

Wellcome Trust centre for Human Genetics (WTCHG)

Minimising the environmental impact of work with radioactivity

General guidance.

The University is committed to minimising so far as is reasonably practicable the impact of its work with radioactive materials on the environment and any individuals exposed as a result. This commitment to environmental optimisation is consistent with the Environment Agency's requirements that employers adopt "**Best Practicable Means**" (**BPM**)¹ or "**Best Available Techniques**" (**BAT**)² to limit the impact of radioactive discharges. These principles are included in conditions of EA Permits authorising the accumulation and disposal of radioactivity. To satisfy them, the University is required to have appropriate management systems and relevant controls in place that should not be disproportionate to the risk.

Centrally, procedures to minimise environmental impact are detailed throughout the relevant University Policy Statements: S1/12 "*Management of work with ionising radiation at the University of Oxford*" and S7/10 "*Laboratory Clearance & Decommissioning Procedures*".

The University minimises the environmental impact of its work by controlling the quantities of radioactive material in use and radioactive waste generated as a consequence of that use. Accumulating radioactive waste will be stored for the optimum period, allowing it to decay where this is a practicable option to reduce the activity disposed of. The University will at all times strive to ultimately dispose of that waste using the best environmental option. Additionally, the University will ensure that facilities are designed such that they can be used and maintained to meet the highest practicable radiation safety standards.

The University Safety Office is responsible for establishing safety policy across the University; advising on implementation of that policy; and auditing the measures in place across departments to implement that policy. In addition to departments' own programme of internal audit and review (specified below), arrangements within departments will be reviewed during periodic radiation safety audits carried out by the University Radiation Protection Officer.

Environmental optimisation procedures are inherent to the department's own local rules for work with radioactivity and, where necessary, in supplementary procedures. The arrangements in place within this department are set out in the following pages.

¹ "BPM" is a condition of Certificates of Authorisation issued under the Radioactive Substances Act 1993. Whilst the 1993 Act is no longer in force in England, certificates issued under it (and conditions therein) remain in force until revoked.

² "BAT" is a condition of Permits issued under the Environmental Permitting (England & Wales) Regulations 2010. In accordance with EA guidance on compliance with Permits, the requirements of BPM and BAT are broadly similar in the non-nuclear sector.

Minimising the environmental impact of work with radioactivity in the WTCHG

1. MANAGEMENT STRUCTURE

The **Head of Department** is responsible for compliance with radiation protection statutes and University radiation safety policy.

Arrangements for compliance with radiation protection legislation and University policy are documented within departmental **local rules** for work with radioactivity and further specific radiation procedures. Where relevant, these are referred to within this document.

To assist the Head of Department to comply, radiation protection supervisors are appointed. The **Senior Radiation Protection Supervisor** (SRPS; Pierre van Zijl) acts as a coordinator of radiation protection arrangements within the department crucial to achieving compliance with Permit conditions. For example, SRPS approval is required before undertaking new protocols involving radioactive materials or before placing any order for radioactive materials. The SRPS is also the individual named alongside the Permits as being responsible for supervising the keeping and use of registered materials and the accumulation and disposal of radioactive waste.

Additionally, **Radiation Protection Supervisors** (RPS) are appointed for specific work areas to directly supervise work and ensure it is carried out in accordance with the local rules and other relevant departmental radiation procedures. These procedures include the accumulation and disposal of radioactive waste on and from the Institute. In WTCHG, an RPS is appointed for each research group that works with radioisotopes.

On all aspects of compliance with radiation protection legislation and University radiation safety policy, the WTCHG consults the University's appointed **Radiation Protection Adviser** (RPA; Mark Bradley, the University Radiation Protection Officer). Contact details for the RPA are contained where relevant in departmental procedures for prompt reference.

2. JUSTIFICATION

All work with radioactive materials within the department must be justified in advance. Radioactive material will only be used if it is the only practicable option to achieve the necessary outcome and that the scientific benefits of using radioactive material offset any risks associated with its use.

Before commencing work with radioactive materials, individuals will register with the University Safety Office as radiation workers. This registration process requires the signature of their line manager or academic supervisor (to attest that their intended work with ionising radiation is justified) and ultimate endorsement by the SRPS. Subsequent significant changes to the work, such as work with new isotopes, require additional notification to the Safety Office with the endorsement of the SRPS.

Every protocol for work with radioactivity carried out within the department must be accompanied by a justification argument which concludes that the use of radioactivity cannot be avoided and that no alternative methods will suffice i.e.

Can the use of radioactivity be avoided?

In addressing this question, where relevant users should consult colleagues, peer groups, other institutions and research papers and relevant publications to determine whether non-radioactive alternatives exist? For established techniques commonly in use (e.g. southern blots), justification may be a simple reference to previous research papers or peer reviewed journals.

The scientific benefits of undertaking the work with radioactive materials, i.e. the reason for undertaking the particular research, should be included in the protocol documentation. Before commencing new work with radioactivity, the SRPS and academic supervisor will review this justification.

The justification for work will be recorded on the OUSO/RADS/1 form (*University of Oxford open radiation source risk assessment*) and reviewed at least annually or on revision to the protocol.

3. OPTIMISATION

Optimisation as a concept is applied to all aspects of planning work with ionising radiation including the control of personal exposures so far as reasonably practicable (ALARP, IRR99 Regulation 8). In the context of this document it includes the use of best available techniques to minimisation of quantities of radioactive materials being used and ultimately disposed, and consequently the risks posed to persons and the environment by those materials of i.e.

Has the optimal isotope and activity been selected?

The minimum amounts of radioactivity to generate statistical significant results will be used. This is achieved by conducting the following steps:

- (i) The work with radioactivity is planned beforehand. As part of this process, a review of relevant publications will be made, with reference to the procedures being used and quantities of materials in use. If no such publications are available, a small pilot study will be performed.
- (ii) The optimal radioisotope is chosen. The reasons for choosing the specific isotope should be recorded. The isotope is not only selected on the basis of the experimental needs, but also taking into account waste, emissions and potential worker exposures, costs etc.
- (iii) The amount of radioactivity needed for the experiment is calculated beforehand, taking into account the detection method, sensitivity/specificity of tracer, type of experiment and unit quantities sold.

(iv) Reasonably practicable steps will be taken to avoid mistakes/repeats/contamination: the experimental procedures are tested and practised beforehand by conducting them as a 'cold' (non-radioactive) run. On the job training, including in the safe use of radioactive materials is provided by the RPS and/or SRPS.

(v) The procedures of an experiment are written down as a step-by-step explanation in the corresponding risk assessment, recorded using the OUSO/RADS/1 form (*University of Oxford open radiation source risk assessment*). The risk assessment is reviewed at least annually.

(vi) Before the work can commence, the RPS and/or SRPS must review the work and sign their agreement that adequate control measures are in place on the OUSO/RADS/1 form.

(vii) If the minimum order quantity exceeds the required quantity, the radioactivity will be shared if possible. First other colleagues within the same research group; secondly other research groups within the same department will be consulted. Isotopes will only be shared with other departments following prior consultation and written agreement of the University Radiation Protection Officer.

(viii) The optimisation of radioactive waste disposal is detailed in Section 4.5 of this document.

All decisions will be recorded and will be available for periodic review.

4. CONTROL

The control of radioactive materials from the point of ordering through to their disposal as radioactive waste is governed by written procedures, as outline in the WTCHG local rules for work with radioactive materials.

4.1 Competence

The department will achieve the highest practicable standards of radiation safety by ensuring the competence of all persons engaged in work with ionising radiation or associated, however peripherally, with that work.

Each person working with radioactive material is registered with Oxford University as a registered radiation worker. Before they are allowed to start work with radioactive materials, all radiation workers in the department must be provided with the following training, for which they must be signed off by the RPS or SRPS:

- *Radiation Safety for Laboratory Workers* - Session provided by the University Radiation Protection Officer for all open source and irradiator users, or

- *Radiation Safety for work with Sealed Sources and Radiation Generators* - Session provided by the University Radiation Protection Officer for all closed source users (including irradiator users) or users of x-ray equipment and accelerators (even if that work is carried out in another department);

plus:

- On the job training provided by the department, including all procedures involved in the experiment. This will include training in handling radioactive materials; requirements of the departmental radiation safety management procedures; the departmental local rules; standard operating procedures; and specific requirements for storage, use, accumulation and disposal of radioactive materials and wastes from the department.
- Each registered radiation worker is shown the local rules, which are housed in each radiation suite and introduced to our intranet page which has links to: the permits we operate under, this BAT statement, the Safety Offices S1/12 "management of work with ionising radiation at the University of Oxford" and many other resources.

4.2 Ordering radioactive materials

The ordering of radioisotopes is controlled by the SRPS as detailed in the departmental local rules and as described in the document *WTCHG SOP1 (appendix 2 in the local rules): Ordering radioactivity*. Procedures are aimed at ensuring that radioactive materials can only be brought onto the premises (i.e. an order placed or an arrangement made to transfer materials from another department or institution) if:

- (i) They can be kept and used in accordance with the conditions of Permits issued under the Environmental Permitting (England & Wales) Regulations 2010³. The material must be of the type covered by the Permit i.e. an "open source" or a "closed source" as relevant. The isotope must be listed in the schedule (either specifically or as part of a grouping e.g. "beta/gamma emitting isotopes") and the proposed quantity must not take the cumulative total of all isotopes in the same category in the Schedule over the limit for that category.
- (ii) The waste that will be generated by its use in the department's protocols can be accumulated and disposed of in accordance with the conditions of the Permits issued under the Environmental Permitting (England & Wales) Regulations 2010⁴. The quantity (in terms of activity and volume) and type of waste (i.e. solid, aqueous, organic liquid and gaseous) must not exceed limits in the Permit.
- (iii) The radioactive material will be used in an authorised protocol, for which risk and waste stream assessments have been carried out and documented using the OUSO/RADS/1 form *University of Oxford open radiation source risk assessment*).
- (iv) The order has been placed by a registered radiation worker from the WTCHG.

4.3 Delivery of radioactive materials

Procedures for accepting radioactive materials onto WTCHG premises are included in *WTCHG SOP2 (appendix 2 in the local rules): Receiving & opening radioactive packages*, which are in the local rules. Procedures ensure that:

³ Certificates of Registration under the Radioactive Substances Act 1993 remain in force as Permits under the Environmental Permitting (England & Wales) Regulations 2010

⁴ Certificates of Authorisation under the Radioactive Substances Act 1993 remain in force as Permits under the Environmental Permitting (England & Wales) Regulations 2010

- (i) Deliveries of radioactive materials are only be made when the building is occupied and packages can be accepted and signed for by an authorised person. Those authorised persons are made aware in advance of the expected delivery.
- (ii) Only expected packages addressed to a known individual within the department will be accepted.
- (iii) The security of radioactive materials is maintained from the point of acceptance from the courier to their entry into a suitable radiation store in the user group. All handovers are confirmed by signature and an appropriate source record is maintained.
- (iv) Radiation exposures of department staff and other persons as a result of the delivery of radioactive materials are restricted so far as reasonably practicable.
- (v) Any incidents involving radioactive materials (e.g. loss, theft, damage) are quickly and appropriately dealt with in accordance with legislative requirements. All such incidents will be promptly notified to the University Radiation Protection Officer.

4.4 Keeping & use - Work with radioactive materials

Procedures for keeping and use of radioactive materials in accordance with the requirements of the Ionising Radiations Regulations 1999 and the conditions of the Permits under the Environmental Permitting (England & Wales) Regulations 2010 are contained within the departmental local rules.

Amongst other things, these local rules contain:

- (i) Written instructions (dos and don'ts) for work involving the storing, using, accumulating and disposing of radioactive materials and radioactive waste, which ensure that radiation exposures, arising directly from the work or from resulting wastes, are minimised.
- (ii) Contingency plans for reasonably foreseeable accidents or incidents involving ionising radiation, including loss/theft of materials; radioactive spills, releases and personal contamination; fire in the laboratory; unauthorised use; personal exposures; or any other breakdown of controls (i.e. a failure to follow University procedures).
- (iii) Contact details for persons with supervisory and advisory responsibilities and with whom persons can raise any enquiries or concerns regarding work with radioactive materials.

Departmental facilities and equipment will be selected and maintained to achieve the highest practicable standards of radiation protection. New laboratories will be designed in consultation with the University Safety Office and Estates Department to achieve best practice, addressing the requirements of the Ionising Radiations Regulations 1999 Approved Code of Practice and Guidance Notes and any currently available Environment Agency guidance. Design considerations will include matters such as laboratory ergonomics, structural shielding, security of materials, waste handling, and ease of decontamination, as detailed in the Safety Office guidance to Estates.

Equipment for use at work with ionising radiation will, where appropriate, be subject to routine inspection, maintenance and testing schedules designed to ensure that it remains capable of achieving the necessary standard of performance to allow the department to meet optimisation requirements. The Department will ensure that appropriate service contracts are in force, for example, for fume hoods, gamma counters and liquid scintillation counters, and that radiation monitoring instruments are presented annually for testing in accordance with Regulation 19 of the Ionising Radiations Regulations 1999.

The Department will arrange for all closed radioactive sources to be tested for leakage of radioactive material at least once every two years in accordance with Regulation 27(3) of the Ionising Radiations Regulations 1999.

4.5 Accumulation & disposal of radioactive waste

Procedures for accumulating radioactive waste on Oxford University premises, in particular WTCHG, are in *WTCHG SOP3 (appendix 2 in the local rules): Accumulation & disposal of radioactive waste* which is in the WTCHG local rules. Procedures ensure that:

(i) All activities capable of generating radioactive waste are identified; that the different categories of wastes are identified and appropriate procedures implemented to deal with and ultimately dispose of waste. Flow charts identifying the mechanism of radioactive waste production from the department are appended to this document. At an experimental level, waste stream estimates will be carried out for all protocols before they can commence. See section 3.

(ii) SOP3 contains procedures for accumulation of radioactive waste in accordance with Permit conditions. Where relevant for shorter-lived isotopes (e.g. ^{32}P), waste activities are decay corrected at the time of disposal to produce an accurate record of waste disposed from the premises.

(iii) Sufficient staff and resources are dedicated to managing the department's radioactive waste, ensuring that waste is disposed of safely, in compliance with **Permit** conditions, and using the best environmental option. *Staff resources:* The department has appointed sufficient RPSs to supervise its local waste accumulation and disposal arrangements. *Financial resources:* The Department does not have to meet the routine costs of radioactive waste disposal from its own budget. The University Safety Office has an annual radiation safety budget in the region of £100,000 for radioactive waste disposals and a further £100,000 for related expenses, including waste consumables (bins) and licence variations. Nonetheless, the department will make finances available to meet radiation safety needs whenever required.

(iii) Annual reviews are carried out of all protocols to ensure that the optimum methods are used and that quantities of radioactive waste generated by the experiment are as low as reasonably practicable and that waste continues to be disposed of using methods producing the lowest impact on the environment.

5. AUDIT & REVIEW

An annual review of the department's radiation protection arrangements, including individual protocols and waste optimisation, will be carried out by the department with the assistance, as necessary, from the University Safety Office and Area Safety Officer. A report will be prepared and any recommendations made on actions necessary to ensure compliance with legislative requirement, University Policy and best practice will be addressed by the Department.

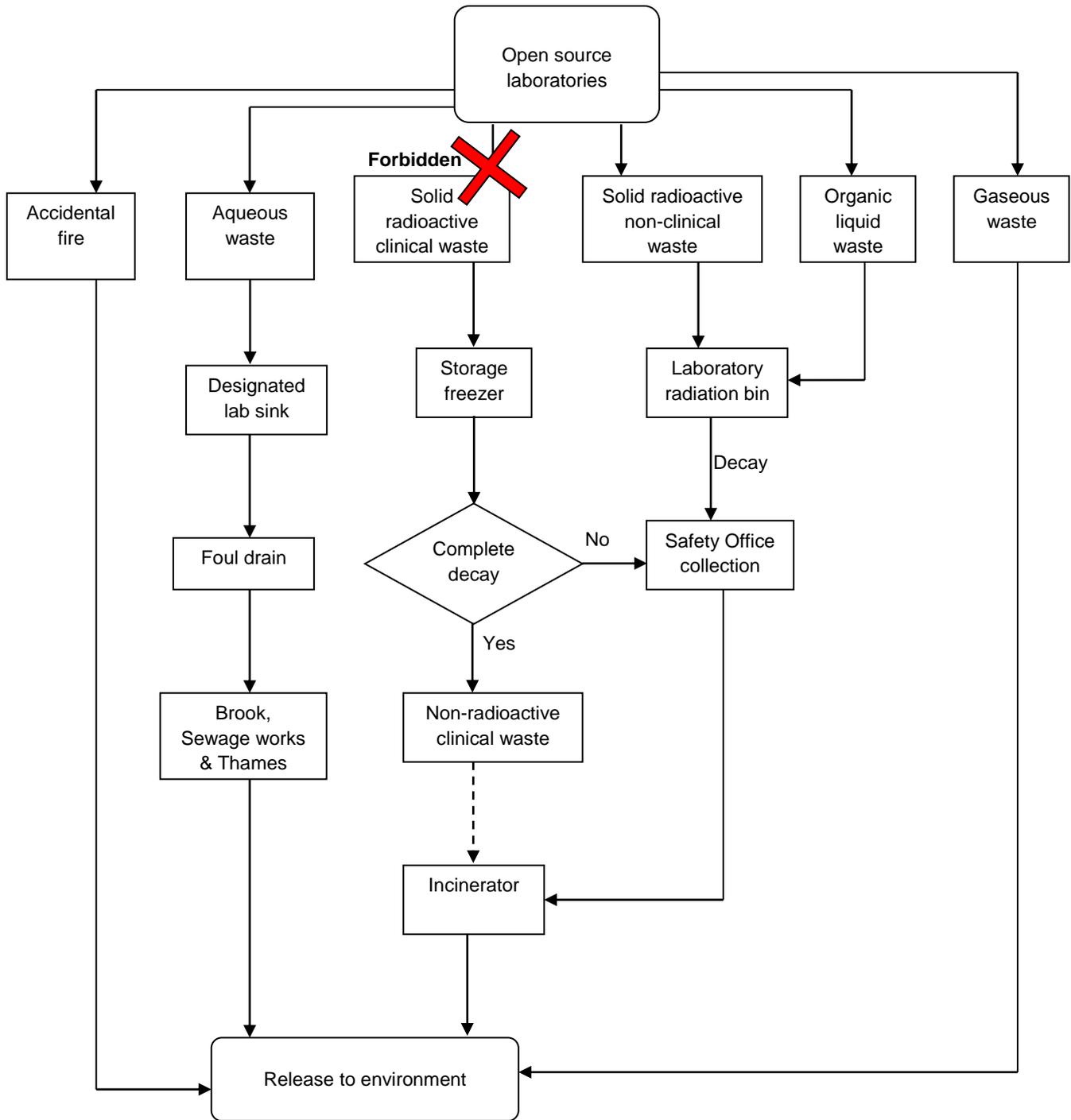
Separately, the Safety Office will undertake periodic audits of the department's radiation protection arrangements, including optimisation arrangements as part of a rolling programme of audits all radiation-user departments. Once again, any recommendations made as a result of that audit will be addressed by the Department.

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June 2015

APPENDIX 1: Generation of radioactive waste by WTCHG



APPENDIX 2: Generation of Uranium radioactive waste by WTCHG

