University Occupational Health and Safety Guidance Notes

DISPOSING OF RADIOACTIVE WASTE

1. PURPOSE

The employer's primary duty is to ensure that all personnel, whether working or not with ionising radiation are protected from its potentially harmful effects.

The purpose of this document is to inform departments on the methods that are available for disposing of radioactive wastes and any restrictions that are in place for each given method of disposal.

2. RADIOACTIVE WASTE

2.1 Disposal of Solid Radioactive Waste

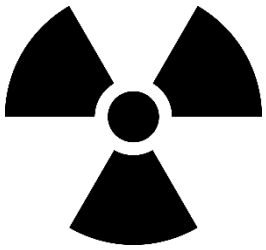
Solid radioactive waste includes any redundant sealed sources or any material (including biological materials), that has been in contact with radioactive materials and on examination with an appropriate monitor (or via swab/wipe counts) shows traces of radioactive materials that cannot be cleaned and recycled.

Any department that generates solid radioactive waste is to have a suitable procedure in place for the waste's removal from the laboratory to a holding area prior to its final transfer to the radioactive waste store or to the waste permitted person. This process will be discussed as part of any application to work with ionising radiations at the time of application.

The University segregates its solid radioactive wastes into the following categories:

1. $T^{1/2}$ < 90 days – Includes such isotopes as Phosphorus^{32} or Iodine^{125}
2. $T^{1/2}$ > 90 Days – Includes such isotopes as Tritium (H^3) or Carbon^{14}
3. Scintillant Wastes – This can include any isotopes that have been used in a liquid scintillant counter.

All solid radioactive wastes are to be placed into specially designated bins with a unique ID number that will be provided by the URPO. These bins are constructed from red plastic, and only those supplied by the URPO are to be used. The department must mark each waste disposal using a printed waterproof label or indelible black ink. An example for a bin containing Iodine^{125} waste would be:



Radioactive Waste

Short Half Life ($T^{1/2}$ <90 Days)

Isotopes: Iodine^{125}

Activity (MBq): 4.8MBq

Any bin of solid waste may not contain more than 40MBq of total activity and may not weigh more than 10Kg to allow for ease of movement by the URPO, DRPS and waste contractors.

Before transfer to the University waste store or to a waste contractor, swab wipes are to be taken of all surfaces of a bin, which are then to be counted to demonstrate that the surface of the bin is free from contamination.

Swabs are to be taken and counted in a manner applicable to the isotope involved. A background control swab must be taken, and all swabs compared to this background. Any surfaces where swabs demonstrate levels of contamination (as defined in the relevant

Safe System of Work) are to be cleaned and re-swabbed. Where this does not remove any contamination, the DRPS is to be contacted for advice.

To calculate the standard deviation, a worked example is available in Appendix 1.

The final disposal of all solid radioactive waste will be organised by the URPO on behalf of the University, and will be made via the University's authorised waste contractor.

Depending upon the location of the waste as well as the isotopes and activities in question, this material may be transferred to the University waste store, or the collection may be arranged to occur direct from the department in question, for example as in the case for some radiological biological materials.

2.2 Very Low Level Waste (VLLW)

Whilst the University previously had the option of disposing of radioactive materials with extremely low levels of activity through the normal (black bag) waste route, this is no longer allowable under our operating permits.

No department may make a disposal where radioactive material is mixed with non-radioactive material for disposal to a municipal or commercial waste facility.

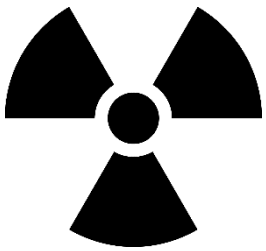
Due to the potential for incorrectly disposing of radioactive material, regulatory activity, damage to the local environment and the University's reputation, any incident of such a disposal is to be notified to the URPO immediately upon being discovered.

2.3 Disposal of Liquid / Aqueous Radioactive Waste

The majority of unsealed radioactive materials that are used in the University under the terms of its permits will be disposed to the local sewer system, provided the only potential hazard is the radioactive nature of the material, and can only be done via a number of specifically designated 'radioactive waste' sinks.

All departments that make use of liquid forms of radioactive material, or solid radioactive material dissolved or dispersed in a liquid will need to ensure that they have a suitable plan in place for disposing of the waste material. These plans are to be included in the application to work with radioactive materials, and will be approved by the URPO / URPA.

A designated sink is to be treated, to all intents and purposes, as a bin for the management of disposals. It must be labelled appropriately so that all persons that work in the area are aware of the potential hazards associated with the bin/sink. As an example, designated sinks should have a label that has the following information:



Radioactive Designated Sink

FOR THE DISPOSAL OF RADIOACTIVE LIQUIDS ONLY

DRPS: Dr. J Smith Tel: 0141 548 1234

Designated sinks will also be subject to the same maximum disposal limit as a bin for solid wastes would be. This is a total disposal activity per month of 40MBq of combined isotopes.

All disposals made in this manner are to be recorded and entered into the University's electronic radiation management system, eRad.

Under no circumstances may liquid disposals be made to any sink other than those so designated.

The URPO will make regular checks on the amount of material disposed of via this method to ensure that the University does not exceed its allowed limits.

2.4 Disposal of Gaseous Waste

Under the terms of its permits, the University is allowed to dispose of a limited amount of gaseous radioactive material to the local atmosphere. These disposals shall only be made via a number of specifically designated ventilation systems.

All disposals made in this manner are to be recorded and entered into the University's electronic radiation management system.

Under no circumstances may gaseous disposals be made to any ventilation system other than those so designated.

The URPO will make regular checks on the amount of material disposed of via this method to ensure that the University does not exceed its allowed limits.

APPENDIX 1 – WORKED EXAMPLE OF A CALCULATION OF STANDARD DEVIATION

To ensure that only statistically significant levels of contamination are recorded, the University uses the principle of readings 2 Standard Deviations above background are classed as contaminated.

To calculate the standard deviation, the following formula is used:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

This is broken down into the following steps:

1. Take the mean of all of swab readings.

Example swab readings

9, 2, 5, 4, 12, 7, 8, 11, 9, 3, 7, 4, 12, 5, 4, 10, 9, 6, 9, 4

Background Reading = 4

Therefore, our mean would be 140 / 20 so μ = 7

2. Subtract the mean from each of the readings and square the result.

For example, the first reading, 9, would be $(9 – 7)^2$ which is equal to 4.

Repeated for each reading gives the following values:

4, 25, 4, 9, 25, 0, 1, 16, 4, 16, 0, 9, 25, 4, 9, 9, 4, 1, 4, 9

3. Take the mean of the adjusted values

We total the adjusted values and take the mean again

Therefor our mean would be 178 / 20 = 8.9 (This is called our variance)

4. Take the square root of the variance

The square root of this would be 2.983, which is also the standard deviation.

5. Multiply

Two standard deviations would be 5.967 or 6.

Therefore, any swabs that are six counts or more above background would be considered contaminated.

In this example, that would mean the following counts were indicative of contamination

9, 2, 5, 4, **12**, 7, 8, **11**, 9, 3, 7, 4, **12**, 5, 4, **10**, 9, 6, 9, 4

These areas would then need to be cleaned, re-swabbed and checked again to ensure that any contamination had been removed.