MANCHESTER 1824
The University of Manchester

University Health & Safety Arrangements: Chapter 25

Ionising Radiation Safety

Target audience:	Heads of School, Principal Investigators, all staff and students working with sources of ionising radiation.

"Senior Managers" are responsible for health and safety within their organisational unit, specified areas or as a consequence of their activities, and for any additional activities as agreed and delegated to them (e.g. where they accept responsibility for day-to-day safety arrangements for staff who have other line managers, for reasons of geographical or other convenience). They may be Deans, Heads of School, Directors of Institutes, Directors and Heads of Service in non-academic areas, the University Librarian, the Directors of the Manchester Museum and the Whitworth Art Gallery, and their equivalents.

Introduction

1. This document, University Arrangements Chapter 25, should be read alongside Health and Safety Executive (HSE) publication 'Work with ionising radiation' L121 (2nd Ed.) 2018 (www.hse.gov.uk/pubns/books/l121.htm), which it mirrors in respect of its layout and approach. University Arrangements Chapter 4 'Radiation safety' also relates (www.healthandsafety.manchester.ac.uk/policy/arrangementschapters/).
2. The University of Manchester has responsibility for the management and development and control of work with radiation, for the operation of systems and source accountancy, and also for developing and promulgating knowledge and understanding radiological protection. The University must ensure compliance with all legislation governing work with sources of ionising radiation. The University uses a large number and range of radiation sources in its teaching and research. Health and safety arrangements are generally made and enforced locally, with the central Radiation Safety Unit providing oversight, policy direction and technical and legal expertise and guidance.
3. All purchases of ionising radiation must be arranged with the approval of the Radiation Safety Unit so that the University's consents, registrations and permits to keep and dispose of them can be complied with and fully audited.
4. The statutory landscape within which the University operates is complex, being framed by the;
    - Ionising Radiations Regulations 2017 (IRR17; www.hse.gov.uk/pubns/books/l121.htm), which apply to the use of sources of ionising radiation in radiation practices(1).
    - Environmental Permitting (England & Wales) Regulations 2016 amended by the Environmental Permitting (England & Wales) (EPR) Regulations 2018 (www.legislation.gov.uk/uksi/2016/1154/contents/made) and the Radioactive Substances Act 1993 (RSA93; www.legislation.gov.uk/ukpga/1993/12/contents), which apply to the holding, use and authorised disposal of radioactive materials, and which are discussed in DEFRA(2) guidance.
    - BEIS Guidance On The Scope Of And Exemptions From The Radioactive Substances Legislation In England, Wales And Northern Ireland (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731733/RSL_Guidance_update_BEIS_format_v5_180803.pdf).

- Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPIR; www.hse.gov.uk/radiation/ionising/reppir.htm), which apply to quantities of certain radioactive materials above specific threshold values.

5. The primary purpose of this Arrangements Chapter is to set in writing the requirements that must be followed to ensure that;
   - the University operates within the scope of the consents and permissions laid down by the Environment Agency and Health and Safety Executive
   - and that all radiation exposures are As Low As Reasonably Practicable (ALARP[3]).
6. The governance structure by which the University manages radiation security and radiological protection can be found in the ancillary Health and Safety Arrangements Chapter 4, which must be read and understood along with this chapter.

Justification, optimisation, dose limitation and people

7. The corner stone of radiological protection, as laid down by the International Commission on Radiological Protection (ICRP[3]) are that practices must be justified, optimized and comply to dose limits.
   - **Justification:** A particular use of ionising radiation cannot be justified unless there is a net benefit arising from that use - and alternative methods cannot be used, or are clearly of much less benefit. All exposures to sources of ionising radiation carries some risk of detrimental health effect be this an air flight or industrial radiography, and so the act of justification is to ensure (calculate) that the individual and societal benefit of the exposure outweighs the detriment examples ranging from exposure to x-rays as a medical diagnostic tool to the use of ion beam accelerators in the study of metallurgical damage in structural materials
   - **Optimisation:** all practices must be planned so as to reduce the potential for and magnitude of exposures, such as is achieved by using simple Perspex screens to shield against high energy beta emissions from laboratory radiochemicals or the use of robotically controlled auto-pipetting machines to reduce handling times in repetitive processes;
   - **Dose Limits:** all exposures must comply with strict statutory dose limits, which in UK legislation[(1)] means persons are restricted by annual dose limits. The limits that are included in UK legislation are based on the fundamental limits recommended by ICRP
   - **People:** The University will treat students as employees in respect of radiological protection, although dose limitation will aim to be at the lower public limits.

The management of ionising radiation safety

8. Radiation safety[(1)] governance and radiological protection[(2)] will be managed centrally on a day-to-day basis for the University Campus, which is inclusive of all sites situated north and south of the Mancunian Way. The principle of

subsidiarity applies for the Wolfson Molecular Imaging Centre, The Cancer Research UK Manchester Institute, and the Dalton Cumbrian Facility, where day-to-day management will be undertaken locally.

9. Inventories of radioactive materials, records of transfers and of radioactive waste disposals will be held 'locally', i.e. in Schools with respect to 'local' Environment Agency Permits[2] although some details of local management structure may differ between the various sites (reflecting differences in the nature and scale of their radiological activities), the overall harmonising arrangements described in this document will apply to every such site.
10. The Head of Radiological Safety who is also the Radiation Protection Officer (RPO), the Radiation Safety Unit (RSU) and Radiation Protection Supervisors (RPSs) within individual University Schools will coordinate day-to-day management of radiological safety for the Central Campus. Local Management will be subject to advice from the appointed RPA / RWAs, and for Dalton Cumbria Facility by a locally appointed RPO.
11. Day-to-day management of radiological safety at the Wolfson Molecular Imaging Centre will be carried out by the site RPSs in association with Christie Medical Physics and Engineering as the appointed RPA / RWA.
12. Day-to-day management of radiological safety at the Cancer Research UK Manchester Institute will be carried out by the appointed RPSs and with Christie Medical Physics and Engineering as appointed RPA / RWA.
13. The Head of Radiological Safety is ultimately responsible to the University Registrar and Chief Operating Officer through the Head of Safety Services.
14. The role of the Radiation Safety Unit is described in the University Health and Safety Arrangements Chapter 4.
15. Oversight of radiological safety is undertaken by the Radiation Safety Advisory Group (RSAG), which meets quarterly before the Health Safety and Wellbeing Committee that is chaired by the Registrar and Chief Operating Officer (see 'Arrangements' Chapter 4).
16. The latest radiation safety information and resources can be found at the Radiation Safety Unit's web pages at www.staffnet.manchester.ac.uk/rsu/.

Procedures: permits, registration and consents

17. A certificate has been issued by the HSE, under IRR17 Reg. 6 to provide for the uses of radiation generators (x-rays), artificial radionuclides (e.g. H-3, C-14, P-32, P-33, S-35, I-125) and naturally occurring radionuclides processed for their radioactive properties (e.g. natural thorium and uranium salts). This effectively means that all routine uses of sources of ionising radiation have been notified to the HSE for all University sites including, for example, Central Campus, Dalton Cumbria Facility, WMIC, Alderley Park.
    - Registration Certificate ♯IRR00013142.
18. Higher risk practices are permitted subject to HSE 'Consent' [IRR17 Reg.7] and on behalf of all University sites, RSU holds consent certificates for

- The deliberate administration of radioactive substances to people or animals for medical or veterinary diagnosis, treatment or research ♯IRR00013143;
- The deliberate addition of radioactive substances in the production or manufacture of consumer products or other products, including medicinal products #IRR00014054
- Operation of an accelerator (except when operated for industrial radiography or industrial irradiation purposes and except an electron microscope) ♯IRR00013145;
- Working with a high-activity sealed source (HASS) (except for industrial radiography or industrial irradiation purposes) ♯IRR00013144;
- Industrial radiography ♯IRR00029986.

19. For premises where University and NHS (for example) workers occupy shared premises on a collaborative basis the University consents are matched by NHS consents and ensure both radiation employers are cooperating in the spirit of IRR17 Reg. 16.
20. Schools may provide the details above to suppliers to secure purchases of equipment, such as hand-held x-ray devices, although permission to purchase should first be obtained from RSU. Further instruction on the acquisition of radioactive materials and devices is given below.
21. The uses of radioactive materials and the accumulation and disposal of waste is subject to the terms and conditions of permits issued by the Environment Agency under the Environmental Permitting Regulations.
22. North Campus Permits:
    - Standard rules SR2020 Category 5 Sealed Radioactive Sources permit;
    - Certificate of Registration for Open Sources Permit Number BX8661 dated 01/10/2004.
    - The Accumulation and Disposal of Radioactive Waste BX8645 dated 02/09/2004.
23. South Campus Permits:
    - Sealed Source Permit Number EPR/LP3893SW dated 25/01/2012.
    - Open Source Permit Number EPR/NP3893SRdated 15/10/2012.
24. Local Permits:
    - Supervised Areas using open sources receive local permits that limit the activities held and disposal limits and conditions.

Procedures: risk assessment

25. Written risk assessments must be made of all techniques and procedures which have radiation safety implications for staff or students. Risk assessments must be carried out in accordance with the specific requirements of IRR17, and associated Contingency Plans prepared, prior to the equipment being used or the technique being implemented. As a guide, Schools and research groups should each have a set of risk assessments that are tailored to their own practices, and each assessment should be approved by the RPS and the Head of School or a person authorised to act on their behalf (e.g. a Head of Department or a Risk and Compliance Manager). Such assessments should also be checked by the RSU who will give an opinion on their suitability. A 'sign-off' sheet or similar bearing the appropriate signatures must accompany all risk assessments.
26. The RSU and colleagues have prepared several over-arching 'top level' template-style risk assessments that can be adopted by Schools and Research Groups as appropriate, although it may be the case that Schools may need to prepare their own bespoke assessments. These assessments must follow IRR Reg. 8(1-4) and in particular ACoP paragraphs 70 and 71.
27. Where appropriate the over-arching assessments must be supported by supplementary focused assessments that address relatively minor variations or practical considerations on how protocols are amended to reflect operational matters and variations, or how a task must be undertaken. These supplementary assessments should not necessarily follow the ACoP paragraphs as their value is in providing task specific detail and instruction in a concise, readable and understandable manner.
28. All radiation workers must read and ensure they understand the conditions and requirements of the relevant risk assessments, and Schools are expected to maintain current lists of persons who have read any such assessments that must be available for inspection.
29. The RSU will consult with an appointed RPA on the suitability of risk assessments.
30. Risk assessments must be signed by the Head of School or their nominated deputy (as written in each School's Safety Policy).

Procedures: restriction of exposure

31. In going further than the regulatory requirement the University will ensure that effective exposures are ALARP by Schools ensuring that dose control measures make it unlikely that a person can receive an effective dose greater than 1 mSv/y.
32. Priority must be given to using engineering controls and 'defense in depth', and adopting other means to restrict radiation exposures.
33. RPSs will ensure that the philosophy of 'Time, Distance, Shielding and Activity' is considered at all times to ensure exposure are ALARP

- **Time:** reduce the time spent handling radioactive materials and / or being in proximity to sources of external radiation, which can be achieved by planning and rehearsing experiments
- **Distance:** increase the distance between people and sources of ionising radiation, for example, use long tongs to handle source vials and sealed sources where possible after considering any loss of manual dexterity
- **Shielding:** make use of Perspex (or lead impregnated) body shields, storage boxes and beta-cabs, and for strong beta and gamma emitters lead-lined safes to minimise external irradiations
- **Activity:** use the minimum practicable quantity of radioisotopes to achieve good scientific results.

34. Further to the above, when using x-ray generators consider the operating parameters (kV, mA), hardness of the x-ray source, beam filtration and collimation, and also the current (kV and mA). Instantaneous external radiation dose rates must not exceed 7.5 µSv/h and preferably should not exceed 2.5 µSv/h in accessible locations: RSU must be informed where dose rates may possibly exceed 2.5 µSv/h.
35. The RSU must be consulted on the proposed use and thereafter on use for the first time, of x-rays generators. Critical examinations and periodic routine checks will be required.
36. Sources must not be directly handled / manipulated by hand.
37. Volatile radioisotopes and solutions must only be used under LEV (that is inspected annually), and the dispensing of stocks must be carried out in fume cupboards, glove boxes, beta cabs or similar wherever reasonably practicable. Fume cupboards may be temporarily designated as Controlled Areas for the purposes of dispensing, in line with relevant risk assessments: seek the assistance of RSU.
38. Where sources of ionising radiation are used in designated or radiation areas or x-ray generators suitable and sufficient warning notices, signs and labels must be posted (template signs can be found in the downloads section at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/).

Procedures: PPE

39. If required by a risk assessment the University must provide suitable PPE for radiation workers and for use in responsive actions in an accident occurs. Typically, PPE in radiation laboratories comprises safety glasses, protective gloves and laboratory (sacrificial) coats and in some areas overshoes are required. In specialist areas protection against sharps and needle will be required, although blunt needles should be considered wherever possible.

Procedures: maintenance and engineering controls

40. Formal programmes of tests of active design features such as exhaust systems, LEV, the effectiveness of shielding, interlocks, annunciators, (usually annual) Planned Preventative Maintenance (PPM), programmes etc. must be established in liaison with Estates Services.
41. Passive controls for contamination control such as the continued suitability of easy-to-clean surface, surface joints, drainage systems, etc. must also be periodically checked.
42. The condition of PPE e.g. eyewear, laboratory coats must be periodically checked.

Procedures: dose limitation, investigation level and overexposure

43. (National) effective dose limits are 20 mSv/y for any employee or trainee over the age of 18 Other dose limits are 20 mSv/y to the lens of the eye, and 500 mSv/y to the extremities and to the skin when averaged over an area of 1 cm^{-2}.
44. The dose limit for any other persons such as members of the public, visitors is 1 mSv/y. This means that schools and colleges visiting University radiation laboratories are permitted, subject to risk assessment etc.
45. The University does not permit employees or trainees under the age of 18 to work with radiation, although they may visit areas for the purposes of making observations.
46. Supervised (external) visitors may visit University laboratories to make observations, in accordance with School protocols for visitors.
47. The process describing the use of dosemeters is described in Appendix 1a (is a dosemeter required) and 1b (the process for managing dosemeters). But in brief, the RPSs manage their radiation users dosimetry and the RSU oversees all radiation dose reports from the dosimetry service.
48. Whole body & internal exposure and extremity dose triggers are tiered as follows:
    - 0.1 to 0.4 mSv (whole body) – all low exposures are logged and reviewed along with other 'system components' such as perceived flaws in risk assessments and local rules to identify 'precursors' that may point to weaknesses in radiation safety systems;
    - low trigger doses of 0.4 - 0.9 mSv (whole body) and 1-9 mSv (extremity) are noted on the Event (incident) database so that doses can be identified and investigated (by the RPS in conjunction with RSU) to determine the cause - the primary aim of these low dose investigations is to determine whether the cause is a one-off event, a process failing, or early insight into the potential failure of a safety feature, shielding, or a behavioural matter;
    - high trigger doses of 1 mSv (whole body - the public dose limit) and 10 mSv (extremities) leads to a more detailed investigation being undertaken - the RPA will be notified;
    - an exposure in excess of three tenths of a dose limit, for example 6 mSv to the whole body and the public dose limit potentially being exceeded will

lead to an investigation as described above, with the Head of Department being involved in the investigation.

49. In the event of an overexposure a detailed investigation will consider:
    - the work routine of the worker and their colleagues;
    - the use of alarms and personal monitors;
    - any other known incidents the person may have been involved in;
    - the adherence to local rules, the results of any surveillance, the condition of any physical control measures;
    - training, instruction and competence.
50. An investigation report will be considered by the Radiation Safety Advisory Group and (at least a summary) provided to the radiation worker.

Procedures: restriction of exposure – public doses

51. Excepting medical irradiations in a hospital or treatment setting, for which other legislation applies, where it has been assessed that a member of the public could be exposed to direct radiation or contamination a dose constraint for a single source must not exceed 0.3 mSv/y. If an assessment shows that a member of the public could be exposed to radiation this must immediately be brought to the attention of RSU in writing.

Procedures: restriction of exposure - conduct of investigations

52. It is the jointly held responsibility of Schools, RPSs and Radiation workers to ensure that all incidents / accidents, near misses or 'events' are recorded on the 'Events Database'. This is to ensure that any 'reportable incidents' are reported to the HSE (by the Head of Radiological Safety or the Head of Safety Services if classified as RIDDOR events; www.hse.gov.uk/riddor/) within statutory time scales, that trends in the occurrence of events can be analysed, and also, that the University can continue to learn from events. Your local RPS or safety officer will be able to assist (www.staffnet.manchester.ac.uk/news/display/?id=12265).
53. All events / incidents involving sources of ionising radiation must be recorded on the events database www.healthandsafety.manchester.ac.uk/toolkits/accidents/reporting.
54. The RSU will undertake (written) investigations about the trigger / investigation level of 1 mSv as measured by dosemeters (or suspected doses). It is expected that the RPA will be consulted, but in any event consulted once a dose of 6 mSv has been determined. In addition to reporting on the events database the circumstances of investigations must be discussed at the Ionising Radiation Working Group and Advisory Group. Compliance and Risk Managers should discuss any learning outcomes at their safety committees with a view to ensure that good practice is refreshed.
55. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Procedures: contingency plans

56. The purpose of a contingency plan is to have arrangements that restrict exposures that arise from accidents so far as is reasonably practicable, and so, Schools must have well developed plans that RPSs must ensure are periodically rehearsed.
57. Emergency actions and contingency plans must be rehearsed by Schools on an approximately annual basis and records of attendance must be made by RPSs and held for five years.
58. The plan should identify:
    - the person(s) responsible for putting it into effect;
    - what are the immediate actions necessary for assessing the seriousness and for the mitigation;
    - what emergency equipment and PPE are necessary;
    - how to obtain radiation expertise (to immediately notify RSU
    - what emergency services or dosimetric follow up is required.
59. The useful results of any practices of events should be fed back to the 'Events Database' so that lessons can be learned (www.healthandsafety.manchester.ac.uk/toolkits/accidents/). Typical 'learning lessons' would be addressing matters of statutory non-compliance and understanding how such matters arose, looking at poor practices and potential accident scenarios, looking for improvements in 'good practices' to ensure the University develops 'best practice', which is important as other institutes look to Manchester to take the lead in several disciplines.
60. The complexity of the plan should be proportionate, simple to read and easily understandable. An emergency plan has been prepared by the RSU that covers most instances of the uses of unsealed radioactive materials and which is located in folder <downloads/local rules> at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/. RPSs should ensure that the plan:
    - covers any likely scenarios that may occur in their laboratories, amending the plan where necessary;
    - a copy of the main elements of the plan is incorporated into local rules.

Arrangements: Radiation Protection Advisers

61. In pursuance of IRR17 Reg14. and Schedule 4 the University has appointed a suitable number of experienced Radiation Protection Advisers (RPAs) and Radioactive Waste Advisers (RWAs). The 'general' RPA that will advise on most routine matters as RPA / RWA is UK Health Security Agency; a specialist RPA, Jacobs Clean Energy, has been appointed to advise on matters pertaining to 'Project Rose'.
62. Contact with the RPAs / RWA must be channelled through, and coordinated by, the RSU. The only exception to this is contact with Jacobs on Project Rose 'special projects', which is by agreement between RSU and the Nuclear Laboratory Manager.

63. The role of the RPAs is specifically (though not constrained to) advising on radiation risk assessments, the designation of controlled and supervised areas, the drawing up of local rules and contingency plans, plans assessments, periodic examination and testing of engineering controls and safety features, regular calibration of radiation monitors, dose assessment and recording, and the handling of investigations.

Arrangements: worker permits and training

64. The important aspects of radiation safety training i.e. 'good lab practice' are given locally, being specific to local radiation practice(s). RPSs must ensure all workers receive practical training before commencing radiation work for the first time, and refresher training must be given approximately every three years thereafter.
65. Awareness training on University procedures, risk assessment and local rules etc. is provided by RSU either face-to-face or via e-learning, Teams / Zoom or video. A flow chart showing the permit application process is given in Appendix 2.
66. RPS training is more complex and delivered or arranged by RSU, who should be contacted to advise on individual's training needs.

Arrangements: co-operation between employers (outside workers)

67. When University employees work on sites managed by other employers they have a legal responsibility to co-operative fully with that employer regarding any work with sources of ionising radiation, and must undertake to comply with that employers health and safety procedures, instructions and processes. Similarly, where the University shares premises or otherwise collaborates with other 'radiation employers', the employers and their employees must co-ordinate the measures taken and fully inform each other of the risks arising out of their work.
68. The collaborating / sharing radiation employers and their employees must ensure their local rules, instructions and any relevant information are shared and that they have been checked to ensure compatibility between working practices.
69. Details of designated radiation areas and contingency arrangements for action to mitigate the consequences of any radiation accident must be shared.
70. The University has several health and safety Arrangements Chapters that must be complied with when relevant. These include, but are not limited to
    - Chapter 16: Student Placements http://documents.manchester.ac.uk/display.aspx?DocID=20204
    - Chapter 18: Working across organisational boundaries http://documents.manchester.ac.uk/display.aspx?DocID=13897
    - Chapter 20: University and NHS shared premises http://documents.manchester.ac.uk/display.aspx?DocID=14772

- Chapter 24: Health and safety in off campus work, including field-work etc. http://documents.manchester.ac.uk/display.aspx?DocID=15496

71. In addition to the requirements for co-operation between employers for employees (including research students) visiting outside sites, radiation workers and their RPSs must discuss with RSU any proposals to undertake radiation work on nuclear sites or research facilities such as
    - the European Synchrotron Radiation Facility (ICRF),
    - European Joint Research Centre (JRC),
    - the Institute for Trans-uranium Elements (ITU),
    - Joint European Torus (JET),
    - National Nuclear User Facility (NNUF),
    - UKAEA-Culham, etc.
72. Discussions should must as soon as possible. Specific (often detailed) working arrangements may need to be put in place and safety & security agreements made to safeguard collaborators. Arrangements may also need to be put in place to ensure compliance with transport and export regulations.

Designated areas: new and refurbished facilities

73. Where new radiation facilities are being designed or refurbished a safety brief must be prepared. The purpose of a safety brief is to ensure that radiation safety matters are addressed, identify the success criteria, and record the appointments of a Suitably Qualified and Experience Person (SQEP) and independent reviewers. The complexity and length of safety briefs should be proportionate.
74. The University laboratory guidance note[5] must form the basis of design considerations (see folder <Downloads/Information sheets> at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/).

Designated areas: controlled, supervised and 'radiation' areas, de-designation

75. Controlled areas must be designated where it has been identified by a radiation risk assessment that it is necessary to follow 'special procedures' to restrict 'significant' exposure to ionising radiation. Significant exposure means where
    - there is a likelihood that an employee could receive an effective dose greater than 6 mSv a year, an equivalent dose greater than 15 mSv a year for the lens of the eye, or 150 mSv a year for the skin
    - the external dose rate exceeds 7.5 μSv/h when averaged over the working day
    - the hands can enter an area and the 8-hour time averaged dose rate exceeds 75 μSv/h
    - there is a risk of spreading significant contamination outside the work area.
    - IRR17 Reg. 17 and paragraphs 297-319 refer.
76. The expectation is that with a very few exceptions, such as approved walk-in x-ray bays or specialist glove box facilities, HASS facilities, the conditions requiring the designation of a controlled area must not be permitted to exist.

In almost all cases the likelihood of controlled areas being created can be prevented by the use of engineering controls or reduced radioisotope activities. Fume cupboards or beta cabs used for the dispensing of sources should only be temporary controlled areas so designated for occasional short-term use.

77. Laboratory areas in which radioactive materials are handled or stored, or in which X-rays are generated, must be designated as 'Supervised Areas' or 'Radiation Areas'. All supervised areas must be clearly delineated with physical barriers or highly visual markers and also with appropriate warning signs (that met the requirements of the Health and Safety (Safety Signs and Signals) Regulations 1996[4]. Template radiation warning signs are located in folder <downloads/ionising radiation safety signs> at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/; these may be adapted for local variations and needs.
78. The RPS must consult the RSU about any proposed changes to area designation, practices or the acquisition of any additional significant sources of ionising radiation in designated areas.
79. The only persons permitted to enter a controlled or supervised area are registered radiation workers who have permission to enter from a local RPS or person acting on their behalf. Estates or Security personnel may enter designated areas subject to RPS approval: a permit to work or other written instruction may be required from the RPS.
80. Local rules must be written for Supervised Areas that set out the arrangements that have been made to restrict exposure. The local rules should be pertinent, concise, understandable and appropriate for the degree of risk and complexity of the work being undertaken. It is most likely that the local rules will refer to other SOPs, instructions, and information of relevance. Local rules must also summarise the contingency / emergency arrangements in place. it is important that some means of document control is in place to enable changes in content to be tracked.
81. Persons may only work in controlled areas under the provisions of a written system of work (WSoW). A WSoW may be an enduring document, single use document / instruction or prominently displayed document that is referred to in local rules.
82. Local rules are not appropriate for 'radiation areas', which are best managed through standard operating procedures (SOPs).
83. If work with ionising radiation is discontinued in an area that was previously designated as a controlled or supervised area (or if a designated sink is no longer required for disposal of aqueous radioactive waste) a thorough decommissioning survey or check must be made by the RPS to ensure that no radioactivity remains as contamination. The RSU must then be requested to formally de-designate the area (or sink).
84. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Designated areas: inspections

85. Regular reviews of radiation safety and radiation dose / contamination surveys that also cover administrative procedures (risk assessments, local rules, SOPs), must be carried out on an annual basis by each University School in accordance with a local schedule, for all radiation areas designated or otherwise, although these may form part of a broad reviews of Health and Safety. A written report must be kept of all findings. In addition, RSU will conduct random laboratory surveys and inspections for the purposes of providing assurance to the University and issue a report to the Head of School, through their Faculty Compliance and Risk Managers and RPSs.
86. A list of the names of all persons with special responsibilities for radiation protection within a School must be included in the Local Rules for each University School.
87. The regular reviews must also confirm that controlled and supervised areas must remain correctly designated and that suitable legible radiation safety signs are posted.
88. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Designated areas: local rules

89. All work with ionising radiation must be described in written Local Rules, the purpose of which is to set out the key arrangements for restricting radiation exposure in a particular School or an area therein. As a guide, Schools and research groups should each have local rules that are tailored to their own practices, and each set of local rules must be approved by the RPS and the Head of School or a person authorised to act on their behalf (e.g. a Head of Department, Compliance & Risk Manager, suitable nominated person). The RPS must pass such local rules to the RSU who will give an opinion on their suitability.
90. Local rules must follow the requirements of IRR17 Reg.18 and in particular address the points raised in paragraph 336 and consider paragraph 337 of the ACoP to the IRR17. As for risk assessments, the RSU has prepared a template set of local rules that may be adapted locally (these are located at folder <downloads/risk assessments> at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/).
91. All local rules must be accompanied by a 'sign-off' sheet or similar bearing the appropriate signatures, which all radiation workers must sign to confirm the have read, are familiar with and agree to abide by the Local Rules pertinent to their work areas. Lists, which must be available for inspection, must be held by Research groups, lab managers, local health and safety coordinators, etc. A local rules template is available in folder <downloads/risk assessments> at www.staffnet.manchester.ac.uk/rsu/ionising-radiation/).
92. The RSU will consult with an appointed RPA on the suitability of risk assessments and local rules.
93. Local rules must be signed by the Head of School or their nominated deputy as written in each School's Safety Policy.

Designated Areas: Radiation Protection Supervisors

94. IRR17 Reg. 18(5) requires that the radiation employer appoints, in writing, one or more Radiation Protection Supervisors (RPSs) for the purpose of securing compliance with the regulations. In the University the duty holder is the Head of School or their nominated deputy as written in each School's Safety Policy (www.staffnet.manchester.ac.uk/rsu/ionising-radiation/).
95. It is a fundamental requirement that any person appointed as RPS must;
    - understand the requirements of the relevant legislation and of local rules in so far as they affect the work of the School;
    - have the personal authority and be given the time and facilities to exercise the necessary supervision;
    - understand the precautions needed to restrict exposures;
    - must be able to apply the IRR17 to the radiation practices in the laboratories they supervise.
96. Any individual being considered for the post of RPS will be encouraged to discuss the required duties with the RSU prior to any decision being made to accept the appointment.
97. A Radiation RPS will:
    - provide direct supervision, enabling the University to comply with the requirements of the relevant legislation where sources of ionising radiation are in use;
    - be directly involved with the School's work with ionising radiation, preferably in a line management position that will allow the exercise of close supervision to ensure that all work is done in accordance with the Local Rules;
    - be available to coordinate any emergency actions and supervise recovery work;
    - recognise that responsibility of compliance with the IRR17 lies with the Head of School (this responsibility cannot be delegated to the RPS).
98. The core duties of an RPS include:
    - monitoring to ensure that all radiological work within their area of responsibility is taking place within agreed local rules, current legislation and accepted good practice;
    - maintaining and monitoring the inventory of sealed sources of ionising radiation within their area, checking that they are securely maintained, recorded at their specified locations, under appropriate management control; and ultimately disposed of by an authorised route;
    - ensuring that in the event that an ionising radiation source is transferred either (a) to another university school, or (b) to an authorised contractor (e.g. for final disposal), that such a source is handed over securely and that a record of transfer is signed by both parties;
    - monitoring the list of classified and non-classified radiation workers within their area and that the RSU is informed;
    - providing advice to staff, students and management in regard to radiation protection matters;
    - referring promptly to the head of school any radiation protection problem that cannot be resolved locally on a time scale commensurate with the risk
    - liaising with fellow RPSs, the RSU, Faculty Compliance and Risk Managers and other central advisers on health and safety matters;

- attending meetings of the relevant committees when required and in particular the relevant School Safety Committee and the Ionising Radiation Working Group;
- ensuring that incidents and accidents involving ionising radiation are reported and investigated;
- disseminating radiation protection information and reports to appropriate staff and students;
- ensuring that new members of the school receive adequate information, instruction and training with respect to radiation protection matters;
- identifying staff or students in his/her area who would benefit from appropriate radiation safety training or occupational health surveillance;
- co-ordinating the implementation of advice from the RSU
- periodically (and not less frequently than annually) reviewing radiation protection procedures within his/her area;
- in larger University Schools, it may be appropriate or necessary to appoint several RPSs, each with a responsibility for a particular area - as a guideline, HSE recommendations are for the allocation of one RPS to every 10 – 15 radiation workers;
- while it is recognised that the RPS may not be the immediate line manager or supervisor overseeing the work with ionising radiation, the RPS must nevertheless ensure that adequate supervision is maintained through meeting regularly with the relevant staff and students;
- the Head of School may also assign such other radiation protection duties to an RPS as appropriate.

99. It should be noted that the following two paragraphs have been added to the 'RPS Nomination SOP' at the request of RPSs and managers:
    - this is an outline of the duties normally undertaken by an RPS; they are written to give guidance to the HoD and nominee, they are not applicable to every situation, should be interpreted and treated as such, being read as flexible; the statutory / legal position is stated above, and so these duties have no 'legal' basis – they are the 'spirit of the law';
    - an RPS may be appointed pending training to ensure that a person is named and identified. - caveat could be written into the appointment latter stating 'you will not be expected to formally take up your duties until you have attended an appropriate training course', which would ensure some continuity in departmental arrangements.
100. RPSs should attend the Ionising Radiation Safety Working Group, which meets approximately twice a year, and report on deliberations to their Schools.
101. The RPS must be appointed in writing and must accept that appointment in writing, this being a 'handshake contract'.

Designated areas: radiation monitoring

102. The purpose of radiation monitoring is to check that areas are correctly designated, for which dose rate (health physics) monitors are required, that the spread of contamination is being controlled, for which contamination monitors are required, and that engineered control systems are performing as intended. Monitoring will also confirm decisions made with respect to radiation dosimetry.
103. All areas where unsealed sources are stored or handled must be regularly and systematically monitored in accordance with local rules at regular intervals, with the results recorded in writing. Records must include the area, date, person undertaking the monitoring, contamination levels (Bq/cm^{-2}) and/or radiation dose rate levels (μSv/h), along with action to be taken, and the frequency of monitoring for frequently used areas should be weekly. If surface contamination is detected, decontamination must be carried out and monitoring repeated to ensure a return to normal background levels. The RPS must agree appropriate monitoring arrangements with the RSU: monitoring need not be carried out by the RPS but can be delegated to a suitable person.
104. Contamination monitoring must be undertaken if the dispersal of radioactive material is suspected, and prior to maintenance work being carried out on fume cupboards, ventilation systems, drains etc.
105. External radiation dose rate monitoring is required when there is a potential external radiation hazard from penetrating radiations (e.g. from gamma emitters, X-rays, or kBq quantities of beta emitters with a maximum energy > 0.3 MeV).
106. Individual University Schools will be responsible for the provision of sufficient, and suitable contamination and/or dose rate monitors (as appropriate).
107. The RSU must also be consulted before any new or replacement instruments are purchased.
108. Radiation monitors must be tested or calibrated approximately annually in accordance with IRR17 Reg. 20 and ACoP paragraphs 413-418 and with reference to National Physical Laboratory Good Practice Guide No. 14 the examination, testing and calibration of portable radiation protection instruments(6). Public Health England (PHE) currently tests health physics type (dose rate) monitors and certain contamination monitors, with general contamination monitors being tested by RSU.
109. Monitoring records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Radiation workers: designation of classified persons & medical surveillance

110. As an employer of radiation workers the University is required to designate as Classified any radiation worker who is likely to receive a dose of ionising radiation which exceeds 6 mSv/y, 15 mSv/y to the lens of the eye or 150 mSv/y to the skin or extremities. No person under the age of 18 may be designated as a Classified Radiation Worker. If it is proposed to Classify a radiation worker, an RPA and the (HSE) Appointed Doctor must be informed of

the reason. Each classified worker will be issued with appropriate extremity and / or whole-body dosimetry.

111. All persons having supervisory or significant roles such as that of an Experimental Officer in industrial radiography must be designated as classified workers.
112. All persons handling significant quantities (>50 MBq) of the alpha-emitting radionuclides neptunium and plutonium must be designated as Classified Workers.
113. In addition the dose criteria for designation, University staff and research students may need to be Classified as one of the requirements to enable them to work on the premises of external employers such as nuclear sites or EU joint research facilities.
114. In deciding whether a person should be classified the University must take account of the potential for exposure and the history of previous doses received by radiation workers
115. Any employee of the University who needs to be designated as a Classified Radiation Worker must undergo a prior medical examination, and be certified as 'fit', before commencing work, and annually thereafter. The Appointed Doctor, who will maintain a confidential health record for each Classified Radiation worker, will provide medical surveillance. This record will be kept for monitoring the effects of radiation only.
116. When a Classified Worker changes employment (joins the University) the pre-employment medical examination need not be carried out if the person has been previously certified as fit within the previous 12 months and their relevant certification is made available for their new health record.
117. Any medical problems suspected or arising from the use of ionising radiations must be referred to the Occupational Health Service. A further medical examination may be required on ceasing work with ionising radiations or on leaving the University.
118. If a person believes they have received an exposure they must notify the RSU immediately. The RSU must discuss the event with the RPA and, on the advice of the RPA, with the Occupational Health, the Appointed Doctor and the ADS. An Event must be recorded on the Events Database and investigated by RSU.
119. The University must retain the health record and of each Classified Worker for 50 years from the date of the last entry. The statutory requirement for keeping dosimetry records for Classified Workers must (in any event be kept) by an Approved Dosimetry Service until the person is 75 years of age or in any case for 30 years from the date of the last record; record keeping time scales are contained in http://documents.manchester.ac.uk/display.aspx?DocID=37629.
120. Employees who, as a result of their work activities, are unlikely to receive a dose of ionising radiation which exceeds three-tenths of any relevant dose limit, but may receive a dose exceeding one-tenth, must be registered with the University's Approved Dosimetry Service as Non-Classified radiation workers and, where appropriate, issued with appropriate extremity and / or whole body dosimetry.

121. Dose limits for the abdomen of women of reproductive capacity are intended to protect the foetus, which is particularly sensitive to ionising radiations. Radiation workers who become pregnant should inform their Head of School, in writing, as soon as possible so that the Occupational Health Service and / or RSU may give appropriate advice.
122. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Radiation workers: arrangements for pregnant or breastfeeding women

123. Nothing in the IRR17 prevents pregnant of breastfeeding persons from working with ionising radiation providing exposures remain below dose limits and that doses are ALARP.
124. A new or expecting mother should notify the employer of their condition as soon as reasonably practicable, and once declared, the Head of School must ensure that the foetus cannot receive a dose greater than 1 mSv during the period of pregnancy. Where the mother is exposed to external radiation this is taken to mean the dose to the abdomen must not exceed 2 mSv. The potential of certain radionuclides (e.g. calcium and phosphorous) being preferentially absorbed and concentrated in the placenta and foetus must be considered.
125. The radiation worker must understand the importance of notifying the employer, which must be done in writing, even if the worker would prefer to keep their condition confidential. Line managers should appreciate the wishes for confidentially.
126. Risk assessments must be carried out as soon as pregnancy has been declared, and when a mother returns to work following maternity leave. Occupational Health must consider work with radiation in the advice they give to pregnant and returning mothers.
127. HSE advice[7] for mothers is here www.hse.gov.uk/pubns/indg334.pdf.

Radiation workers: washing, eating and changing facilities

128. Schools must provide suitable and sufficient washing and changing facilities, and accommodation for clothing etc. for persons who enter or leave designated areas, and such facilities must be properly maintained. In changing areas, outdoors clothing must be strictly segregated from lab coats and other PPE so as to prevent the likelihood of cross contamination.
129. The possibility of accidents such as spillages and the spread of contamination must be considered when deciding whether it is appropriate these facilities.
130. Washbasins must be of a type that can be operated without using the hands, i.e. by foot or elbow. Soap and disposable towels (not hand blowers) must be provided
131. Workplaces must be designed or have arrangements to ensure goods and materials coming into or leaving facilities are monitored for contamination.
132. Eating, chewing, drinking, (smoking) and similar activities likely to result in the ingestion, inhalation or absorption of radioactive substances is prohibited.

Control of radioactive substances: open or closed sources

133. The purchase or acquisition of sources of ionising radiation is not permitted without the prior written consent of the RSU. This is to ensure continued compliance with relevant permits and HSE registrations / consents.
134. Should an item of equipment containing a radioactive source become redundant and targeted for disposal, the RPS should inform University RSU and notify the relevant Faculty Safety Manager. Assisted by the RSU and RWA, as appropriate, the RPS should prepare a Risk Assessment and appropriate instructions for the safe decommissioning of the equipment. In cases where decommissioning involves the University Estates team, the latter should have (i) been provided with copies of the above documents, (ii) clearance certificates where appropriate, and (iii) received suitable training, prior to decommissioning commencing. The area RPS and / or RSU must be present during decommissioning whenever radioactive materials are relocated.

Control of radioactive sustances: ONR (formerly Euratom)

135. On behalf of the University, the RSU will co-ordinate the accountancy of materials covered by European Commission Regulation (Euratom) No 302/2005 and submit inventory change reports (ICR), mass balance reports (MBR), physical inventory listings (PIL) as required by the Commission. [After 31st December 2020, reporting to the International Atomic Energy Agency through Euratom will cease, but will be through the Office for Nuclear Regulation.
136. Qualifying Schools must appoint a 'Euratom' co-ordinator to collate monthly returns, which should be received by the RSU by the 7th of each month. Qualifying Schools, which have no report to make for a particular period, will send a 'nil report' to RSU.
137. Areas holding or using qualifying materials must comply with instruction RSU SOP 2021-11 ONR ACP.

Control of radioactive substances: the acquisition of radioactive materials

138. Permission to purchase or acquire any source of ionising radiation must be obtained from RSU on each occasion **prior** to developing proposals to bring materials onto the University. This is to ensure that the University is always compliance with the terms and conditions of its EPR permits.
139. Suppliers of radioactive materials and x-ray generators may wish to see or receive confirmation of EPR permits and HSE consents before releasing transactions of sources of ionising radiation to the University.
140. Persons (such as earth scientists) attending fieldwork trips must always discuss the likelihood of the acquiring / collecting potentially radioactive environmental samples (e.g. rocks, minerals and sediments) before taking such field trips.

141. Proposals to acquire radioactive of contaminated materials, such as slurries, metals, uranium munitions must discuss their proposals with RSU in advance of collecting or receiving such materials.
142. For Schools that employ sealed sources containing short lived radioisotopes such as polonium-210 particle neutralisers that are exchanged under an on-going contract with a manufacturer / supplier it is sufficient that initial approval to purchase is given, and thereafter the RSU is notified when a source is to be exchanged for a (similar) replacement.
143. Appendix 3 gives the process flow chart.

Control of radioactive substances: uranium and other actinides

144. The purchase or acquisition of uranium / thorium and other actinide metals or compounds is only permitted with the prior permission of RSU. Permission is also required from the Head of School for each transaction: the forms found here must be used www.staffnet.manchester.ac.uk/rsu/ionising-radiation/acquisitions-of-actinides/.
145. The purchase of alpha sources such as isotopes of plutonium and neptunium with activities greater than 10 MBq must also be authorised by the Dean of Faculty or a person authorised by them to act on their behalf.

Control of radioactive substances: accounting for radioactive substances

146. Schools must compile records of the activities and locations of radioactive sources, both sealed and unsealed, and these should be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629. Accounting for sources must commence immediately after receipt of the source, and records should contain the following information
    - means of unique identification
    - date of receipt
    - activity on date of receipt
    - location of source (updated regularly)
    - date and route of disposal / removal
    - activity on date of disposal / removal.
147. Records of disposal should be kept locally for a minimum of 2 years after disposal by the School and duplicate records, which will become the 'statutory record' by the RSU for the period of time as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.
148. Sealed radioactive sources must be uniquely identified, and the relevant details (source identification no., radionuclide, activity on receipt) must be recorded on both a local (i.e. School) and central register. Monthly checks should be made by the RPS on the location of all sealed sources, records forwarded to the RSU. The central register will demonstrate compliance with the site EPR Permit.
149. Where sources are used in different laboratories within a School, they should be logged in and out of an appropriate locked store or safe. Whilst out of storage, the location of such sources should be monitored by the RPS on a

more frequent basis (e.g. daily), and appropriate records kept. The purpose of such records is to enable any losses to be identified quickly. Any 'missing' sources must be reported immediately to the RPO, so that relevant regulatory authorities may be informed.

150. An annual audit should be undertaken of all sealed sources to ensure that accounting record is a true record. This should ideally be combined with an annual leak test. This will be undertaken by the RPS in conjunction with RSU.
151. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Control of radioactive substances: accounting for substances of known identity

152. The RSU, after consultation with the RPA / RWA, will arrange for the transfer of life-expired sealed radioactive sources to approved contractors, in accordance with the site Permit issued by the Environment Agency under the EPR. In accepting any such item, the RSU must be provided with all relevant documentation relating to the source. On receipt, the item will be placed in secure storage, with appropriate shielding and relevant documentation, pending transfer to an approved contractor or disposal in accordance with the University's Permit. If disposal under a relevant EPR exemption order is permissible, this may also be undertaken. All information relevant to the item, its date of receipt, storage and disposal will be entered into a written Inventory logbook. The Head of School will ensure that suitable financial provisions are put in place or agreements made.
153. Arrangements have been made and agreed with the Environment Agency and financial provisions put in place with respect of the HASS.
154. Appendix 4 outlines the process for transferring materials to RSU.
155. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.

Control of radioactive substances: accounting for substances of unknown identity

156. On occasions, The RSU may be required to deal with radioactive materials or artefacts of unknown origin and / or activity. In accepting such items, the RSU will endeavour to ascertain as much information as possible relating to each item, including written and verbal history, together with details of the owner and previous location on campus. On acceptance of such an item, the RSU will use appropriate monitoring apparatus to determine the nature of any radiological hazard, together with the activity and associated radiation dose rate. All such items will be regarded as inherently hazardous until proven otherwise. Once a formal characterisation of the item has been completed, it will be placed in storage within the RSU, with appropriate shielding, pending transfer to an approved contractor or disposal in accordance with the University's EPR Permit. All information relevant to the item, its date of receipt, characterisation, storage and disposal will be entered into a written Inventory logbook. In certain cases, prior to accepting such materials for storage, it may

be necessary for the RSU to notify the Environment Agency of the nature and activity, in order to ensure compliance with the conditions of the University's EPR Permits.

157. Appendix 4 outlines of the process for transferring materials to RSU.

Control of radioactive substances: sealed sources and maintenance

158. In circumstances where planned maintenance or building operations are necessary in the vicinity of equipment containing sealed radioactive sources, the equipment should, wherever possible, be temporarily decommissioned and the source removed by the RPS for secure storage in a locked, shielded facility. Where this is not possible, all work operations in the vicinity of the equipment should be subject to a Risk Assessment by the area RPS, in association with the relevant Project Manager or a representative of the University Estates team, to determine the likely risk of damage to the source or equipment housing it, e.g. through physical vibration. Particular attention should be focused on the likelihood of disturbance of any integral shielding material(s) that could give rise to a radiation dose in the vicinity of the equipment.

Control of radioactive substances: the disposal of sources of ionising radiation

159. Radioactive sources (including stocks) or items of equipment containing embedded radioactive sources must be disposed of if they
    - come to the end of their Recommended Working Life (or agreed extended RWL, which in most cases will be two times the RWL or after an expiry date set in a RWL assessment (Appendix 5 refers)
    - become redundant and are targeted for disposal
    - (for unsealed sources) have been unused for a period of three years.
160. The RPS should inform the RSU and the relevant Compliance & Risk Manager, and the RSU will seek the advice of the Radioactive Waste Adviser (RWA) on source disposal. In preparation for disposal the RPS must prepare a risk assessment and appropriate instructions for the safe decommissioning of the equipment.
161. Disposal certificates and associated documentation may be required, and if so, will be provided by the RSU.
162. Responsibility for financing and ensuring safe disposals falls to Schools. The RSU will assist in making arrangements for, and coordinating disposals.

Control of radioactive substances: the disposal of radioactive waste

163. The RPS must coordinate and account for the disposal of radioactive waste from laboratories or appoint a radiation worker to do this on their behalf. The RPS must oversee the accountancy of radioactive waste disposal and submit monthly disposal records to RSU at the end of each month.
164. Schools are issued with local permits containing limits and conditions on the accumulation and disposal of radioactive waste. Appendix 6 refers.

Control of radioactive substances: storage / moving radioactive substances

165. All radioactive materials must be kept in a suitable receptacle and in a suitable store.
166. Sources and / or source containers must have labels affixed that bear a radiation trefoil, the word 'radioactive', the source and its activity.
167. The source container must provide adequate shielding to reduce external dose rates to below (at least) 2mSv/h, preferably below 0.1 mSv/h and ideally < 10 μSv/h. Ensuring a suitable distance between the source and where a person might stand when using it will further reduce radiation dose rates.
168. In laboratories it is good practice to ensure that maximum accessible time average dose rates are <2.5 μSv/h.
169. The source container must be able to withstand damage and environmental damage (e.g. from rain) and from foreseeable accidents. It should be fire resistant.
170. The source store must be capable of preventing unauthorised access, theft, exposure or dispersal. It must be dedicated to the storage of radioactive substances and any associated equipment, i.e. anything highly flammable or explosive must not be kept in the store.
171. Physical security conditions must consider access control (e.g. access cards and / or secure keys) and CCTV monitoring.
172. Considerations should include the storage environment (e.g. is it corrosive, hot, pyrophoric or explosive) and whether it is well ventilated.
173. The transport of radioactive materials must be undertaken in compliance with IAEA regulations[9].
174. The RSU must be consulted on all matters of source labelling, keeping, storage considerations and transport.
175. Unsealed sources in transit beyond local laboratories must be enclosed in three sealable plastic bags and in closed locked or sealable outer containers. UN regulations for packaging must be complied with[9].
176. The advice of the RSU must be sought on all transport considerations; in cases of off-campus transport RSU will issue transport / consignment documentation.
177. Off-site transport is not permitted without the prior written consent of RSU.

Control of radioactive substances: notification of occurrences

178. Regulation 31 of the IRR17 states that the employer must notify the HSE in any case where significant quantities of radioactive materials have been released to the atmosphere as dusts, aerosols or gases, or as liquids, or have been released in such a manner as to cause significant contamination. Column 5 or Part 1 of Schedule 7 of the IRR17 specifies amounts that are considered significant by the HSE.
179. RPSs must, therefore notify RSU of all spillages or unplanned releases of radioactive materials immediately, in writing i.e. by email, of any such events. The Head of Radiological Safety (or acting deputy) must then notify the Head of Safety Services and Director of Compliance & Risk as soon as is reasonably practicable.

180. The loss or theft of radioactive materials must be reported to the Environment Agency by the Head of Radiological Safety (or acting deputy) immediately such an event occurs or is suspected to have occurred. Reporting must be done using the Environment Agency emergency hotline (0800 80 70 60; www.gov.uk/report-an-environmental-incident) and report details should include the time and date, contact names (usually this will be RSU), a brief précis, and an estimation of the risk: the Agency will usually follow up by contacting the RSU or Head of Radiological Safety for more details. This reporting does not include minor spillages etc. that might, time to time, happen in a laboratory.

Duties of manufacturers and suppliers: critical examinations and surveys

181. A Critical Examination must be carried out, in consultation with an RPA, of the way in which the article was erected or installed for the purpose of ensuring that;
    - suitable and sufficient safety features and warning devices are fitted and operate correctly;
    - and that there is sufficient protection for persons from exposure to ionising radiation.

    The examination need not be undertaken by a University appointed RPA and can be undertaken by an erector or installer (the legal responsibility rests on the installer).
182. Repeat periodic examinations must be carried out to a similar standard by RSU on an approximately annual basis.

Duties of Employees: Radiation workers

183. Radiation workers may only work with sources of ionising radiation if they hold a valid permit to do so.
184. All individual's working with sources of ionising radiation must adhere to the procedures and conditions contained within Local Rules. Prior to commencing work with ionising radiation, each worker is required to sign a declaration confirming that he or she has read and understood the Local Rules, and agrees to act in accordance with them.
185. No individual may work with sources of ionising radiation in an unsupervised capacity until they have attended a centrally delivered radiation safety awareness course or similar local training agreed with the RSU, and that the RPS has provided a formal statement to the RSU (e.g. through authorising an individual's Radiation Worker Permit equivalent) that they are deemed to be competent and have received sufficient local instruction and training to enable them to work safely with those radioactive sources.
186. All individuals working with sources of ionising radiation must be familiar with the properties of the ionising radiations that they propose to use, and understand that they have a legal duty to protect both themselves and others from any potential hazards associated with their work.

187. All individuals working with sources of ionising radiation must use 'reasonable care' to ensure their own and their colleagues' safety, and they must cooperate with all instructions from their RPS regarding the use of Personal Protective Equipment, dose measurements and assessments and, if relevant, medical surveillance.
188. All individuals working with sources of ionising radiation must not expose either themselves or others to ionising radiation to a greater extent than is reasonably necessary for the work.
189. If a radiation worker intends to work with ionising radiation at another establishment, the relevant RPS and RPA must be informed of the details of such work prior to its commencement. The University RPS will then liaise appropriately with his/her counterpart at the other establishment. All individuals working with sources of ionising radiation must inform the relevant RPA, through the RPS and RSU, of any notifiable incidents, such as an apparent overexposure, spillage of material or loss of a source.
190. Any accident involving ionising radiation must be reported, without delay, to the relevant RPS and the RSU.
191. Records must be kept as directed in http://documents.manchester.ac.uk/display.aspx?DocID=37629.
192. The process for training and obtaining a radiation worker permit is given in Appendix 2.

Duties of Employees: Group Leaders and Principal Investigators

193. In accordance with the general policy for the Management of Health and Safety within the University, Principal Investigators (PIs) (including independent Research Fellows) have a duty, delegated to them from the Head of School, to provide such supervision as is necessary to ensure the safety of all persons for whom they are responsible. This includes all postdoctoral, postgraduate and undergraduate students working with sources of ionising radiation. PIs shall seek advice from their RPS in the first instance regarding any work they intend to carry out with ionising radiation and will inform them in advance of any intention to bring radioactive sources onto campus. Upon termination of a project, the PI must ensure that all radioactive materials are disposed of by means authorised in the site Permit.

Duties of Employees: Heads of Schools

194. Heads of Schools are responsible for ensuring that
    - the local arrangements for ionising radiation safety management are described in the School Safety policy
    - the local RPSs and their duties, submission process for risk assessments, spillage and waste management, accident and incident reporting
    - work with ionising radiation is adequately supervised and undertaken in accordance with written Local Rules, and that RPSs will ensure that such supervision is undertaken

- the RPS is provided with a letter of appointment defining his/her roles and duties
- all ionising radiation workers are registered with the RSU
- all registered radiation workers are adequately instructed and trained to carry out their work with ionising radiation
- an inventory of School radiation-monitoring equipment and radioactive materials is drawn up, maintained and reviewed
- procedures for the safeguarding of radioactive materials, and for the safe disposal of radioactive waste are drawn up, maintained and reviewed, such that all requirements of the EPR are satisfied
- no new or modified work activity involving ionising radiation commences unless a suitable and sufficient assessment of the risk to any employee or other person has been performed, and that any remedial actions required by this assessment have been carried out
- upon written notification, the conditions of a pregnant ionising radiation worker's exposure are such that the equivalent dose to the foetus is unlikely to exceed 1mSv during the remainder of the pregnancy, and also, that the exposure of breastfeeding staff will be restricted to prevent significant contamination of the employee
- ancillary staff, such as cleaners, porters and maintenance staff, who are likely to work in the proximity of areas in which sources of ionising radiation are stored or handled, are instructed to recognise radiation warning signs and aware of any precaution that may be necessary.

Transport of Radioactive materials

195. The consignment of radioactive materials is only permitted in accordance with the terms and conditions of a Transport Radiation Protection Programme (TRPP) and associated contingency plan or emergency plan.
196. Hazmat is appointed the Emergency Responder on behalf of the University. RSU must coordinate the involvement of the Emergency Responder in conjunction with Departmental RPSs who have been approved to transport radioactive materials.
197. A TRPP Form TP1 X must be prepared for each consignment.
198. Materials may be consigned by Hazmat acting as 'consignor' on behalf of the University, but these must be routed through RSU who acts as the 'controlling mind'.
199. The transport of radioactive materials as Exempt packages is permitted, but the approval (in writing) of RSU is required on each and every occasion.
200. The University is permitted to receive consignments of radioactive materials from suppliers and consignors providing the University has no part in the consignment process as a 'consignor'.
201. 'Consignor' is legally defined in the Carriage of Dangerous Goods Regulations (CDR)[10] and the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)[11] as the operator who prepares, packs, sends, transports and completed associated transport documentation (https://www.gov.uk/government/collections/transporting-dangerous-goods).

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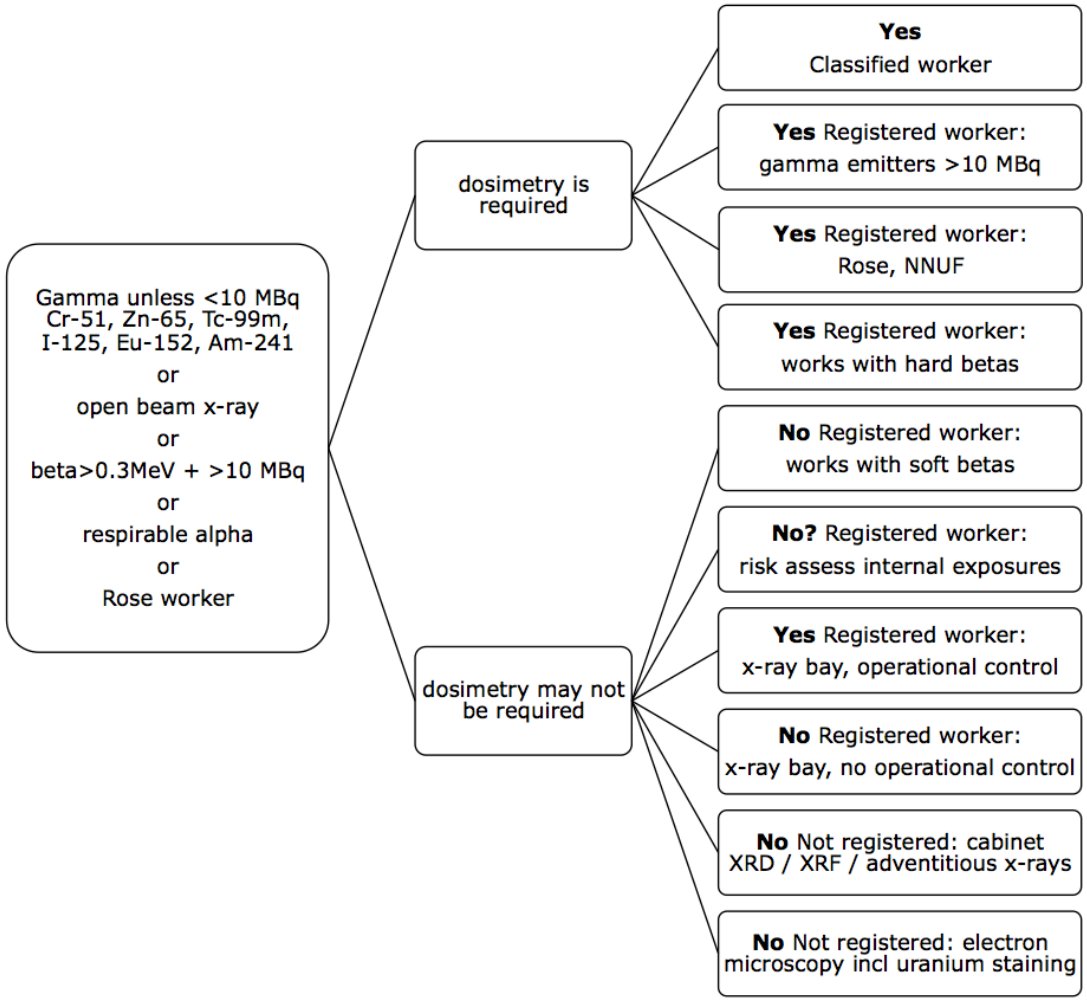
Glossary

- **ACoP:** Approved Code of Practice.
- **ALARP:** (Radiation exposures should be) As Low As Reasonably Achievable.
- **Euratom:** Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of the Euratom Safeguards.
- **EPR:** Environmental Permitting Regulations (policed by the Environment Agency).
- **HASS:** high activity sealed source. HASS sources are permitted separately from other sealed sources, although included on the same EPR permit.
- **HSE:** Health and Safety Executive.
- **IRR17:** Ionising Radiations Regulations 2017 (policed by the Health and Safety Executive).
- **LEV:** local exhaust ventilation.
- **PPE:** personal protective equipment.
- **PHE:** Public Health England (an RPA / RWA body).
- **Radiation Employer:** Reg. 2(1) and ACoP 2(1) refer to Radiation Employers as the owners or directors of a company that carry out practices. This is

difficult to define in an academic institute but is taken to mean the Board of Directors, Vice Chancellor or Registrar of a university with the assistance of Deans of Faculty / Heads of Schools.

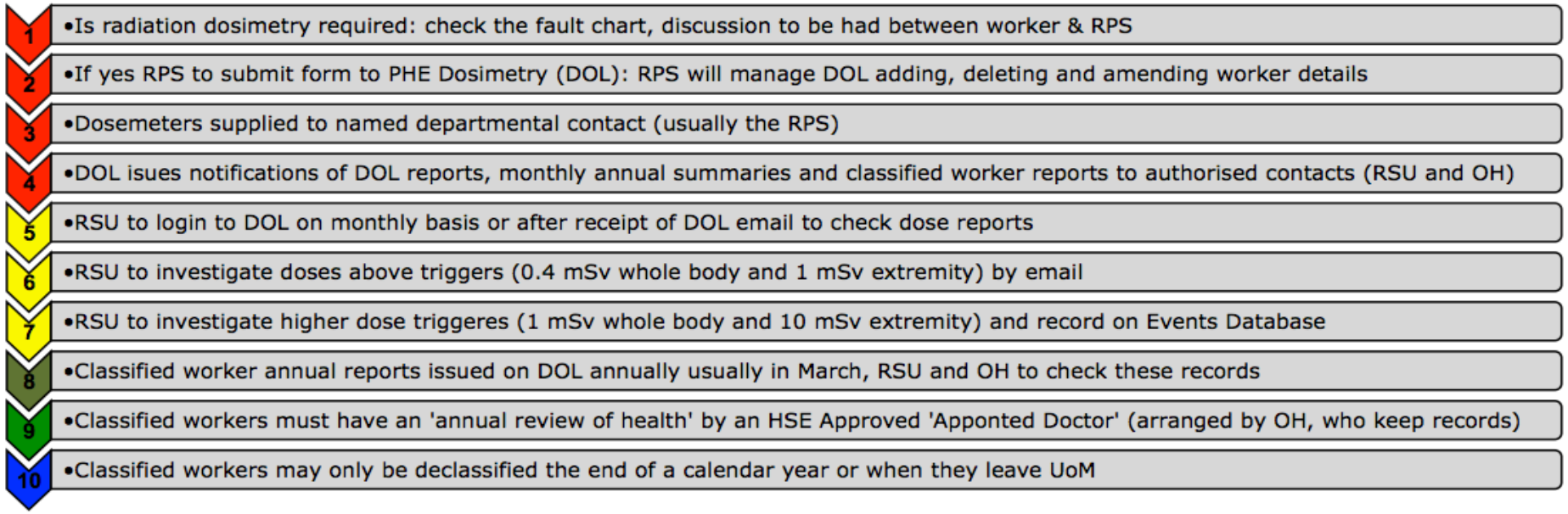
- **Radiation 'practice':** a broad category describing the uses of ionising radiation, for example, x-ray diffraction, x-ray accelerators, x-ray inspection, unsealed radioactive materials in metabolic or tracer studies (H-3, C-14, P-33, P-32, S-35, I-125 count as one group), thoriated / uranyl compounds in environmental studies.
- **RIDDOR:** Reporting of Injuries Diseases and Dangerous Occurrences Regulations 2013 (www.hse.gov.uk/riddor/).
- **RPA:** Radiation Protection Adviser - appointed in compliance with IRR17 Reg. 8 and Schedule 4, the RPA may be an employee or consultant who has a statutory duty advise the Radiation Employer on matters of compliance with the regulations.
- **RPS:** Radiation Protection Supervisor - a person appointed in compliance with IRR17 Reg. 18(5) to assist the Radiation Employer in complying with the IRR17. THE RPS is not responsible for compliance, the Radiation Employer cannot delegate this responsibility.
- **RWA:** Radioactive Waste Adviser - a person appointed in compliance with EPR.
- **RWL:** Recommended working life - of a radioactive source, which is (initially) determined by a source manufacturer.
- **RSU:** University Radiation Safety Unit.
- **WSOW:** Written System of Work - a specific set of instructions under IRR17.
- **1µSv:** 1 microSievert - an SI Unit measure of radiation effective dose.
- **1Bq:** Becquerel (2.7 e-11 Curies) - an SI Unit measure of radioactive quantity.
- **1 kBq:** kilobecquerel - 1000 Bq.
- **1MBq:** megabecquerel - 1000 kBq.

Appendix 1a: Dosimetry fault chart - is dosimetry required?



Appendix 1b: The process for managing dosemeters

- The RSU is responsible for the day-to-day maintenance of registered and classified workers dosimetry, for determining whether persons should be in receipt of dosimetry and for liaising with radiation workers, RPSs and the HSE Approved Dosimetry, Public Health England Dosimetry Service (DOL), as necessary.
- The Occupational Health Service (OHS) and RSU are responsible for reviewing Classified Worker annual dose summaries, which are available directly from PHE on DOL.
- The Occupational Health Service is responsible for arranging an Annual Review of Health for each Classified Worker, which must involve an HSE Appointed Doctor (for ionising radiation) and where issued, for updating workers Radiation Passbooks.
- The RSU is responsible for undertaking dose investigations, including investigations of overexposure, and for liaising with OHS where appropriate.
- Reports on overexposures and dosimetry concerns must be raised at the OHSTAG committee, which advised WSH committee.



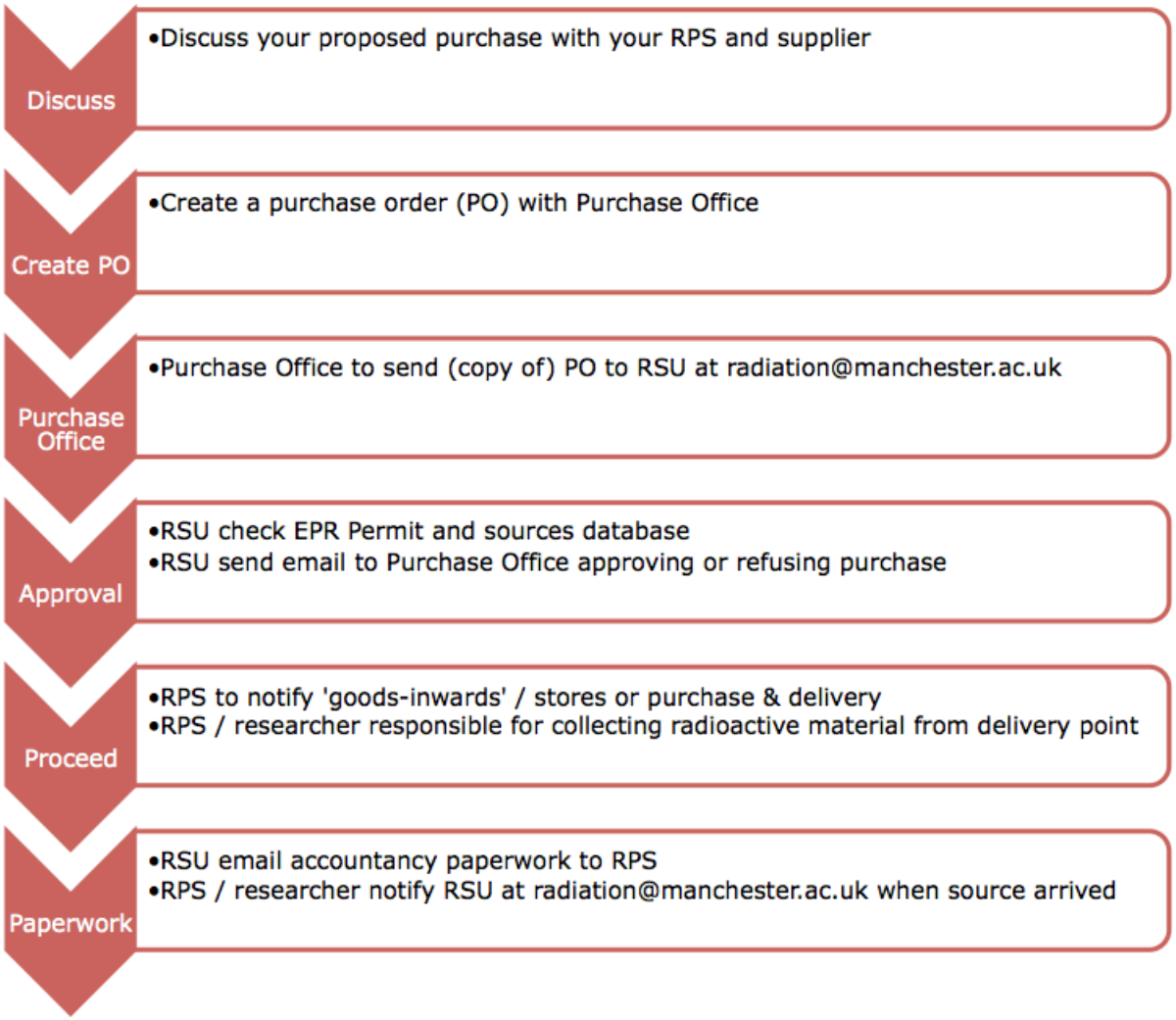
Appendix 2: How to get training and apply a permit to work

- The RSU will provide a general introduction that covers the basic uses of radiation, University management and control systems, the theory of risk assessment, local rules and standard operating procedures (SOP), and healthcare arrangements.
- The School will provide specialist induction training on how to work safety in School labs. Training provided here will vary in complexity according with the uses, hazards and risks.
- Sign-off must be obtained at each step and it is the workers responsibility to ensure they obtain this

1. •Register for a Radiation course through Staff Learning and development and complete form RW1 that must be sent to RSU
2. •The catalogue will send an email to you regarding your application
3. •Forward the email to your RPS
4. •The RPS will email confirmation to you
5. •Send that confirmation to katharine.sullivan@manchester.ac.uk who will update your status in the training catalogue
6. •You will be sent details of a place on the training course
7. •At the end of the training course you will be given a permit containing the training details [this constitutes RSU permission to work]
8. •The permit may need to be endorsed by person responsible for overseeing local training [this constitutes local permission to work]
9. •You need to check that your RPS and line manager / lab manager has a copy of your signed permit
10. •You have received 'Central' training > You Have received local induction training > any questions? ask Katharine Sullivan

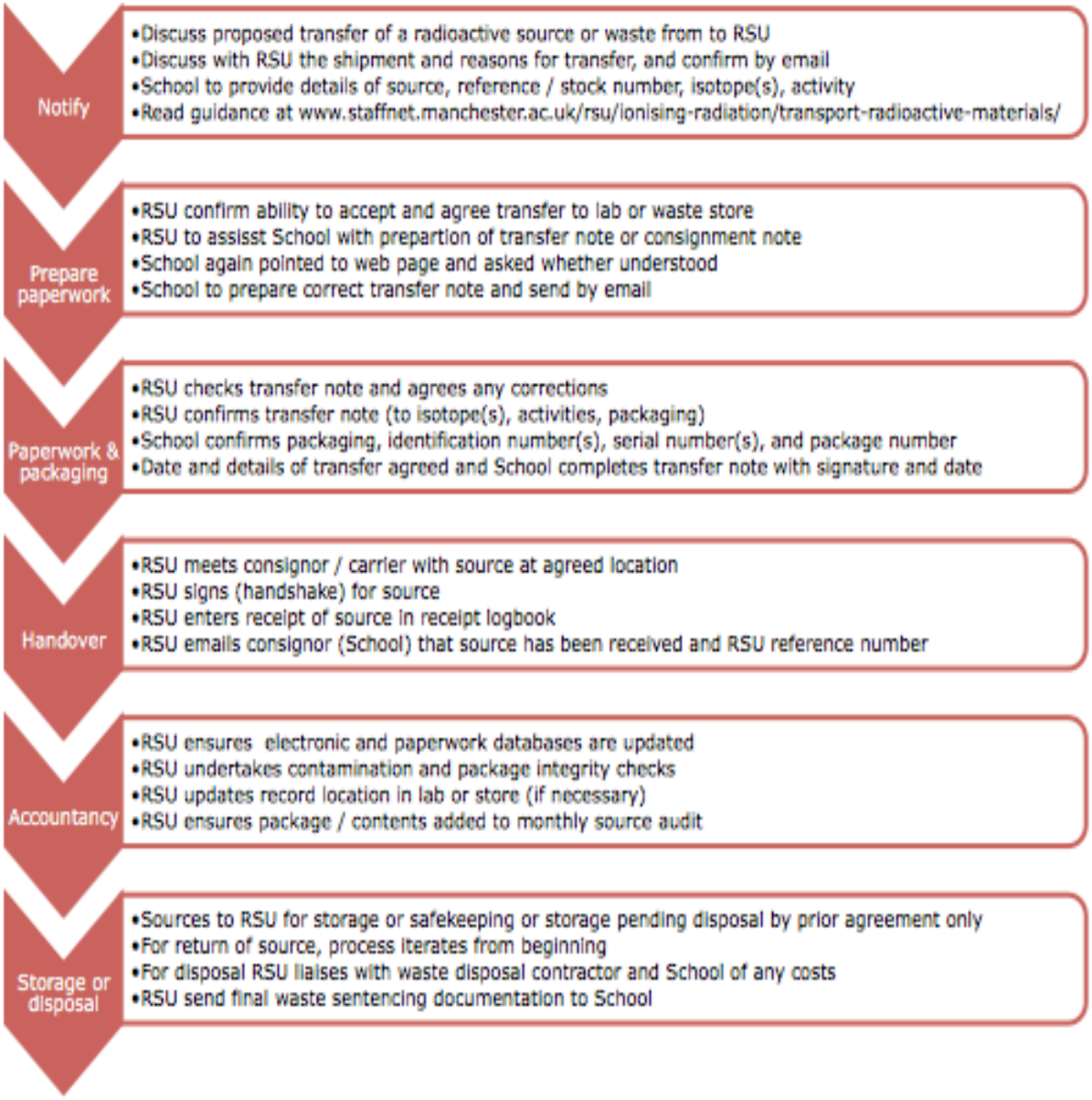
www.staffnet.manchester.ac.uk/rsu/training-permit

Appendix 3: Process for purchasing Radioactive Sources



Note: With the exception of uranium salts for electron microscopy staining, the purchase of actinides (depleted uranium etc.) is not permitted without the prior written consent of the Head of School and Radiation Safety Unit. For further details go to www.staffnet.manchester.ac.uk/rsu/ionising-radiation/acquisitions-of-actinides/

Appendix 4: How to transfer radioactive materials to RSU



Appendix 5: Criteria for Establishing a Source's Recommended Working Life

Health and Safety Executive: Control of Radioactive Sources (IRIS8)

- The HSE publication 'Control of Radioactive Sources' Ionising Radiation Protection Series 8 (IRIS8, 11/01) recommends that the frequency of leakage testing sealed sources be increased from the required 2 year interval for sources that have exceeded the manufacturers recommended working life.

Health and Safety Executive: Guidance to the Ionising Radiations Regulations 1999 (L121)

- Paragraph 589 of the ACoP recommends more frequent (leakage) testing in circumstances where the implications or the consequences of a loss integrity of the source capsule containment could be sever, or where the physical or chemical conditions are such that the deterioration of source or its containment might occur, such as hot and humid environments.

Environment Agency: How to comply with your EPR RSR environmental permit - sealed sources (v 1.1 2011)

- Section 2.7.1 of the guidance states:

  '…it need not be assumed that sources which continue to be used after the end of their RWL are not fit for purpose or that they automatically become disused or waste sources. Under the Ionising Radiation Regulations, the advice adopted by HSE is as set out in Paragraph 482 of the Approved Code of Practice (ACOP): "Where a sealed source reaches the end of the working life for the source capsule recommended by the supplier or manufacturer, a review of its condition is advised, with a view to replacing the source or having it examined by the supplier or manufacturer. If the source is not replaced it is advisable to set a time limit on its continued use after which a further review would normally be undertaken. Where the supplier or manufacturer does not specify a RWL, it may be advisable to carry out the first review within 5 years of manufacture of the source or to seek advice from the RPA about a period for review which is more appropriate in the circumstances." Paragraph 491 in the ACOP recommends increasing the frequency of leak testing from biannually to annually where the RWL is exceeded, unless the manufacturer's recommendation is different...'

International Standards Organisation: Radiation protection - sealed sources - leakage test methods (ISO 9978:92)

- It is only manufacturers of sources or authorised bodies that are able to undertake emanation tests or immersion tests and issue certifying documentation (Special Form certification then issued by the National Authority; Section 5.1 to 5.2 of ISO 9978:92). Users must carry out dry or wet wipe tests as specified in Section 5.3. Wipe testing carried out for the purposes of the RWL assessment was in accordance with Section 5.3.2 using methanol as the solvent.

Department of Health, Queensland Government: Information about the requirements to continue using sources beyond their recommended working life (RWL v1 2013)

- In the absence of direct explicit guidance in the UK the Queensland Government has determined that the RWL for double encapsulated sources of Co-60, Cs-137,

Am-241 (including Am/Be) and Ra-226, where not specified by a manufacturer should be 15 years.

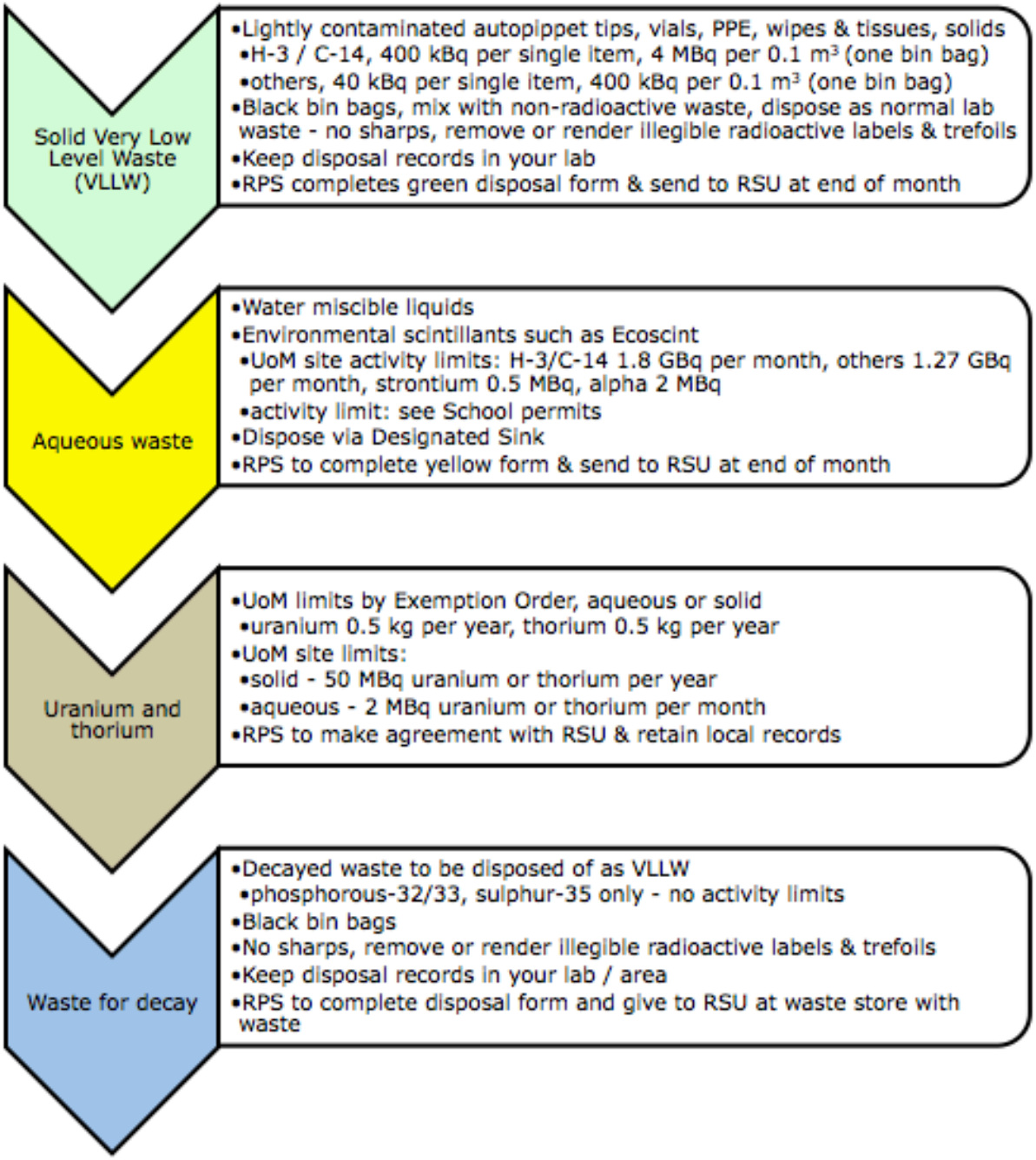
The Lorch definition (Radiation Protection Bulletin 34, 1980)

- This best recognised published working definition, albeit it a pseudo-definition, gives a RWL for alpha sources is two years, however this is dependent on encapsulation and environment, and the likelihood of physical or chemical changes within the capsule e.g. pressure build-up.

Review of sealed source designs and manufacturing techniques affecting disused source management (IAEA TECDOC-1690: 2012)

- IAEA points out that the Lorch definition does not specify the environmental conditions in which a source is used, the general assumption being that this definition would work for hostile environments, and so, for benign environments the RWL could reasonably be expected to be longer. Indeed the inference from the IAEA TECDOC is that the concept of RWL is only appropriate for hostile environments.

Appendix 6: Radioactive waste disposal conditions and limits



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