that disposal funds are held by the School / Directorate or Institute should be in place, and that the Regulatory Authority approval / consent is obtained and held.

The Head of an S/I/D must ensure that all staff using radiation receive induction and training in radiation protection, safety and information on QMUL arrangements for radiation, as stipulated under section 7.

The Head of an S/I/D must ensure that the QMUL Pregnancy Risk Assessment [14] form is completed as soon as the pregnancy has been declared by the worker, so that the necessary precautions can be taken to ensure that the effective dose received by the unborn child during the term of pregnancy is restricted to less than 1 mSv for the remainder of the pregnancy.

The Head of an S/I/D must ensure that any change of procedure, equipment or environment which may affect the radiation safety precautions in their School / Institute / Directorate are reported to the QMUL RPO for review by the RPA or RWA.

The Head of an S/I/D must ensure that their Principal Investigators (PI) / Group Leaders of research groups using radiation are fully aware of relevant legislation, QMUL management and arrangements, safe practices and their responsibilities in respect of the safety of their staff and those affected by their work.

(iii) The Radiation Protection Adviser (RPA) for QMUL

QMUL must appoint a Radiation Protection Adviser (RPA) (IRR99 Regulation 13). The RPA must hold a current certificate of competence to act as an RPA issued by an approved RPA assessing body and meet the Health and Safety Executive's Criteria of Core Competence for RPA's [15].

The RPA should be appropriate for QMUL's activities and must have a formal letter of appointment from QMUL, issued by the Director of the Health and Safety Directorate.

The RPA's function is to advise QMUL on all matters concerned with compliance with IRR99, EPR 2010 and any other relevant national or EU regulation concerning radiation protection. In strict legal terms, this post does not carry the responsibility for implementing regulations but does have the responsibility to provide timely, adequate and accurate advice on radiation matters as would be expected by an RPA accrediting body.

Full details of the advice provided are contained in the Service Level Agreement (SLA) issued by the Director of the QMUL Health and Safety Directorate.

As part of the advisory process, the RPA will be in attendance at the RPSC meetings. The RPA may also be invited to HSAG and other safety management groups to advise on any arising radiation issues. The RPA can also have direct access to relevant senior managers and QMSE as required and which is facilitated by the QMUL RPO.

In respect of practices regulated under the Ionising Radiation (Medical Exposures) Regulations 2000, a Medical Physics Expert (MPE) (as defined in regulations) must be consulted. If the RPA is also the MPE, the advice provided must be distinct from that provided as RPA under IRR99.

(iv) The Radioactive Waste Adviser (RWA) for QMUL

QMUL must appoint a Radioactive Waste Adviser (RWA) (Article 38 European Basic Safety Standards Directive - 96/29/EURATOM [16]) if permits issued by the Environment Agency to hold radioactive material or authorisations to accumulate or dispose of radioactive waste are held.

The RWA must hold a valid ‘Certificate of Recognition’ issued by the Environment Agency UK RWA Approval Board subject to their competency and training criteria, and a formal letter of appointment from QMUL.

As part of the advisory process, the RWA will be in attendance at the RPSC meetings. The RWA may also be invited to HSAG and other safety management groups to advise on any arising radiation waste issues. The RWA can also have direct access to relevant senior managers and QMSE as required and which is facilitated by the QMUL RPO.

The full role and responsibilities are contained within the QMUL letter of appointment for the RWA.

(v) QMUL School / Institute / Directorate Radiation Protection Supervisor (RPS)

The Radiation Protection Supervisor (RPS) provides the day-to-day supervision of radiation workers. They have the authority to exercise control over all radiation work and all radiation workers within the School / Institute / Directorate radiation facilities.

Appointment of members of staff to RPS must be in writing by the Head of S/I/D (using the RPS appointment form at [13]) following consultation and confirmation by the QMUL RPO.

The Head of an S/I/D may where required, appoint a local Radiation Protection Supervisor Manager (RPSM) to oversee multiple RPS’s, and where more than one RPS is needed for cover purposes, a Deputy RPS. A Deputy RPS would require same level of training and expertise as an RPS.

An RPS / Deputy RPS / RPSM are in terms of their responsibilities managed by, and are accountable to, their respective Head of S/I/D.

The criteria for appointment, duties and responsibilities of the RPS are contained within the RPS Appointment Form [13]. Appointment will only be made if the person has

successfully completed accredited RPS training. This training may be provided externally by an accredited company or internally by the QMUL RPA in line with HSE guidelines.

The RPS will ensure that:

National regulations, the QMUL Ionising Radiation Management Policy and Campus Local Rules are adhered to.

Local Rules and other radiation records are accurate and kept up to date using the QMUL ISOSTOCK software.

The RPS is also expected to provide practical training and advice on radiation matters to radiation workers and others who may affected by the work.

The RPS should be available during normal working hours.

They must keep their HOD/HOS/DOI and the QMUL RPO appropriately informed of arising radiation matters.

A Deputy RPS may be appointed but requires the same level of training and expertise, The Deputy can cover when the RPS is absent from the workplace, but otherwise the RPS is deemed to be more senior in the partnership.

An RPS and/or their Deputy are members of, and would be expected to attend the Radiation Protection Safety Committee on a regular basis.

(vi) The QMUL Radiation Protection Officer (RPO)

If the appointed RPA is contracted from an external organisation to QMUL, the Director of the Health and Safety Directorate (HSD) may appoint a specialist Health and Safety Adviser in HSD (termed the 'QMUL Radiation Protection Officer') to assist in providing day to day radiation protection coordination, management and advice to QMUL Schools / institutes / Directorates through consultation with the RPA / RWA and other consultant radiation experts.

The full role and responsibilities are contained within the QMUL letter of appointment for the RPO, which include management of the radiation protection system for QMUL (e.g. ISOSTOCK, corporate radiation records, annual radiation returns, management of the RPSC, facilitation or provision of radiation training, management of radiation audits and inspections).

(vii) The Radiation Protection Safety Committee (RPSC)

The RPSC acts as a forum for all issues of radiation safety and oversees the management of radiation on QMUL premises.

The Committee is chaired by a senior QMUL academic / manager, experienced in radiation work and radiation protection.

The Chair, and a deputy, of the Committee are appointed by the Principal, upon the advice of the Director of the QMUL Health and Safety Directorate.

The Secretary of the RPSC is a member of the Health and Safety Directorate and would normally be the RPO.

Membership comprises of all QMUL appointed RPS's. The RPA and RWA will be attendance.

It is intended that the Committee is held once a term within the academic year.

Minutes of each meeting, significant reports relating to ionising radiation, and the annually reviewed Terms of Reference are presented to the QMUL Health and Safety Advisory Group for consideration.

(viii) Ionising Radiation Workers

All persons exposed to ionising radiations in the course of their work are categorised as either Classified or Non-Classified Radiation Workers according to the areas in which they work and the annual doses they are liable to receive.

(ix) Classified Radiation Workers

All persons whose radiation doses might exceed three-tenths of any dose limit are designated as Classified Workers i.e. those who exceed an annual whole body effective dose of 6 mSv or three-tenths of any tissue specific Equivalent dose limit (IRR99 Regulation 11, Schedule 4).

Classified workers can be of any gender but must be at least 18 years of age. However, women of reproductive capacity are restricted in the rate at which they may reach their annual dose limit. The decision to designate a classified worker would be on the basis of the QMUL Project Approval (risk assessment) and in consultation with the QMUL RPA.

QMUL endeavours to avoid the categorisation of Classified Radiation Workers by the implementation of strict controls on radiation exposure.

In the event of a QMUL staff member being designated a Classified Radiation Worker by the RPA, the QMUL Occupational Health Service will arrange the required medical examinations by an appointed doctor and retain the appropriate medical records.

The QMUL Occupational Health Service will arrange appropriate medical advice and examination in the event of an over exposure to ionising radiation.

Classified radiation workers must be monitored by an Approved Dosimetry Service (ADS).

(x) Non-Classified Radiation Workers

Persons who work in Controlled or Supervised Areas and who are unlikely to receive doses in excess of 3/10 of any worker dose limit but may receive more than 1 mSv per year (the public dose limit) are designated as Non-Classified Radiation Workers.

To demonstrate that the dose limits are not exceeded, personal and/or environmental monitoring will be carried out by an Approved Dosimetry Service (ADS).

For the purposes of safety control, all QMUL staff / students or others working with radiation are designated as non-classified radiation workers. All staff, post graduate students and undergraduate students (over 18's only) and others are subject to the same dose limits.

It is emphasised that Non-Classified Radiation Workers who work in Controlled Areas must do so under a written Scheme of Work (See Section 13 below).

7. Radiation Worker / Protection Supervisor Training

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All staff and students involved in work with ionising radiation must be adequately trained in practical and theoretical aspects of the work. The Head of S/I/D in association with the RPS responsible for the radiation facility must ensure that all users of radiation attend the QMUL training course "Working Safely with Ionising Radiation" prior to commencing radiation work in their area. The course booking process, content and information is available at the Health and Safety Directorate website [17]. Radiation course attendance records are noted by HSD within the QMUL training records system, and an attendance certificate is provided to all attendees for their training records.

The Head of S/I/D, RPS and Group Leader for the research group are responsible for ensuring that all radiation workers, as indicated on the Project Approvals are competent in all practical aspects of the work they plan with radiation and that records of any internal training or mentoring must be kept by the individual radiation worker and PI. The QMUL H&S training record template [17] should utilised to record all radiation (and other health and safety) training in a research group.

A QMUL Staff member prior to appointment as a Radiation Protection Supervisor must attend the QMUL RPS training course (or an appropriate external RPS training course) and then undergo refresher training at least every three years. The RPS course content and information provided to the attendees is available at [17]. Classified radiation workers should also attend the RPS training course.

8. Radiation Safety Incidents

Significant radiation incidents such as spillages of radionuclides, accidental exposure, near misses, etc. must be reported to Health and Safety Directorate as soon as possible by phoning the QMUL RPO (contact details [18]).

The QMUL accident & incident report form [19] must be completed and emailed to the HSD Office and copied to the RPS and Head of S/I/D. Significant incidents will be reported to the RPA by the RPO by telephone and copying the accident report form to them.

All losses or thefts of radiation sources must be reported as soon as possible to the RPO as the HSD is required to inform the RWA and where required, the Environment Agency and/or NaCTSO. The QMUL accident & incident report form

[19] must be completed and emailed to the HSD Office and copied to the RPS and Head of S/I/D.

Any serious accidents and incidents may result in the immediate revocation of Radiation Project Approvals by the RPO subject to further investigation. Incidents that are reportable to the authorities and result in a formal investigation may result in the loss of the entire site permit to hold and dispose of radioactive materials. In the event of a prosecution for any incident there is the possibility of a substantial fine or even imprisonment of responsible person/s.

9. Definition of Radiation Work Areas

All radiation working areas in which sources of ionising radiation are used, are designated according to the potential health hazard of the work carried out in the area. Separate assessments are made in terms of external and internal hazards.

The IRR99 defines two types of areas: 'Controlled Areas' and 'Supervised Areas'.

Controlled Area: This is an area where any person who enters or works is likely to receive an Effective dose greater than 6 mSv a year, or an Equivalent dose greater than 3/10th of any dose limit, and/or must follow special procedures to restrict significant exposure to ionising radiation

Supervised Area: This is defined as an area where work condition must be kept under review, and where a person is likely to receive an Effective dose greater than 1 mSv a year, or an Equivalent dose greater than 3/10th of any dose limit.

The decision on the designation of an area is part of the Project Approval process and will be made by the RPA.

The area designation will depend on external dose rates and the total quantity of unsealed radioactive substances present expressed in terms of the annual limits on intake (ALI) (see Appendix 4). Quantities in each of the three categories are as follows:

Numbers of ALI's

	Minimum	Maximum
Controlled areas	10	-
Supervised areas	3	10
All other areas	0.3	3

Values of ALI for a selection of radio nuclides are given in Appendix 4

Controlled or Supervised Areas can vary widely. For example, a fume cupboard may constitute a Controlled Area, but the room in which it is situated may only be a Supervised Area, based on its environmental conditions. Supervised Areas can be part of a larger laboratory where other, non-radiation work may be in progress depending on laboratory layout and subject to commissioning criteria.

Signs indicating the classification of the area from the point of view of external dose and contamination must be fixed at every entrance and the demarcation of such areas must be clear. Plans showing the precise location and extent of all Controlled and Supervised Areas must be submitted with any Project Approval, kept with the laboratory records and appended to the Campus Local Rules. Environment Agency holding and disposal permits that apply need to be displayed **inside** the radiation facility.

10. Radiation Local Rules

All designated radiation areas, whether 'Controlled' areas or 'Supervised' areas for the use of radiation sources or areas with X-ray emitting equipment must have up to date Radiation Local Rules in place.

The QMUL RPO provides Campus Radiation Local Rules for each QMUL Campus conducting radiation work to cover the core requirements and arrangements for radiation protection, and to which specific laboratory procedures for an individual radiation laboratory can be appended if required.

Local rules should be made readily available and prominently displayed **inside** the radiation area, and staff / students should be provided with a copy or have them easily accessible. All radiation workers before commencing work must sign the 'radiation user page' indicating that that they have read and understood the document and give a copy of the signed sheet to their local RPS.

The Local Rules should list, and be updated with, all active Radiation Project Approvals, with maximum holding and disposal limits for each project. They should contain in easily understandable terms, the specific measures which must be implemented to ensure radiation protection e.g. specific shielding, working practices, regular environmental (surface and airborne) and personal contamination monitoring with associated records retained for a minimum of two years, necessary signage, and records of annual dose meter calibration. Any additional procedures should be appended to the Local Rules.

11. Design of Ionising Radiation Facilities

Facilities where radiation work is to be carried out or radioactive materials or wastes are stored must be designed to ensure that doses to radiation workers (staff or students), others (e.g. maintenance, contractors) and members of the public are kept as low as reasonably achievable and, where open radioactive sources are used, the layout and facilities should minimise the spread of contamination, and that all surfaces should be constructed to facilitate decontamination.

When new facilities are planned, or are being upgraded, the Head of S/I/D with the RPS must ensure that the RPA and the RPO are FULLY consulted early in the design stage, following the procedures in the QMUL Estates Projects Handbook [20].

New facilities and upgrades should comply with the guidance given in the Medical and Dental Guidance Notes (IPEM 2002) [21] and the Guidance on Standards for Radiochemical laboratories in Non-Nuclear Premises given in the Environment

Agency Field Officers Handbook (available from the RPO) and any further sector guidance / QMUL documents issued by the HSD.

The design must ensure that radioactive materials are securely stored and that access to the radioactive work areas is restricted pertinent to EA permits / authorisations and NaCTSO security documentation. Details on security requirements are available from the RPO.

Signage declaring designation of a radiation facility (Controlled or Supervised) complying with appropriate standards (BS 3510:1968 or ISO 361:1975 must be fixed at every entrance to the facility or area.

12. Commissioning and Maintenance of Radiation Facilities

Commissioning: Prior to the commissioning of any radiation facility the RPA, in association with the RPO, will conduct an inspection. The RPA will issue and sign the commissioning report, and issue a certificate upon successful commissioning. Work in a radioactive facility can only commence in the area once this certificate is received.

Specifications of all installations and facilities for radioactive work or storage must be kept by QMUL Estates & Facilities Directorate and copied to the relevant S/I/D and HSD (RPO), including any installed shielding, and of the designated radioactive drain and vent disposal / exhaust routes, including an accurate plan / diagram of the routes.

Maintenance: It is the responsibility of the Head of S/I/D to ensure that the existing infrastructure of the facilities is maintained in a suitable state for radiation work or storage. Any changes or failings in the standard required must be reported to the RPO. If required, the specification may need to be upgraded to meet changes in regulation and QMUL policy. Adequate resources must be provided for the upgrade by the Head of S/I/D.

13. Access to Radiation Work Areas

Entry to both Controlled and Supervised Areas must be restricted to authorised access only. In most instances this will require a secure entry system (restricted card swipe/pin code/coded digital lock) to prevent unauthorised access. The RPS should retain an up to date list of persons with authorised access. Swipe card access list should be regularly scrutinised and updated. Pin codes and digital lock codes should be regularly changed.

Controlled Radiation Areas: Only Classified Radiation Workers are permitted to work regularly in Controlled Areas. Other persons, including non-classified radiation workers, laboratory workers, visitors, maintenance and service personnel, can enter these areas **only** if a written Scheme of Work (SoW) is available and instigated in consultation with the QMUL RPO, and approved by the RPA. This is to ensure that doses limits that apply to non-classified radiation workers and others are not exceeded. Any SoW should be appended to the Local rules.

Supervised Radiation Areas: These areas must also have a Scheme of Work or Local Standard Operating Procedure (SOP) appended to Campus Local Rules in respect of access by designated radiation workers and supervised permitted non-radiation workers, e.g. Estates Maintenance, Contractors. The Scheme of Work (SoW) should be written by the facility RPS, in consultation with the RPO, and approved by the RPA.

Access to Controlled or Supervised areas by non-radiation workers, either by internal personnel such as Estates maintenance or cleaners; or external such as service engineers; a Permit to Work [22] must be completed and signed off by the RPS prior to granting temporary access. Any major works to a radiation area (or its vicinity) may require decommissioning of all or part of the facility by the RPA (see below).

14. Decommissioning Radiation Work Areas

All areas in which radioactive substances have been used, and ceases to be used for this purpose, a formal decommissioning process must take place before the area can be used for any other purpose. In addition any major building works in the area or in close proximity which may affect or be affected by the presence of radioactive materials may require decommissioning of the area.

The decommissioning process will involve robust monitoring, decontamination procedures and scrutiny of records. The QMUL Laboratory Clearance Guidance document and procedure [23] must be followed and completed to ensure the decommissioning process is conducted effectively. The form, monitoring and disposal records must be provided to the RPO. A final inspection of the area will be carried out by the RPA, along with the RPO, before the final clearance report and certificate will be signed off and issued by the RPA. Once the certificate has been received, all signage relating to radioactive work must be removed before any change of use can take place.

15. Control of Radioactive Materials and Sources

The use, holding and disposal of radioactive material are subject to national control through the Ionising Radiation Regulations 1999, and Environmental Permitting Regulations 2010 (as amended). The effective regulation of these materials is by the Environment Agency (EA). The quantities permitted for use and disposal on QMUL premises are strictly stipulated in the permissions issued to QMUL by the EA. There are separate licences / permits for each QMUL campus site for sources and accumulation / disposal of radioactive waste.

All control of individual radiation project work is via the QMUL Project Approval process and use of QMUL radiation auditing software ISOSTOCK

Variations or additions can be made to existing permits / licences on application to the RPO. The success of the request is conditional on the availability of funding and sufficient justification that would be acceptable to the Environment Agency Inspectorate. Therefore a Project Approval detailing the variations needs to be submitted to HSD providing this justification, before an application is made.

16. Project Approval for Work with Radioactive Materials

(i) Radioactive Sources:

Project Approval must be sought and completed before all new work, significant change of existing work (including change of named radiation workers) or transfers of work from other Institutions can be undertaken. A completed Project Approval form must be submitted to the RPO (Project Approval forms available at the HSD website [13].

This form must be completed by the Research Group Principal Investigator / Supervisor, and approved by the local RPS. The RPS and RPO can provide advice on completing the forms and the fully completed draft version should be sent to the RPO for initial review. The final document should be signed off by the Head of S/I/D (i.e. the person with overall responsibility for the radioactive work within the School / Department / Institute). The Project Approval will be then reviewed by the RPA and signed off by the RPO on behalf of QMUL, and then work can commence.

All Project Approvals are given a unique QMUL Project Approval reference code. Projects prior to January 2011 do not have this code and are therefore no longer valid. This reference code should be used in all correspondence and where appropriate included in any record keeping such as Local Rules and on ISOSTOCK

Project Approvals have a maximum active life of three years, and on this anniversary are subject to review or termination. Project Approvals may also be reviewed from time to time as a consequence of changes in statutory measures and accidents / incidents.

Project Approvals can be revoked at any time by the RPO / RPA in light of inspections / accidents / incidents / unsafe practices. If a Project Approval is revoked all related work must cease immediately and radioactive sources securely stored until such time that the work is re-approved.

(ii) Naturally Occurring Radioactive Materials (NORM)

The RPO must be informed of all work involving NORM and the quantities on site, e.g. uranyl acetate, pitchblende. Regulations apply to the holding limits and disposal of this material therefore advice should be sought from RPO before any item is procured, transferred, used or stored on any QMUL site.

For X-ray generating equipment see section 22.

17. Ordering, Transfers and Delivery of Radioactive Materials

(i) Ordering of Radiation Open (Unsealed) Sources

Ordering of radioactive materials must only be performed by the authorised person/s at QMUL. All purchases must be authorised by the relevant RPS (or in their absence, the Deputy RPS) within each Department / School / Institute. Monthly purchase limits are set in the Project Approval in line with campus permit limits.

Both the purchaser and the RPS must ensure that the Project Approval limits that apply to each order are not exceeded.

The Head of Department / School or Institute should ensure that there are at least two independent levels of control to ensure compliance with Project Approval limits so that the aggregate of projects allowances (both current holding and intended purchase) do not exceed the Environment Agency Registration limits for the QMUL campus site.

All purchases **must** be made via the QMUL electronic procurement system, Agresso. Prior to any orders being made for open source radioactive material, a requisition must be entered onto ISOSTOCK. This requisition can **only** be authorised by the relevant RPS (or in their absence, the Deputy RPS). An authorised requisition will generate a unique requisition number. The specific radioactive material identifying product code (Agresso) and this requisition number must be entered in the appropriate fields on Agresso. The ISOSTOCK requisition number will be printed on the Purchase Order.

Arrangements must be in place to ensure that radioactive consignments are delivered **directly** to the School / Institute / Directorate or to a designated central reception point. Specific written arrangements should be made and lodged with QMUL Security Manager for both normal working hours and out of hours deliveries, whereby the consignments can be securely stored (e.g. locked cabinet with radioactive signage) and only accessed by the consignment authorised personnel. These written procedures should be appended to the Local Rules. On arrival all new stocks must be entered onto ISOSTOCK that same day.

(ii) Acquisitions of Naturally Occurring Radioactive Materials (NORM)

The RPO must be informed prior to any acquisitions of NORM materials, and the appropriate holding requirements obtained prior to acquisition.

(iii) Acquisitions of other types of Radiation Sources

For all other types of Radiation sources, inform the RPO prior to any acquisition. Specific acquisition requirements exist.

(iv) Transfers of radioactive materials to and from QMUL

Transfers of any radioactive sources and materials to another Institution either within the UK, the EU or non EU countries, requires prior consultation with the QMUL RPO and RPA in order to ensure all legally required documentation and procedures are in place, whether these are regular or infrequent shipments.

Transfers of radioactive sources and materials (other than waste, for which see 4.5 below) to another QMUL campus require adherence to the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009. Consult the RPO for further information.

Written agreement from the receiving institution RPS / RPA should be gained along with documentation confirming that the materials fall within their Site /

Organisation's EA permits. Consignment Transfer Notes should be provided and fully signed consignment documentation relating to the shipment retained.

18. Records and Control of Radioactive Materials within QMUL

Suitable and sufficient approved Local Rules must be in place in each radiation facility.

(i) Open (Unsealed) Sources:

For open sources the Local Rules should prominently display all active approved projects using the QMUL reference codes (implemented January 2011). Against each active project code, the permitted holding and disposal limits should be displayed. In addition, the total allowable limits for individual radioisotopes based on the currently active approved projects within the radiation facility should be recorded.

All records for the use of radioactive open sources, must be kept on the appropriate campus QMUL ISOSTOCK computer management database. Paper records are not acceptable as a record.

All radiation workers and/or RPS must ensure that source delivery, holding stocks, usage, and disposal records are kept up to date. ISOSTOCK records must be correct by the day. Entries of all new stock should include the appropriate Project Approval Reference code at the requisition / authorisation stage. All stocks must be associated with a current member of QMUL staff.

Repeated failure to maintain records adequately will result in a letter to the Head of Department / School or Director of Institute from the RPO informing them of this situation with a request for immediate resolution of the breach. If this action fails to resolve the situation, the matter would be taken to QMUL Senior Management and may result in the Project Approval being revoked.

All unsealed radioactive material including all, primary stocks, aliquots and sub-samples must have an identity label with the isotope, and the **ISOSTOCK reference code** date and activity.

ISOSTOCK is overseen on all campuses by the RPO. Password access and level of access to ISOSTOCK can only be granted by the RPO. Any errors or problems with ISOTOCK should be reported to the RPO and details of all leavers as soon as possible.

(ii) Naturally Occurring Radioactive Materials (NORM):

All Departments/ Schools / Institutes must keep an inventory of any quantity of NORM, accurately identifying the individual materials, the quantities in grams and the location where kept. A log of the condition and disposal of these materials must be kept. Any disposals regular or individual must be pre-agreed with College RPM and RPA. All holdings must comply with the Euratom Safeguards derogation for Small Holders of Nuclear Materials (SHMN) [24].

Holding and disposal limits may also apply to certain NORM which are not exempt.

Records should be submitted annually to the QMUL RPO on the designated form (available from the RPO).

(iii) Other types of Radiation Sources

For all other types of Radiation sources, appropriate records must be kept within ISOSTOCK.

19. Fire Safety, Security, Storage and Transfer of Radioactive Materials

Security requirements issued by the EA within permits and National Counter Terrorism Security Office (NaCTSO) handbook must be adhered to. Advice on specific requirements can be obtained from the RPO and RPA.

Radioactive materials must always be used and stored in conditions which do not present a hazard to other persons in the vicinity, and are secure against theft or unauthorised tampering, and in an area with a suitable fire detection system.

Access to all radiation areas should be restricted to authorised personnel only using a restricted entry system. In addition, Controlled and Supervised Areas must be locked when not in use. Radioactive Open sources must be stored in locked containers e.g. a safe or lockable fridge.

Containers used to transfer radioactive materials to and from a store should be designed to reduce to a reasonable level the dose received by persons carrying them, other staff and members of the public and should be designed to avoid spillage

Regular checks of the stocks of open sources must be made. An up to date stock check list from ISOSTOCK must be put on the front of the storage unit as designated on ISOSTOCK. Regular location checks for sealed sources must also be carried out and logged on ISOSTOCK. Any missing stocks or sources must be immediately reported to the RPS, and RPO.

Fire Red Boxes: Information on types of radioactive material and maximum activities along with a floor plan showing the location of the substances must be provided to the HSD Fire Safety team for inclusion in the secure ‘Red Boxes’. It should include an estimation of the risk level to the fire services and environment (High / Medium / Low) based on likely containment and immediate / long term effects on population and environment.

20. Disposal of Radioactive Waste

(i) Open (Unsealed) Source Waste:

The appropriate routes of disposal of open source waste are determined as part of the Project Approval Process and in line with authorised EA Permits issued to

QMUL. The Project Approval sets the limits of waste accumulation and disposal and these limits must be adhered to by all radiation workers. Department/School/Institute/Centre waste limits are also noted in the Local Rules for Radioactive Work. The RPS has day to day responsibility at a local level for the supervision of accumulation and disposal of radioactive waste. Any instances where limits might be or have been exceeded must be reported to the RPO as soon as possible.

Only authorised routes of disposal must be used and records as accurate as possible kept of day-to-day disposals on ISOSTOCK. Storage for accumulation and decay prior to disposal should only be in the designated campus radiation waste accumulation stores.

The generation of solid waste is minimised by:-

(a) Using the very minimum amount of radioactivity necessary for a given experiment.
(b) Storage of short-lived isotopes for (physical) decay, subject to EA authorisation.

(ii) Naturally Occurring Radioactive Materials (NORM) Waste

The RPO and RPA must be consulted prior to any disposals of NORM.

(iii) Other types of Radiation Source Waste

For all other types of Radiation sources, inform the RPO prior to any waste disposal. Specific waste disposal requirements exist.

21. Annual Returns

The RPO is responsible for ensuring that the required annual returns are made to the Environment Agency and other regulatory bodies, including the

i. Annual Pollution return for Open Sources
ii Return and updates of changes for other sources

The returns are required for the *previous* calendar year during the first month of the *following* calendar year. RPS(s) must ensure that all records are up to date at the end of each calendar year and the RPO promptly informed of any potential discrepancies in the records.

22. Control of X-ray Equipment

(i) Approval, Purchase and Registration of X-ray equipment

Prior to the purchase and installation of any X-ray generating equipment, an X-Ray equipment registration and risk assessment form [25] must be completed by the Research Group Principal Investigator / Supervisor, approved by the RPS, and

signed off by the Head of S/I/D. It must be then submitted for an initial review to the RPO. The RPA will then be consulted and approval obtained for the proposed installation and use.

(ii) Installation and maintenance of X-ray equipment

The installer of any equipment producing ionising radiation has a duty under regulation 31(2) of IRR99 to undertake a critical examination of the installation together with an accredited RPA. Arrangements must be made by the Head of S/I/D during procurement to establish whether the QMUL RPA or the installer's RPA oversees this critical examination.

The equipment must be maintained and serviced according to the manufacturer's recommendations by a company qualified to carry out such maintenance. Records of annual critical examinations and any in house routine external dose rates must be retained by the relevant RPS.

(iii) Disposal of X-ray Equipment

X-ray equipment is not radioactive waste but must be made incapable of being reused before disposal. It is likely that the X-ray tube head / cooling oil will require separate disposal. The X-ray tube may have a beryllium window and must be disposed of as hazardous waste. Care must be taken not to damage the window during disassembly since toxic beryllium dust may be released. All Hazardous waste must be disposed via authorised routes for disposal, contact HSD for further information (see QMUL Laboratory Hazardous Waste Policy and Procedures [26]. Disposal of all non-hazardous electrical equipment must adhere to the WEEE Regulations [27].

23. Medical Uses of Radiation

(i) Control of Medical Exposures

The RPO and RPA must be consulted on any intended radiation procedures work involving the intentional administration of, or exposure to radioactive materials to humans. Medical uses of radiation within QMUL must comply with the Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R 2000, as amended [3]) . This regulation is made under criminal law and is intended to protect the patient from the hazards of ionising radiation.

The main requirement of Regulation 2 is to ensure an overriding management framework document is prepared by the Institute / School / Directorate concerned and that it is put in place for all procedures and projects. Consent to commence a procedure must be obtained in writing from the QMUL RPA, RPO and Director of HSD that they agree and are satisfied with any management framework document submitted.

The management framework must also determine the other duty holders 'entitlement' (i.e. authorisation to act on behalf of the Employer) and their professional responsibilities. Four types of duty holder are defined, the Employer, Practitioner, Operator and Referrer. QMUL in this context would be the Employer

and its duties are set out in Regulation 4, and only QMUL will able to determine the 'entitlement' of other duty holders.

It is the responsibility of the Heads of S / I /D's to ensure that any 'entitled' duty holders comply with any relevant sections of the management framework (Regulation 5) e.g. written procedures, training, dose constraints and incident reporting.

Where QMUL staff are involved with medical exposures where Barts Health NHS Trust is the employer, the QMUL staff must hold honorary Trust contracts, and there must be clear lines of responsibility.

(ii) Duty Holders for Medical Physics Exposures

The **Employer** is QMUL and their duties are set out in Regulation 4 IR(ME)R. Employers are legally responsible for ensuring that safe practices and robust written procedures/protocols are in place within an overall management framework. In addition to comply with the regulations the management framework must take into account a number of issues including but not restricted to; aspects of quality assurance, justification, optimisation, dose constraints, adequacy of 'entitled' duty holder training and patient accident/incident reporting, The Head of S / I /D must also put in place steps to ensure that the 'entitled' duty holders comply with the written procedures (Regulation 5 IR(ME)R) and must ensure that all staff authorised to act as Practitioners and Operators are adequately trained in current practice (Regulation 11) and that adequate training records are kept and available for inspection.

The **Practitioner** is the person responsible for the justification of the exposure. The Practitioner for Nuclear Medicine investigation must ensure that he/she holds a current Administration of Radiation Services Advisory Committee (ARSAC) certificate and submit a copy to QMUL (HSD).

The **Operators** are staff involved in tasks that affect the extent of the exposure. The Referrer is a competent person who can assess available information against referral criteria. Both Practitioners and Operators are responsible for keeping exposures as low as reasonably practicable, compliance with any written protocols or Standard Operating Procedures) according to the scope of their duties as defined in the management framework.

(iii) Medical Physics Expert (MPE)

A Medical Physics Expert (MPE) in Diagnostic Radiology or Nuclear Medicine as appropriate should be appointed and consulted on any matters relating to compliance with IR(ME)R 2000 and the RPA (via QMUL RPO) for matters concerning the IRR99. For all work carried out on QMUL premises or by QMUL employees, the Director of HSD with the RPO will determine whether a candidate is a suitable for appointment to the position of MPE for the research project based on the criteria, documented evidence of experience and accredited training as defined in Regulation 9 IR(ME)R. Consultation costs should be included in any project funding submissions.

(iv) Equipment used for Medical Exposures

Any equipment which is used in connection with a radiation exposure must be designed, constructed, installed and maintained so that the objectives of diagnosis, treatment or research can be achieved with the minimum of radiation exposure.

The installer of any equipment intended to be used in connection with medical exposures has a duty under regulation 31(2) of IRR99 to undertake a critical examination of the installation together with an RPA. Arrangements must be made by the Head of S/I/D during procurement to establish whether the QMUL RPA or the installer's RPA oversees the critical examination.

Arrangement must be made, either with the installer or another party, to ensure electrical and mechanical safety testing is carried out prior to the acceptance test.

Newly installed equipment must undergo acceptance testing under the supervision of the RPA or Medical Physics Expert before the unit is put into clinical use. An acceptance test report must be provided by the RPA / Medical Physics Expert.

An equipment quality assurance programme that complies with the recommendation of the IPEM 91 Report (Recommendation Standards for the Routine Performance Testing of Diagnostic X-ray Equipment) or later revisions must be in place.

A maintenance contract must be in place to provide routine preventative maintenance on all diagnostic equipment.

Equipment requirements and performance must be reviewed and an equipment replacement plan in place.

24. Audit and Reporting Schedules

(i) Minutes of Radiation Protection Safety Committee (RPSC)

The minutes from the scheduled or ad hoc RPSC meetings are presented to the QMUL Health & Safety Advisory Group by the Chair (or Deputy) of the sub-committee.

(ii) Audit of Local Rules and Work Procedures

It is the responsibility of the RPS to ensure that the Local rules that they have in place are suitable and sufficient, up to date and accurate. Local rules are audited every year by the QMUL RPA; this is reported to the Radiation Protection Safety Committee. RPS's will be notified of any significant changes necessary due to changes in legislation, contact details of staff etc. RPS (s) in designated QMUL radiation facilities are recommended to utilise the generic Local Rules available electronically on the HSD website. These can be adapted for each campus and facility use.

(iii) Audit and Reporting Schedules

Radiation audits are scheduled and performed annually in all QMUL designated radiation facilities lead by the QMUL appointed RPA. Radiation facilities can also be inspected at other times such as when setting up of new facilities or decommissioning of laboratories or subsequent to an incident etc. An example of a typical radiation laboratory audit checklist is available at [25]. Written reports for all audits are provided by the appointed RPA. These reports are sent to the Head of S / I / D and appropriate facility managers along with an action point sheet. On completion of the action points, this document must be signed off by the Head of S / I / D and returned to the RPO (HSD) and appointed RPA. Reports and completion of actions are tabled at the RPSC.

The Regulatory Authorities such as the Environment Agency, and Police Counter Terrorism Security Advisers (CTSA) also conduct inspections and audits of radiation premises and documentation. These may be pre-arranged or in response to an incident or significant radiation issue.

25. Definitions and Glossary

Absorbed Dose: The quantity of energy imparted to unit mass of matter (such as tissue) by Ionising Radiation. Unit Gray (Gy). (1Gy = 1 joule per kilogram).

ALARP: As Low As Reasonably Practicable; The principle that (ionising) radiation exposures must be reduced to the lowest level that can reasonably be achieved.

Alpha Radiation: The emission of an alpha particle from an atom. Alpha Particle = 2 protons and 2 neutrons.

Best Available Technique (BAT): means the latest stage of development of processes, facilities or methods of operation which is practicable and suitable to limit ionising radiation exposure. BAT applies throughout the lifetime of a process, from design to implementation, operation, maintenance and decommissioning.

Beta Radiation: An electron emitted by the nucleus of a radionuclide. The electric charge may be positive, in which case the beta particle is called a positron.

Gamma Radiation: A discrete quantity of electromagnetic energy without mass or charge. Emitted by a radionuclide.

Becquerel: (symbol Bq) is the SI derived unit of radioactivity. One Bq is defined as the activity of a quantity of radioactive material in which one nucleus decays per second.

Classified Person: Person who is designated as classified under the Ionising Radiations Regulations, 1999, on the basis of the dose they are likely to receive. They must have their dose properly assessed, e.g., by personal dosimetry, doses recorded in long-term dose records, and have an appropriate health record.

Contamination: an undesirable situation where radioactive material in an unsealed state is present in the working environment, or otherwise un-contained or not required. Contamination can either be loose (easily removed) or fixed. Loose contamination is usually of more concern since intakes of radioactive material through inhalation, ingestion and injection may occur.

Controlled Area: Area designated in accordance with the Ionising Radiations Regulations, 1999. Must be physically demarcated, have access restricted and be described in the Local Rules. Entry into controlled areas allowed for classified persons, and non-classified persons who are working under written arrangements.

Decay: The process of spontaneous transformation of a radionuclide. The decrease in the activity of a radioactive substance.

Decay Product: A nuclide or radionuclide produced by decay. It may be formed directly from a radionuclide or as a result of a series of successive decays through several radionuclides.

Deterministic Effects: Health effects that only appear if a threshold level of dose is exceeded, e.g. radiation-induced erythema (burns). Deterministic effects will appear within the hours, days or weeks following a high radiation exposure.

Dose Limit: is the value of the effective dose or the equivalent dose to individuals from planned exposure situations that shall not be exceeded.

Dosimetry Service: A service that systematically measures and/or records workers' radiation doses, usually by means of personal dosimeters.

Effective Dose: The quantity obtained by multiplying the equivalent dose to various issues and organs by a weighting factor appropriate to each and summing the products. Unit Sievert, symbol Sv. Frequently abbreviated to dose.

Equivalent Dose: The quantity obtained by multiplying the absorbed dose by a factor to allow for the different effectiveness of the various ionising radiations in causing harm to tissue. Unit Sievert, symbol Sv.

Half-life: The time taken for the activity of a radionuclide to lose half its value by decay. (Symbol $t_{½}$)
Ionising Radiation: Radiation composed of particles that individually carry enough kinetic energy to liberate an electron from an atom or molecule, thereby ionising it.
Isotope: Nuclides with the same number of protons but different numbers of neutrons.

Justification: The process of justification requires that before a practice is introduced, it should be shown to give an overall benefit. It is also implicit in approach that all aspects of the practice should be considered. Justification is relevant not only when a new practice is being introduced but also when an existing practice is being reviewed in the light of new information about its efficacy or consequences.

Local Rules: Set of working procedures written in accordance with the Ionising Radiations Regulations, 1999, to enable work with ionising radiations to proceed safely, and in accordance with the Health and Safety at Work Act, 1974.

Mutation: A chemical change in the DNA in the nucleus of a cell. Mutations in sperm or egg cells or their precursors may lead to inherited effects in children. Mutations in body cells may lead to effects in the individual.

NaCTSO: National Counter Terrorism and Security Office. UK Police Agency overseeing security of harmful substance activities that have the potential to be used in terrorism.

NORM: Naturally Occurring Radioactive Material. Long-lived radioactive elements such as uranium, thorium and potassium and any of their decay products, such as radium and radon are examples of NORM**.**

Nuclear medicine: Term usually applied to the use of radionuclides for diagnosing or treating disease in patients.

Nuclide: A species of atom characterised by the number of protons and neutrons and, in some cases, by the energy state of the nucleus.

Open Source: is a source of Ionising Radiation in the form of radioactive material which is not encapsulated or otherwise contained. The implication is that open radioactive material can move around and if uncontrolled would lead to radioactive contamination.

Radiation Protection Adviser (RPA): Person deemed to be competent to give radiation protection advice, under one of the schemes recognised by the Health and Safety Executive (HSE). (A statutory position).

Radiation Waste Adviser (RWA): Anyone who has a legal permit (under the Environmental Permitting Regulations 2010 or an authorisation under the Radioactive Substances Act 1993) to accumulate or dispose of radioactive waste needs to appoint a Radioactive Waste Adviser (RWA). A RWA is a specialist in radioactive waste disposal and environmental radiation protection who has demonstrated competence in the RWA syllabus (A statutory position).

Radiation Protection Officer (RPO): Competent Officer appointed by QMUL to coordinate and operate the management of radiological protection (not a statutory position).

Radiation Protection Supervisor (RPS): Person appointed by the employer to supervise the radiation work, to ensure that local rules are followed (a statutory position).

Radioactive can generally describe the property of a substance (or more accurately atomic nuclei) which are unstable and spontaneously Decay (disintegrate) with the release of energy, the energy being either Electromagnetic Radiation, particulate or both. This process may occur in both naturally occurring radioactive material and man-made substances. For any given element there will be a number of Isotopes, some of which may be radioactive.

Radioactive Waste: For the purposes of Radiation Protection, radioactive waste can be defined as any radioactive substance/s which is no longer required and has no further useful purposes.

Radiological Protection: The science and practice of limiting the harm to human beings from radiation.

Sievert: The Standard International (SI) unit of dose equivalent is the joule per kilogram (J/kg), which has been named the Sievert (Sv) by the International Commission on Radiological Protection (ICRP).

Stochastic Effects: With respect to Radiation Protection, stochastic effects (also referred to as Probabilistic) represent radiation harm for which there is no threshold (see Linear Dose Response). Even the smallest quantity of Ionising Radiation exposure can be said to have a finite probability of causing an effect, and this effect being either cancer in the individual or genetic damage. Dose Limits are set to ensure that these effects are minimised to broadly acceptable levels

Supervised Area: Area designated in accordance with the Ionising Radiations Regulations, 1999. Supervised area need not be physically demarcated and access is unrestricted. Supervised areas must be described in the local rules.

Thermoluminescent Dosimeters (TLD): A dosimeter that works by storing the energy it gets from the ionising radiation, and releasing it, when heated, in the form of light.

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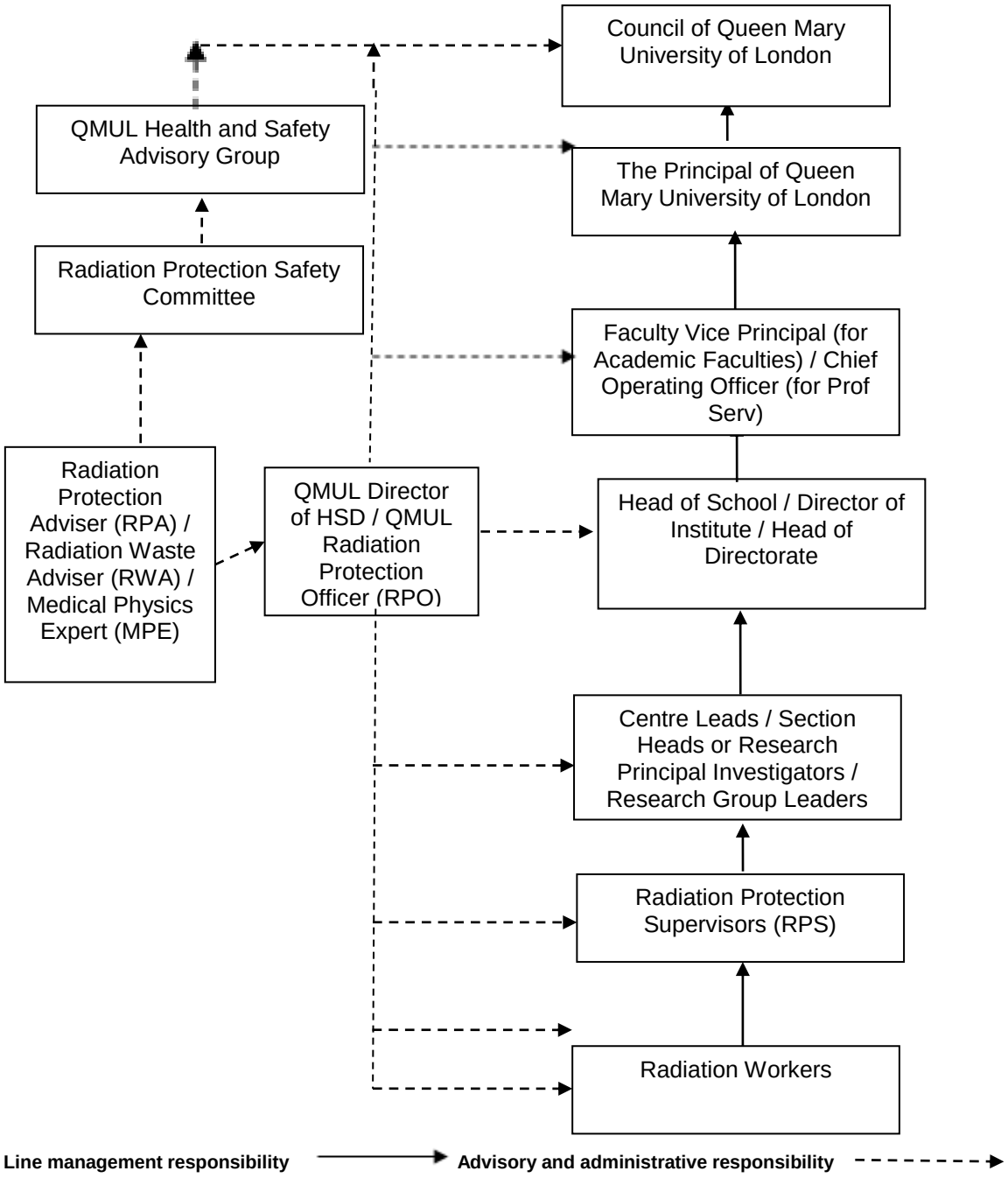
Appendix 1 – Responsibilities for Radiation Protection and Safety at Queen Mary University of London



Appendix 2 – QMUL Radiation Protection Safety Committee - Terms of Reference

Queen Mary University of London
Radiation Protection Safety Committee
(Reports to the QMUL Health & Safety Advisory Group)

(This version reviewed and approved by the QMUL Health and Safety Advisory Group on **15 Dec 2015**)

1. To *advise* the QMUL Health and Safety Advisory Group (HSAG) on such actions as are necessary to comply with statutory and sub-statutory requirements for ionising radiation protection and safety, and the College ionising radiation protection safety policy and procedures.

   In this connection, the committee will have regard to any contemporaneous code of best practice promulgated by the Universities and Colleges Employers Association or any other relevant professional body (e.g. Association of University Radiation Protection Officers, Public Health England).

2. To *make recommendations* to HSAG as to what activities or authority should be delegated to the committee and to undertake such duties as may be delegated by HSAG.

3. To *recommend* to HSAG, objectives and targets by which the committee's performance may be assessed, to audit its activities and to submit an annual report to HSAG on its progress in achieving such objectives and targets.

4. To *advise* QMUL Heads of Schools, Institutes, Directorates of what is required to meet the legal requirements (including QMUL site license requirements) and responsibilities for ensuring ionising radiation protection and safety.

5. *To be advised* by the QMUL Health and Safety Directorate Director and Radiation Protection Officer (RPO), and including the appointed Radiation Protection Adviser (RPA), Radiation Waste Adviser (RWA), Medical Physics Expert (MPE), Occupational Health Service and other relevant policy holders.

6. In conjunction with above advisers, to *review* and where required *revise*, QMUL and local ionising radiation safety policy and procedures.

   In connection with the above noted review, it will give particular attention to QMUL site license requirements, justification for the use of ionising radiation substances or sources including consideration of non-radioactive alternatives; the reduction of ionising radiation hazards to humans according to ALARP (As Low As Reasonably Practicable) principle and adequate control of risks, appropriate health monitoring and surveillance; and the use of Best Available Technology (BAT) principles to ensure environmental protection.

7. To keep under *review*, the implementation and effectiveness of ionising radiation protection safety for staff, students and others affected by its activities, and arrangements to monitor ionising radiation protection safety standards and performance on QMUL premises and other activities that are within its control,

including equipment and systems of work (including the selection, purchase, use, storage, handling and disposal of ionising radiation sources or substances).

8. To *ensure* effective induction, training, mentoring and advice on health and safety of ionising radiation for all relevant staff and students in QMUL.

9. To *ensure* that the latest legal requirements and updates, best practices on ionising radiation protection are communicated to all relevant staff and students.

10. To *ensure* that any external regulatory inspection findings and requirements on ionising radiation protection safety are implemented.

11. To *discuss* the cause and remedies for accidents and incidents involving ionising radiation, and consider if existing procedures need to be revised and new procedures implemented.

12. To *consider* issues regarding ionising radiation protection raised by staff (including Trade Union safety representatives), students and visitors (where applicable).

13. To *establish* working groups or other bodies to undertake specific tasks on behalf of the committee.

The committee will be serviced by the Health and Safety Directorate, with the RPO acting as the Secretary.

Membership

Chair* (a Senior QMUL academic or manager with radiation protection experience)
Deputy Chair* (a Senior QMUL academic or manager with radiation protection experience)
Secretary (Health and Safety Directorate, the QMUL RPO)
Ex-officio RPA to QMUL or deputy
Ex-officio RWA to QMUL or deputy
Ex-officio Director of Health and Safety or other nominated safety adviser(s)
All QMUL Radiation Protection Supervisors / Managers
Trade Union safety representative(s)

*(*appointed by the Health and Safety Advisory Group, upon the advice of the Director of the Health and Safety Directorate)*

Reporting

The outcome of each meeting of the Committee shall be reported to the next scheduled meeting of the QMUL Health and Safety Advisory Group, in the form of summary minutes, presented by the Chair or Deputy Chair.

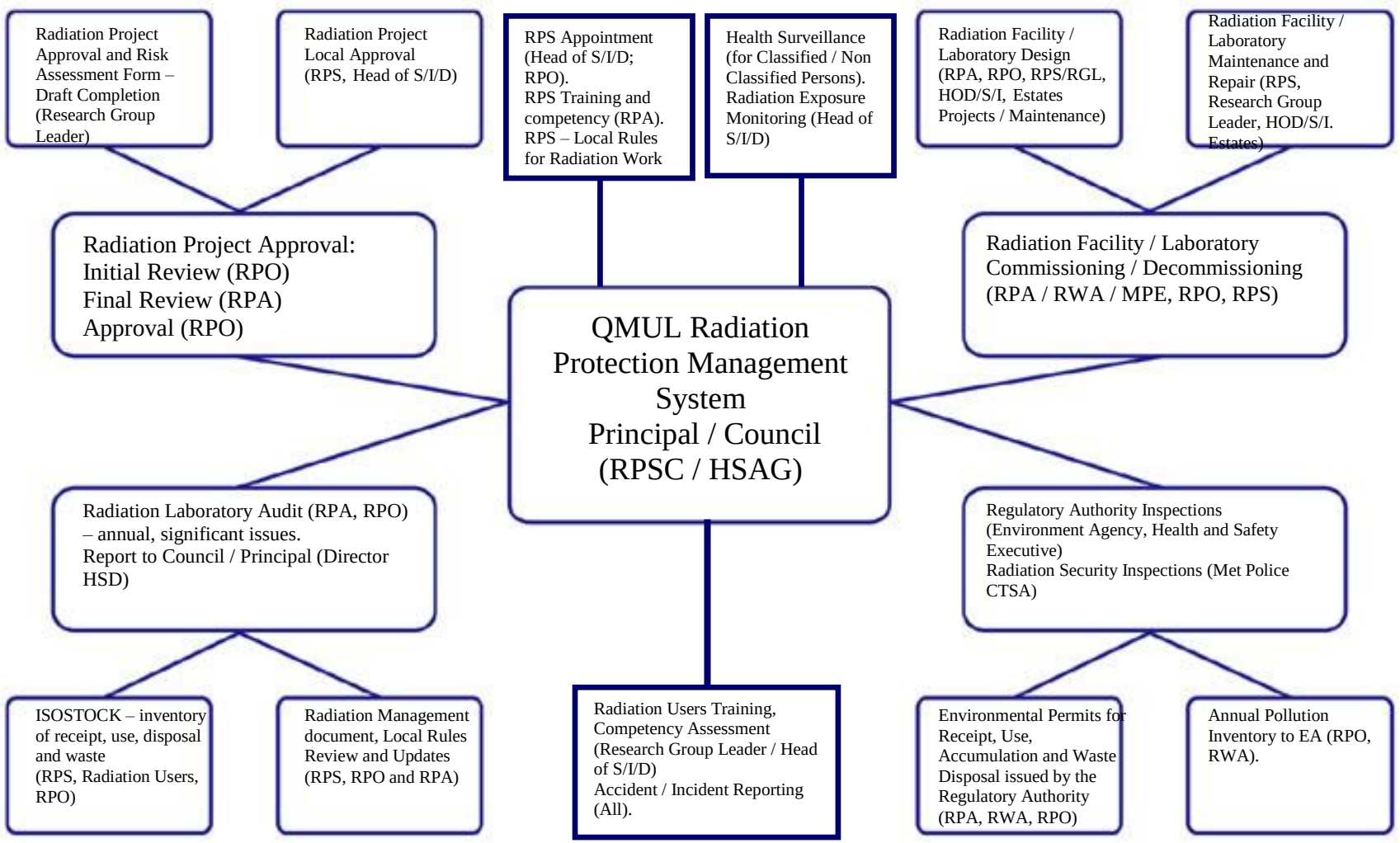
Key outcomes of the Committee meetings shall be disseminated to the relevant Heads of Directorates, Schools and Institutes, as well as to radiation workers in QMUL.

Meetings

The Radiation Protection Safety Committee shall meet, normally at least once a term, and may meet more frequently at the discretion of the Chair. The quorum for a meeting will be the Chair or Deputy Chair, the Secretary, RPA or deputy, and at least 2 RPS's.

Appendix 3

QMUL Radiation Protection Management System
Flow chart indicating key points and personnel



Appendix 4

Annual Limits of Intake (ALI)

The ALI of a radionuclide is the activity ingested or inhaled that would lead to a dose of 20 mSv

Radionuclide	ALI (Ingestion) MBq	ALI (Inhalation) MBq
Tritium	480	490
Carbon-14	34	34
Fluorine-18	410	220
Phosphorus-32	8.3	6.3
Phosphorus-33	83	14
Sulphur-35	26	15
Chromium-51	530	560
Yttrium-90	7.4	12
Technetium-99m	910	690
Indium-111	69	65
Iodine-123	95	180
Iodine-125	1.3	2.7
Iodine-131	0.91	1.8
Thallium-201	210	260

Document Control

Version 3

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2	1 June 2006 (QM/H&S/0072)	Regulatory and management / arrangement updates	Alan Scott (RPO) / Dr Julie Horrocks (RPA for QMUL)
3	16 November 2015	Update of legislation (EPR 2010), Organisational name change, update of management detail at QMUL, Updates / revisions of QMUL arrangements and descriptions	Dr Paul Cassell (QMUL RPO / RWA) / Dr Mark Ariyanayagam (QMUL BSA / Cover RPO) / Prof Julie Horrocks (RPA / RWA for QMUL). Consultation QMUL RPSC 10- 16 Nov 2015