BEST AVAILABLE TECHNIQUES (BAT) FOR THE USE AND DISPOSAL OF UNSEALED RADIOACTIVE MATERIAL

1. SCOPE

This statement details the university's arrangements to comply with its obligations under the Environmental Permitting Regulations 2016 (EPR2016) to dispose of radioactive waste in a manner so as to minimise the radiological effects on the environment and members of the public.

2. INTRODUCTION

Aims and concept of BAT	Under EPR2016, processes are required to be assessed according to Best Available Techniques (BAT). The aim of BAT is to optimise, and thus restrict, the activity of radioactive material handled, the amount of contamination generated and the activity of waste requiring disposal, so minimising the activity which is ultimately discharged to the environment. BAT has the aim of balancing costs against environmental benefits by means of a logical and transparent approach to identifying and selecting processes, operations and management systems to reduce releases/discharges. Part of the concept of BAT is that users should consider the work procedures and the resulting radioactive waste generated before work commences, to ensure the minimisation of waste at all stages. BAT is an ongoing process with reviews both periodically and whenever there is a substantive change in circumstances. The Environment Agency requires that the BAT approach is adopted in an appropriate manner at a level which is proportionate to the environmental risk. There is no *de minimis* level below which BAT does not apply, proportionality therefore being a key principle.

Key elements of BAT	Key elements include justifying the use of radiochemicals in preference of non-radioactive methods, minimising the activities used (optimisation), performing tasks efficiently without creating unnecessary waste/ contamination and decay-storing solid waste where appropriate. All waste minimisation procedures need to take account of such factors as practicality, operator safety, monetary cost, and the benefits to the environment of reduced discharges and disposals.
Purpose of statement	This BAT statement has been drafted to assist compliance with conditions 2.3.1 to 2.3.5 of the university's Permit to use radioactive material and receive, accumulate and dispose of radioactive waste [EPR/TB3698DC] as follows: *2.3.1 The operator shall use the best available techniques:* *(a) to minimise the activity of radioactive material kept or used on the premises.* *(b) to minimise the period over which radioactive waste is accumulated.* *(c) to minimise the activity of radioactive waste produced on the premises that will require to be disposed of on or from the premises.* *(d) to ensure that all relevant parts of the premises are constructed, maintained and used in such a manner that:* *(i) they do not readily become contaminated; and* *(ii) any contamination which does occur can be easily removed;* *(e) to prevent:* *(i) the loss of any radioactive material or radioactive waste; and* *(ii) access to any radioactive material or radioactive waste by any person not authorised by the operator.* *2.3.2 The operator shall use the best available techniques in respect of the disposal of radioactive waste pursuant to this permit to:* *(a) minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment;* *(b) minimise the volume of radioactive waste disposed of by transfer to other premises; and* *(c) dispose of radioactive waste at times, in a form, and in a manner so as to minimise the radiological effects on the environment and members of the public.* *2.3.3 The operator shall use the best available techniques to* *(a) exclude all entrained solids, gases and non-aqueous liquids from radioactive aqueous waste prior to discharge to the environment;* *(b) ensure that any discharge of radioactive gas to the atmosphere is made in a manner which prevents its entry into any building.* *2.3.4 The operator shall maintain in good repair the systems and equipment provided:* *(a) to meet the requirements of conditions 2.3.1, 2.3.2 and 2.3.3; and* *(b) to carry out any monitoring and measurements necessary to determine compliance with the conditions of this permit.* *2.3.5 The operator shall check, at an appropriate frequency, the effectiveness of systems, equipment and procedures provided to meet the requirements of conditions 2.3.1, 2.3.2, and 2.3.3.*

3. JUSTIFICATION

Site policy *An established site policy sets the framework for drafting various procedures in relation to radioactive waste management.*	The university's Environmental Policy includes the requirement to avoid the use of toxic materials where such use is not essential for teaching or research purposes, and to minimise waste generated. The policy therefore requires the use of non-radioactive techniques where feasible and radioactivity should only be used where it is not possible to maintain an acceptable level of sensitivity or specificity with a non-radioactive technique or where the use of radioactivity is essential to the research being undertaken. All uses of radioactive materials are optimised to use the lowest activity and generate the least waste wherever practicable. The lowest level of stock solutions for the work being performed will always be maintained. In addition to ensuring the restricted release of activity to the environment, this policy will also help minimise the exposure of individuals in event of an incident.
Mechanism of Justification *A key requirement in the use of radioactive materials is the justification for their use against other non-radioactive techniques. Once justified, a mechanism of optimisation is required to ensure minimal waste generation.*	Radioactive techniques are assessed by research groups and any changes to existing procedures are discussed with the faculty Radiation Safety Coordinator (RSC) and University Radiation Protection Manager (RPM) prior to work implementation. If alternative methods are available then the cost, COSHH data, availability of the test reagents and any specialist equipment or facilities required will be investigated. The decision to proceed with a radioactive or non-radioactive technique is further based on the health risks relating to any reagents, the cost and the reliability of the reagent supply. Potential non-radioactive methods are first considered and evaluated. A radioactive method is only pursued if the required sensitivity and specificity are not otherwise achievable. If a radioactive method is to be used then the least radiotoxic nuclide is used which will fulfil the required research requirements. All radioactive techniques are reviewed on a regular basis in the light of any new non-radioactive method. A justification statement is entered in the appropriate field on the Radioactive Substance Inventory Database (RSID) assessment form. An assessment is required to be completed by each research group for each

	radionuclide or technique used and management processes ensure that radioactive materials cannot be acquired by the group until an assessment has been completed satisfactorily. This justification process ensures that the minimum amount of radioactivity is used, thus generating the minimum volume and activity of waste.

4. FACILITIES

Design of facilities *All facilities must be designed to provide a safe and secure location for the handling of radioactive materials and the storage of radioactive waste. They should help to minimise* *(1) the risk of incidents which could result in the uncontrolled release of radioactive materials to the environment, and* *(2) the exposure of individuals who work with radiation.*	**Laboratories** Materials, fixtures and fittings employed in radiation labs are designed to ensure containment, with non-absorbent surfaces to allow easy decontamination. Where necessary, impervious floors are sealed with coving extending 15mm up the walls. Designated disposal sinks route aqueous radioactive via drains which are routed directly to the main building effluent. Walls and ceiling are painted with non-absorbent, gloss eggshell paint, to avoid contamination build-up. In addition the university has a design specification for radiation areas that details the design standard required for Supervised radiation areas. **Central waste storage** All solid and organic liquid waste for disposal is collected into the university's central waste storage facilities. Radionuclides with short half-lives are temporarily stored in sealed metal drums in the decay store facility pending final disposal within the permitted time limits. Waste for disposal is kept in the dedicated radioactive waste storage area pending collection by an authorised waste contractor. The waste store is a secure caged area within the healthcare waste store affording good containment and security. Locked lidded wheelie bins contain the solid and low volume organic liquid waste in secondary containers (waste bags).

Maintenance and audit of facilities *Routine maintenance and audit ensures quality control in the function and application of facilities and work procedures.*	The facilities are maintained through documented servicing and calibration, e.g. local exhaust ventilation (fume cupboards) are inspected annually. Fume cupboards are fitted with flow monitors in the ducting which are automatically monitored and alarmed to indicate any flow problem. Radiation monitors are tested and calibrated annually. All fridges and freezers containing important reagents, including radioactive materials, are monitored to ensure they maintain correct temperature within acceptable tolerances. Floors in the designated areas are regularly cleaned and polished to maintain their non-absorbent properties. Facilities used for radioactive materials are audited periodically by the Radiation Protection Manager (RPM) with a report making any recommendations for improvement. Local rules for unsealed source use specify a strict regime of contamination monitoring before and after each use of radioactive materials.

5. OPERATIONAL PROCEDURES

Management of radiation work *A clear management chain ensures that all individuals understand their duties. Clear understanding eliminates any confusion, which could lead to duties not being performed.*	The university's management system for compliance with radioactive materials permit conditions is part of the over-arching Health and Safety management system for the university which is specified in the university's Health and Safety Policy. The policy includes definitions of roles and responsibilities; governance and organisation; delegation for the development of protocols, strategy and plans; and an outline diagram of the management system. The university also has a governance statement for ionising radiation which specifies roles and responsibilities for the management of work with ionising radiation. A university standard for the 'Management of sources of ionising radiation' has been developed under the terms of the policy and specifies the university's requirements for the management of all sources of ionising radiation and is accompanied by guidance for senior managers. Radman Associates are appointed in writing as the university's Radiation Protection Adviser (RPA) to advise on the technical and administrative arrangements for radiological protection.

Storage of stocks and samples *These measures minimise the activity held and the risk of that material being released or stolen.*	All radioactive materials either as stock, labelled aliquots or kit components are stored in secure areas which are only accessible to authorised persons and are kept locked when not in use. Storage conditions are chosen to maximise the viability and longevity of the material.
Working arrangements *Adherence to the methods and guidance in these documents will result in compliance with university policies with regard to minimising radioactive waste.*	All work involving the use of unsealed radioactive substances is subject to Local Rules, associated Standard Operating Procedures (SOPs) and risk assessment. Local rules include the authorisation of personnel, work areas, radionuclides and activity limits; procedures for the safe and proper handling and disposal of radioactive materials; and emergency procedures for the most reasonably foreseeable incidents. Procedures for ordering radioactive materials and source accounting (stocks and waste) are also detailed in the local rules.
Disposal strategies *These strategies, taken together, will result in the minimum activity being released to the environment.*	Disposal strategies for radioactive materials at the university are based on the best practicable environmental options available. The option that provides the most benefit or least damage to the environment, at acceptable cost, in the long term as well as the short term, is always chosen. The activity brought on to site will be kept to a minimum and the activity used in each technique will be minimised by experience of previous use. Waste accumulation and disposal activities are kept below the permitted activity limits by reference to internally authorised limits for each research group. All waste disposals are recorded and waste bag locations tracked using the RSID system. Disposal activities are accounted for by careful reference to the studies involved.
Decay storage	Solid waste consisting of radionuclides with a sufficiently short half-life is decay stored under secure conditions to reduce the activity of the waste. Waste is removed from site before the maximum permitted waste accumulation time limit.

Aqueous waste	Aqueous waste is disposed of via designated sinks by decanting into gently running water followed by flushing of the sink and trap by running water for 10 minutes.
Organic liquid waste	Organic scintillant waste is placed in marked bags in laboratories which are then sealed and transferred to a departmental waste collection area. Waste bags are regularly collected and placed into a skip in the central waste store. Waste is then disposed of within permitted waste accumulation time limits to an approved waste contractor.
Solid waste	Solid waste is placed in marked bags in laboratories which are then sealed and transferred to a departmental waste collection area. Waste bags are regularly collected and placed either into a skip in the central waste store or into the central decay storage facility. Waste is then disposed of within permitted waste accumulation time limits via an approved waste contractor.

6. USER TRAINING

User training and authorisation *The training of all those who are involved with radioactive materials is central in ensuring compliance with university policies. Provision of an understanding of the reasons behind the guidance in the local rules and SOPs ensures greater quality assurance.*	Training requirements are specified in the ionising radiation training matrix. Radiation Safety Coordinators (RSCs) and Radiation Protection Supervisors (RPSs) are formally nominated by the appropriate senior manager (Dean or Head of School) and authorised by the university Radiation Protection Manager (RPM). RSCs attend an external RPS course and receive refresher training every 3 years. RPSs receive appropriate instruction and training from the RPM. All users of unsealed radioactive materials must register for radiation work and complete basic training (online course and practical workshop) followed by specific induction training within their research group. An authorisation permit is issued by the RPM once training requirements have been completed and an individual is deemed competent by their academic supervisor and RSC.

7. CONCLUSION

Are current procedures adequate?	The current procedures for the proposed use of radioactive materials at the university include controls on the justification for use, source acquisitions, and the use, storage and disposal of radioactive materials on and from the site. These procedures are considered adequate for the nature and extent of radioactive work to be performed.
Are current facilities acceptable?	Newly constructed and fitted laboratories, with input from the RPA, will ensure the potential for build up of surface contamination remains low. A dedicated waste store ensures optimum control in the storage and disposal of radioactive waste.