Guidance on completing the Application for an approved scheme of work for working with ionising radiation

Approval

All schemes of work must be approved by the University Ionising Radiation Protection Officer (UIRPO), who will consult with the University's Radiation Protection Adviser. The UIRPO may stipulate certain conditions which must be met in order for approval to be given.

Local laboratory rules

Details given in section 3 of your application will form part of your "Local Laboratory Rules" for this Scheme of Work. The "Rules" must be set out legibly and displayed at all times whilst the work is in progress. Your "Rules" must be attached to the application.

Pregnant of breastfeeding workers

The Regulations give special protection to workers who may be pregnant or breastfeeding. If women of childbearing age will be working with ionising radiation, your scheme of work should identify risks to the unborn child or breastfeeding infant. Women of childbearing age should be informed of the risk and strongly advised that they should declare any pregnancy early. Once an employee declares that she is pregnant or breastfeeding an individual assessment must be carried out, taking account of the scheme of work, to determine whether and what further precautions are needed. For instance if certain tasks present a greater risk to the unborn child, they could be allocated to another worker. In such instances advice should be sought from the University's Radiation Protection Adviser (RPA).

Calculating internal radiation hazard

Please refer to page 38-42 of the AURPO Guidance Notes on Working with Ionising Radiations in Research and Teaching Revised March 2019 Edition. The following notes are for further explanation:

This refers to a model based on NRPB (M443). The NRPB model assumes that a proportion of the activity worked with will enter the body. The modelling has been completed with various standards of laboratory. The better the standard the more material can be worked with to receive a given dose. However, for our purposes we have assumed that University laboratories are equivalent to grade 'C'.

The Annual Limit of Intake (ALI) is an important concept for internal dose estimation. It is defined as the annual dose limit (Sv) / Dose co-efficient (Sv/Bq). An intake of 1 ALI would lead to a committed effective dose of 20mSv. In a Grade 'C' laboratory working with 600 ALI of non volatile radioactive material would lead to a committed effective dose of 1 mSv because only 1/12000th of the radioactive material would enter a worker's body (barring radiation accidents or incidents). This would be equivalent to 3.72 GBq of P-32. Clearly the external dose would dominate the total dose received!

After examining and controlling external dose, for consideration of internal dose it would appear better to adopt a "dose restraint" of 0.2mSv and work with a maximum of 120 ALI's. However, certain radio-nuclides can preferentially concentrate in the foetus.

ICRP 88 is a report by the International Commission for Radiation Protection entitled "*Doses to the Embryo and Foetus from Intakes of Radio-nuclides by the Mother".* It notes that for certain isotopes, concentration in the foetus can be up to 25 times the maternal level (for P-32 this can be x17 at 35 weeks into the pregnancy and x13 when averaged over the whole pregnancy).

Other radio-nuclides, including, P-33, Ca-45 and Ca-47, exhibit this concentrating effect. The most vulnerable time of the pregnancy is when bone mass is being laid down.

For the purposes of risk assessment (before the pregnancy is declared), a "dose restraint" of 0.2mSv in the foetus can be adopted assuming a relative concentration factor of x17, in the case of P-32. Therefore a dose of 0.2mSv would be received by the foetus, after working with approximately 7 ALIs = 43MBq.

The University of Essex Scheme of Work Application requires an estimation of internal dose for activities over 40MBq and seems to fit this choice of "dose restraint" for the worst case of work with P-32.

P-33 is safer to work with because although the concentration factor is x25 at 35 weeks, the ALI is higher (less radiotoxic) at 14MBq compared to 6.2MBq for P-32. The difference between the term of the pregnancy and the standard working year has been ignored. In the case of a "declared" pregnancy, controls would be decided on a case by case basis, after consultation with the RPA.

Work with volatile radio-nuclides should always take place in a fume cupboard and it is assumed that 150 ALI's gives an internal dose of 1mSv.

In the model above, it is assumed that the material worked with, is the material taken out of the stock container rather than the activity stored in the container. This would depend on the design of the stock container and the risk of spillage.

It is also assumed that the material is worked with for 2000 hours over a year.

Calculations in summary for non volatile work: -

The internal dose rate for radiation workers (mSv) = Activity worked with (MBq)

(600 X Activity of 1 ALI).

The internal dose rate for the foetus (mSv) =

Activity worked with (MBq) x Concentration factor in the foetus

(600 X Activity of 1 ALI).

Aims and concept of Best Available Technique (BAT)

The aim of BAT is to optimize and thus to restrict the activity and volume of waste requiring disposal and so minimize that which is ultimately discharged to the environment. Part of the concept of BAT is that users should consider the work procedures and the resulting radioactive waste that will be generated before work commences, to ensure the minimization 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 BAT be proportionate to the level of environmental risk are adopted. There is no level below which BPM does not apply.

The key elements of BAT include justifying the use of radioisotopes in preference to non-radioactive labels, minimizing activity used, volume and selection of radio-nuclides which have a less adverse effect on the environment (optimisation), performing tasks efficiently without creating unnecessary waste and decay-storing solid waste. 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.

Justification

It must be clear that the use of ionising radiation in any work can be supported. It is necessary to look at alternative ways of achieving the same goals and conclude that the use of ionising radiation is justified in terms of risks associated with a successful outcome. Before using ionising radiation you should therefore have considered non-radioactive alternatives and the hazards they present (COSHH), availability of reagents, cost of reagents etc.

Optimisation

You need to consider experimental methods to be adopted, availability of supply volumes, etc. and optimise for quality data with the lowest activities used or volume of waste created.

Having the minimum necessary stock volumes will contribute to safety and minimise disposals. For example stock sharing or sharing of work facilities may be a useful means of optimising, although unused or out of date stock should be disposed of promptly.

An assessment needs to be made of the procedures and engineering controls that minimise the spread of contamination into the environment. You should assess the potential for spills and document measures that minimise them, so reducing unnecessary waste. (For example returning stock to their storage location rather than leaving them out, the use of containment boxes for moving radioactive substances and double bagging waste. Training radiation workers to achieve BPM and the use of containment trays, monitoring and personal protective equipment will also help to minimise the spread of contamination. See sections 7 and 8 of the Local Rules.

Disposal Strategies

The University's BAT assessment has identified disposal strategies to cover all uses, to date. The permits (Certificates of Registration and Authorisation) are appropriate to this assessment and are summarised in Section 2 of the Local Rules.

You should explain:

- how you will assess your waste stream:
- whether you intend to use the Very Low Level Waste (VLLW) route (reasons may be reduced costs, on site for a shorter period, minimisation of waste stored) or solid waste route and why you have made your choice
- why discharge into the atmosphere cannot be avoided in situations where gaseous emissions will be produced
- how segregation of waste at source might contribute to waste minimisation. The Local Rules describe supervisory roles, access to stores and record keeping

Training and competence of Radiation Workers

Radiation workers, Section 3(b) of the *Local rules for use of ionising radiation* describes the competence requirements of radiation workers. Training consists of the following separate components:

- Safe handling of the isotopes covered by their scheme of work
- Experimental protocols for reducing personal and environmental risks
- Departmental systems
- Legal requirements

- University requirements and emergency and contingency plans

If Radiation Workers are not fully competent you will need to describe how the training, including practical training in experimental procedures, is going to be delivered and by whom. Where expertise is not available at the University, you may have to identify and fund training from another provider.

The Application can be submitted prior to training being given, however the scheme cannot commence until Forms 1 (Registration) and 3 (Training Record) have been submitted for the proposed Radiation Workers. If the Radiation Workers are already competent, you will need to submit a copy of their *Radiation workers training record* (Form 3) with the Application.