BEST AVAILABLE TECHNIQUE FOR THE MANAGEMENT OF RADIOACTIVE MATERIALS

Introduction
University College London (UCL) applies the principle of Best Available Technique (BAT) to the management of radioactive materials and waste which arises from the use of radioactive materials on its premises. In doing so UCL ensures that the following are minimised:

- The amount of activity used and disposed of
- The volume of waste transferred from its premises
- The radiological impact of disposals on the environment and the public.

The BAT principle is applied in three scenarios:

- In the routine use of radioactive materials and where radioactive waste is generated;
- In the management of incidents where radioactive contamination has occurred; and
- In the design and decommissioning of facilities where radioactive materials are used.

Routine Use
The majority of work with radioactive materials where waste is generated is in the fields of chemical, biochemical and medical research using unsealed radionuclides as tracers. In most cases the techniques and equipment used are well established and maximise efficient use of the minimal amount of radioactivity. The resulting waste is most commonly liquid (aqueous or organic) and solid. The former arise from the reagents themselves, and/or from washes which take place during the process. Solid waste generally takes the form of contaminated containers, pipette tips, disposable PPE, wipes etc.

Acquisition
All uses of radioactive material at UCL must go through a prior authorisation process, as described in the UCL Local Rules.

Whilst BAT is not about justification, it is relevant that before that process is started due consideration is given to the techniques to be used, the amount of activity to be purchased and the amount of waste which is going to be generated.

Any person wishing to use radioactive materials must seek authorisation from their department before permission is given to proceed, and have a BAT assessment covering the procedure. This system has multiple benefits, but from a BAT perspective it ensures that users have considered all BAT aspects, from purchase through use to disposal. The Departmental RPS ( Radiation Protection Supervisor) will also have ensured that the appropriate facilities and resources are available to manage the waste, and that UCL can manage the material within the limits set down in the relevant Permit under EPR ( Environmental Permitting Regulations). The RPS can co-ordinate sharing of stock where suitable.

Aqueous Liquid Waste
Aqueous liquid waste could be collected for decay storage, transferred to solid by soaking onto absorbent material, or disposed directly to sewer via a designated sink. Both decay storage and transfer to solid add to the radiation burden of staff due to additional handling required, and also increase the risk of contamination through spills and other incidents. These two options also have costs associated with them, in terms of staff time, storage
facilities and space, and materials. Direct disposal to drain has no cost and minimal staff exposure. The impact on the environment is greater, but generally still negligible. Direct disposal is permitted by the EPR Permits, which are supported by an environmental risk assessment. Written operating procedures for aqueous disposal to drain call for large volume dilution at the point of discharge via an authorised disposal sink. Each sink is approved for such disposals by the central UCL Safety Services. Approval looks at length of drain run to riser/main sewer, presence of traps in the drain run, and the ease with which the sink/drain could be decontaminated. UCL plumbers have written procedures for dealing with drains used for radioactive waste disposal, and are supported by an RPS.

Organic Liquid Waste

Organic liquid waste may arise from scintillation counting or from experiments that combine radiochemicals with organic solvents. It is not feasible to dispose of them via the sink due to the hazardous nature of the solvents nor is there a benefit from transferring to solid due to increase in radiation burden of staff due to additional handling. Therefore the preferred option for disposal is via incineration. Decay storage, where appropriate, is used to reduce the environmental footprint prior to transfer.

Solid Waste

It is inevitable that some solid wastes (eg empty stock vials) will be radioactive. Little can be done to reduce the volume of these without increasing the likelihood of contamination (eg bottle crushing). UCL therefore consider such volume reduction methods as being contrary to the principles of BAT and ALARP (As Low As Reasonably Practicable). Minimisation of other forms of solid wastes (eg contaminated gloves, wipes etc) is achieved through good laboratory practice. To this end, UCL insists that all staff who intend to work with unsealed radioactive materials attend an in-house training course which includes practical demonstration of common techniques. This is supported by tailored supervision by the Departmental RPS where needed.

Solid waste could be transferred directly to an authorised contractor for disposal by incineration, controlled burial or consignment to waste repository facilities such as Drigg, depending on the level of radioactivity and the physical form of the waste. Additional review of the isotopes used at UCL indicates that most wastes can be disposed as VLLW (very low level waste) with clinical waste. Other, putrescible waste could be macerated and disposed of to drain.

As solid wastes are most commonly generated in chemical or biomedical research labs, there is a risk that such wastes may also contain other hazards (sharps, biohazards etc). However most wastes from these laboratories are disposed of as 'clinical waste' and already need separation for other hazards such as sharps. Therefore the step to include VLLW in the disposal route is not very different.

VLLW

The introduction and implementation of the VLLW waste route will need careful management and training. A new standard has been written: "UCL Standard for Ionising Radiations (01) - Disposal of unsealed radioactive waste" and its implementation will be tested with a few selected departments followed by sign off by the Health & Safety Committee.

The use of VLLW requires that disposals are grouped into isotopes with similar half-lives, which will facilitate better use of decay storage. Previously a bin with a mix of half-lives may have prevented its disposal as VLLW or following decay storage.
Putrescible waste

Generally the preferred option is to store radioactive putrescible waste in a freezer prior to collection by specialist contractor. However, disposal to sink via maceration may be the most appropriate route in some cases. Choice of the disposal route should be made by departments following a risk assessment which takes into account the isotopes and the activity used.

Waste storage & final disposal

UCL currently has a number of stores on its sites which meet the standards required for decay storage of radioactive waste. Trained staff are available to manage these stores, and the design, layout and containment arrangements are such that doses to those staff and others in the vicinity are negligible. UCL therefore have adopted the recommendations in the EA R&D Technical Report P3-073/TR (“Agency Practice and Future Policy in Decay Storage of Radioactive Wastes”) and decay store solid radioactive waste. Due to space limitations and reduced efficiency in decay storage mostly isotopes with half-lives of 65 days or less will be decay stored for disposal as VLLW. Storage of longer lived waste will be for bulking purposes only, in order to make disposal by transfer more cost effective. Decay storage of short lived radionuclide results in a significant reduction in the amount of activity discharged and consequently on the environmental impact. The authorised waste accumulation periods are such that a large proportion of the decay-stored waste can be disposed of as VLLW.

Solid waste which is not suitable for decay storage will be transferred to one of the authorised contractors on the relevant permit for disposal. It is UCL preference that combustible waste be incinerated as environmental risk assessments have shown that doses from gaseous releases and from activity in ash sent to landfill are insignificant. The alternative of consignment to Drigg is an inappropriate use of this national resource unless the activity levels require it, and other long term storage options do not constitute disposal. It is not appropriate to use these whilst disposal options are available and incur negligible risk.

Uranium and thorium

UCL does have solid waste containing uranium and thorium in various forms. These could be made soluble and disposed of to drain under the existing EPR exemptions. UCL does not consider this option to comply with BAT, taking all hazards into account. The process will increase exposure to staff and may cause contamination. Also, other hazards are being introduced to the sewage system, which may accumulate and result in detrimental effects in the long term. The BAT option favoured by the College is therefore to keep all material (liquid and solid) contained and transfer it to an approved contractor, except for trace amounts where disposal to clinical waste under exemption is permissible.

Gaseous Waste

There is a small amount of gaseous waste generated on UCL sites, mainly as a result of chemical processes carried out in fume cupboards. Air from the fume cupboards is vented to atmosphere via stacks on the premises roof, where it undergoes dilution. Authorised gaseous releases have been subject to an environmental impact assessment which indicates negligible detriment.

The alternative management options for this waste are either to trap the radioactive content on filters and treat as solid waste, or to collect the gas in some type of balloon system and decay store. Both alternatives increase staff exposure, give an increased risk of contamination, incur additional cost, and are of dubious efficiency. Given the low impact, direct discharge is considered to constitute BAT.
Incidents
Radioactive waste will arise from non-routine use – most commonly the clean-up of contamination following a spill of unsealed radioactive material. The volume, activity and impact of disposal of waste arising from spill management will all be reduced by minimising the probability of a spill occurring and by containing the spill if it does occur. UCL has written procedures for handling unsealed radioactive material in such a way that the risk of spills is minimised. These procedures also require more than one level of containment wherever possible – for example by using lipped work trays with disposable liners. Furthermore, staff using unsealed radioactive material all attend a specific training course and are supervised by more experienced staff until competent.

The common procedure for dealing with a spill is to use absorbent material such as tissues and swabs to soak up the contaminant, using chemical agents such as Decon when necessary. Written instructions detail how to do this without unduly spreading the contamination further, and to minimise the amount of absorbent material used, which will subsequently become solid radioactive waste. This serves to minimise the volume of waste generated. The total activity generated is dictated by the amount spilt. Activity can subsequently be reduced by decay storage of short lived waste as described above.

Design and Decommissioning
UCL has written procedures in place to take RPA (Radiation Protection Adviser) advice on aspects of store or facility design which impact on BAT during the operating lifetime of the facility and during decommissioning. Such advice will cover siting of the facility to minimise the environmental impact of discharges, layout of areas where radioactivity is used, choice of construction, drainage and furnishing materials, construction techniques, the use of demountable furniture and fixtures, finishes of walls, benches, floors and sinks and the provision and specification of storage materials. The objective of this advice is to minimise the risk and impact of incidents during normal use and to ensure there is no unnecessary generation of radioactive waste when the facility is decommissioned. One simple example would be to ensure that no absorbent structural material such as wood or concrete can be exposed to long lived radioactive contaminants during the working life of the facility. This can usually be achieved through specification of finishes such as wall and floor coverings and how they should be applied.

The UCL approach to BAT in the management of radioactive waste is subject to regular review by Safety Services and UCL's RPA.