

Ionising Radiation Regulations 2017

# Oxford University Department of Physics Local Rules for Work with Ionising Radiation

# **Department of Physics**

# COMPLIANCE WITH THESE LOCAL RULES BY ALL PERSONS IS MANDATORY

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### **1. INTRODUCTION & SCOPE**

These are the "departmental" local rules for work with ionising radiation in the Denys Wilkinson Building (except Metallurgy & Materials Science), Clarendon Laboratory and Robert Hooke Building. They must be read in conjunction with the University radiation safety policy (Ref S1/12) and with other departmental procedures. The appendices to these local rules incorporate written arrangements for the different working areas within the Physics Department.

The aims of these local rules include the following:

- (i) To ensure that radiation doses to all persons are kept as low as reasonably practicable (ALARP) and well below statutory dose limits.
- (ii) To ensure that the risk of radiation accidents is minimised and that sufficient steps can be taken to mitigate the consequences of such events.
- (iii) To ensure there is adequate control of radioactive sources and wastes to meet the requirements of the University's certificates issued under Environmental Permitting (England & Wales) Regulations 2016.

### 2. CONTACT DETAILS

Senior Radiation Protection Supervisor (SRPS):

Dr G Viehhauser

Tel: (018652) 73410; 07979 375085 (mobile); (01865) 779601 (home)

### Radiation Protection Supervisors (RPS):

Teaching Laboratory:	Dr G Barr	Tel: (018652) 73446
	J Lidgard	Tel: (018652) 73492; (07532)229287
Cryodetectors:	Prof H Kraus	Tel: (018652) 73361; (01865) 557183 (home)
X-ray diffraction:	Prof P Radaelli	Tel: (018652) 70957
	M Cheddi	Tel: (018652) 72353
OPMD (Robert Hooke Bu	uilding):	
	JJ John	Tel: (018652) 83643
DWB lab 514B:	J Lidgard	Tel: (018652) 73492; (07532)229287

The RPS shall be responsible to the SRPS and ensure that at the local level, on behalf of the Chairman of Physics, that all local rules and University policy are complied with. The RPS provides radiological supervision of the work with ionising radiation.

University Radiation Protection Officer (URPO):

Mr M Bradley Tel: (018652) 70811

The URPO advises the Department on all aspects of radiation safety and compliance with relevant legislation.

### 3. SIGNIFICANT RISKS

<u>External exposures</u>: Radiation dose rates close to the radioactive sources can be very high and mishandling or contravention of these local rules could result in significant exposures. Exposure to the primary beam of a radiation generator could result in serious injury.

<u>Internal exposures</u>: Damage to closed sources caused by mishandling or malicious acts could give rise to radioactive contamination and the potential for significant internal exposures.

<u>Female workers</u>: Ionising radiation exposures can be harmful to the developing foetus or breastfeeding infant. Once pregnancy has been declared, the University is required to restrict exposures to the developing foetus to less than 1 mSv during the remaining term of pregnancy. Physics department risk assessments must consider whether this level of exposure is reasonably foreseeable and the department must implement appropriate procedures to prevent exposures accordingly. Exposures to the breastfeeding infant are only possible through the spread of contamination. The work with ionising radiation undertaken by the Physics department is not considered to present a significant risk of personal contamination.

### 4. DESIGNATED AREAS

The following are designated as supervised areas:

- DWB teaching laboratory including the radiation store.
- DWB cryogenics Laboratory (Room 507)
- DWB fish tank (Room 514b)
- Robert Hooke Room F22
- Robert Hooke Room S51

In addition to the general rules detailed in the following sections, work with ionising radiation carried out within the above areas is subject to specific written arrangements contained in the appendices.

### 5. GENERAL REQUIREMENTS FOR WORK WITH IONISING RADIATION

**Rule 5.1** Only registered radiation workers (or students operating under the direct supervision of an RPS or registered laboratory supervisor in the undergraduate teaching lab) are permitted to work with ionising radiation, and then only having attended a Safety Office radiation protection lecture and receiving specific training in departmental procedures.

**Rule 5.2** Anyone intending to work with ionising radiation outside the Physics Department (i.e. in other departments or institutions) must notify the SRPS in advance.

**Rule 5.3** The SRPS must be informed of all proposed new work with ionising radiation. The SRPS will notify the URPO of any new work in advance of commencement of that work.

**Rule 5.4** Radioactive sources must not be brought onto the premises without first obtaining the written authorisation of the SRPS and clearance from the URPO. This includes sources on loan, hire, accompanying visiting academics etc. Receipt of radioactive materials must be in accordance with appendix 2A.

**Rule 5.5** Radioactive sources and materials must not be removed from the department (to other departments or institutions, for sale, loans, disposal etc.) without first obtaining authorisation by the SRPS and clearance from the URPO. Before transporting radioactive sources and materials between Physics department buildings listed in Appendix 2B, consent must be obtained from the SRPS or URPO. Before transporting radioactive sources and materials to any other building or institution, consent must be obtained from the URPO. Rules for transport between different buildings within the department (including their use within lectures and demonstration events) are listed in Appendix 2B.

**Rule 5.6** No person may tamper with, dismantle or deliberately interfere with a radioactive source, source container or radiation generator or any associated safety features, except in accordance with written arrangements (approved by the SRPS and URPO) prepared as the result of a suitable prior risk assessment for the procedure. X-ray generator interlocks must not be defeated without approval of the URPO on completion of a risk assessment and necessary safety procedures.

**Rule 5.7** No new work with ionising radiation must be undertaken unless a risk assessment has been carried out. Risk assessments for existing work must be reviewed at appropriate intervals, and after any significant changes to the work. Risk assessment and local rules need to be displayed next to where the work is taking place or the radioactive material or source is stored.

**Rule 5.8** Most work with ionising radiation carried out within the Physics Department (e.g. calibration or testing of detectors) will be covered by these local rules and appended written arrangements. The SRPS should be informed if it is considered, following a risk assessment, that any activities cannot be carried out in compliance with these local rules. In that case, either additional local rules may be required or the activity may be prohibited.

### 6. PERSONAL PROTECTION

**Rule 6.1** All persons should take care to ensure that their and other persons' exposures to ionising radiation are as low as reasonably practicable.

**Rule 6.2** In the event that any procedure has been assessed to present a risk of external (body) exposures above 1 mSv per year, it is important that female workers undertaking the procedure notify the SRPS, Occupational Health Department, or URPO as soon as possible in writing if they are pregnant or breastfeeding. This information will be handled in the strictest confidence and used only for radiation protection purposes to prompt a review of radiation protection arrangements to ensure that exposures during the remainder of the pregnancy are being appropriately managed.

**Rule 6.3** All persons issued with a radiation dosimeter ("badge") must wear it on the trunk of the body at all times whilst at work with ionising radiation.

**Rule 6.4** The principles of "time, distance and shielding" should be employed to restrict radiation exposures during work. In particular, radioactive sources must not be handled directly. Handling tools should be used to manipulate radioactive sources; taking care not to damage the source. No part of the body should ever be passed through an open x-ray beam. Whenever practicable, radioactive sources should be contained within appropriate shielding.

**Rule 6.5** If you consider that you might have received a radiation exposure *greater than expected* notify the SRPS, informing him of the circumstances of the potential exposure e.g. equipment, proximity, duration of exposure etc.

## 7. MONITORING, SOURCE ACCOUNTANCY & RECORD KEEPING

**Rule 7.1** Radioactive sources should be kept in a suitable container and locked within the radiation store when not in use. The key to the store should be held by a radiation protection supervisor or nominated persons (e.g. a senior laboratory technician). No materials, other than those related to the work with radiation (e.g. handling tools, hand held radiation monitors) should be kept in the store. In particular, flammable substances (solvents, magnetic tapes etc.) should not be kept in the store. Sources should be positioned within the store and shielded appropriately such that external dose rates do not exceed 2.5  $\mu$ Sv per hour.

**Rule 7.2** A monthly check should be made of the continued presence of all radioactive materials. Store holdings should be physically checked against the inventory. The presence of sources mounted in equipment can be verified either by the detection of an external dose rate (using a hand held radiation monitor) or by the continued function of the equipment/experiment. Records should be kept. Failure to account for the whereabouts of a radioactive source should be notified to the URPO in accordance with the contingency plans.

**Rule 7.3** All safety features and warning devices for work with radiation (door interlocks, emergency stop buttons, x-ray warning lights etc.) should be checked quarterly and records kept. No checks should be made which place the individual at risk of significant radiation exposures. In the event of failure of any safety feature, follow the instructions in the contingency plans.

**Rule 7.4** Dose rate measurements should be made around radiation stores, radiation enclosures (e.g. x-ray cabinets) and equipment containing radioactive stores on a quarterly basis and recorded. Significant differences to previous measurements or trends (i.e. a gradual increase in dose rates over several months) should be discussed with the SRPS, who will notify the URPO.

# APPENDIX 1: CONTINGENCY PLANS

## APPENDIX 1: CONTINGENCY PLANS

#### Introduction

The likelihood of incidents which would result in a significant risk to members of staff, emergency services personnel or members of the public is very low. However, it must be recognised that an unshielded or damaged radiation source may give rise to significant dose rates or contamination. If in doubt, stop, withdraw and seek further advice.

Nothing in this plan precludes action which needs to be taken to save life or assist an injured person. However, where such action is required in the presence of high radiation dose rates or radioactive contamination, this should be done under radiation protection supervision where possible.

When implementing any contingency plan, a record of names of all persons involved, their locations with respect to radiation sources in the laboratory and times of exposure should be kept to enable an assessment of doses to be made.

Specific contingency plans are provided for the following reasonably foreseeable incidents:

- 1. Loss or theft of radioactive materials
- 2. Fire in the building
- 3. Failure of safety features, warning devices etc.
- 4. Personal exposures
- 5. Damage to closed sources
- 6. Breakdown of controls

**Note 1:** Specific x-ray contingency plans are contained in the written arrangements for x-ray work contained in Appendix 2G of these local rules.

**Note 2:** In the event of an emergency, actions assigned to the SRPS in these plans may need to be undertaken by the RPS. Also, actions assigned to the URPO in these plans may need to be undertaken by a person deputising for him. If the URPO is unavailable then the Emergency Call-out List should be used to obtain the assistance of such persons.

#### 1. Loss or theft of radioactive materials

This might be detected at a routine source check or after unauthorised entry into the facility.

- An immediate check should be made on all radioactive sources and any missing materials identified and a description prepared of the missing materials.
- Report the circumstances without delay to the SRPS and University Safety Office who will advise on notification of the statutory authorities.
- Continue to search for the missing material.

#### 2. Fire in the building

On hearing the fire alarm and provided it is safe for you to do so:

- Stop work, terminate exposures and return radioactive sources to the radiation store if time allows and it is safe to do so.
- Leave the building by the prescribed route.

- Go to the assembly area and report to the acting fire warden. Notify the (S)RPS if any radioactive sources have not been returned to the radiation store. The URPO should be informed at this stage.
- When the fire brigade arrive, the SRPS should inform them about the presence of radioactive materials within the laboratory and provide advice as required.
- Provided that the fire has not affected the part of the building in which the radioactive sources or radiation generators are situated, authorised users, accompanied by the RPS, may return to the facility when given clearance to do so.
- If the fire has affected the part of the building in which the radioactive sources or radiation generators are situated, damage to the equipment or safety features must be assumed and the possibility of radioactive contamination must not be discounted. The advice of the URPO should be sought prior to returning to the laboratory.
- In that event, a full dose rate and contamination survey should be carried out, together with checks on the laboratory safety and warning systems. The URPO will advise on the appropriate actions to be taken on the outcome of these checks.

# 3. Failure of safety features, warning devices etc. and damage to sources

For example: interlock or shutter failure or loss of shielding which might be detected during routine use or at periodic inspection.

- Equipment should not be used until the fault has been remedied, appropriate tests have been carried out and the equipment has been deemed safe to return to use. The advice of URPO must be sought on the checks required prior to returning the equipment to use.
- If a loss of shielding gives rise to a dose rate greater than 7.5 μSv per hour, terminate exposure or shield source (if relevant and if able to do so without placing yourself at risk); restrict access to the area (set boundary at 7.5 μSv per hour) and notify the SRPS and URPO.

## 4. Personal exposures

- Anyone who considers they may have received a significant radiation exposure (e.g. in close proximity to a radioactive source or primary x-ray beam) should notify the SRPS as soon as possible.
- The exact details of the exposure (source details, generator operating parameters, distances, exposure times, part of body, witnesses etc) should be recorded.
- The URPO should be notified forthwith.

## 5. Damage to closed sources

- Anyone who causes or notices damage to a radioactive source or to equipment containing a radioactive source should immediately notify the SRPS.
- Access should be restricted to the area and the individual should be checked for personal contamination by the (S)RPS using a suitable contamination monitor. Personal contamination should be dealt with as in point 7 below.
- The URPO should be notified forthwith.

## 6. Breakdown of controls

The RPS should notify the SRPS of any breakdown in procedural controls whether or not they resulted in significant radiation exposure. For example, the use of radioactive sources or access into controlled areas by unauthorised/non-registered staff. The SRPS should investigate all notified incidents to review whether existing procedures remain sufficient. The advice of the URPO should be sought.

# **APPENDIX 2: WRITTEN ARRANGEMENTS FOR SPECIFIC WORK**

# APPENDIX 2A DELIVERY PROCEDURES FOR RADIOACTIVE MATERIALS INTO THE PHYSICS DEPARTMENT

### SRPS: Georg Viehhauser

- 1. The conditions of Rule 1.4 of the Physics Department local rules must be satisfied before making arrangements to bring any radioactive materials onto the premises.
- All deliveries of radioactive materials must be made via stores during working hours. Stores can
  accept radioactive packages bearing no labels (*excepted packages*), White-I labels or Yellow-II
  labels.
- 3. Before ordering or arranging delivery of radioactive material the SRPS has to be notified and permission to bring the material to the department must be obtained.
- 4. Planned deliveries of radioactive materials must be notified to the SRPS and the relevant Storekeeper (Clarendon or DWB) in advance, providing exact details of the delivery (isotope and activity). The name of the intended recipient (end-user) should be notified to the storekeeper.
- 5. On delivery of a radioactive source to Stores, before signing to take receipt, the storekeeper should check the delivery paperwork and confirm that the source is exactly as ordered and that the package is visibly undamaged. If the package is damaged, the Storekeeper should not accept the package without first consulting the SRPS.

Packages must <u>not</u> be accepted if the quoted isotope does not match the order or if the activity of the contents (number of "Bq") exceeds the order.

If the package is accepted, the storekeeper should record the date, time of arrival and package contents into the Stores record and inform the SRPS.

- 6. The package should be locked inside the storage safe and the intended recipient of the package should be contacted to attend Stores and collect it. On collecting the package from Stores, the recipient of the package should sign and date the Stores record, thereby taking responsibility for the source and confirming that it has been removed from Stores.
- 7. If the intended recipient cannot be contacted, the SRPS should be informed. He will attend Stores, sign for and remove the package from Stores into the radiation store in the Teaching Lab in the DWB (entering the source details into the source record for the Teaching Lab store). The source should remain in the Teaching Lab radiation store until the recipient has been contacted. On collection of the store from the Teaching Lab radiation store, the recipient should sign and date the store record, thereby taking responsibility for the source and confirming that it has been removed from the Teaching Lab store.
- 8. On returning the package to the location of use, the recipient should record the date, time of arrival and source details (isotope, serial number, activity) into a source record book within the laboratory. If the package is not to be opened straight away, it should be locked in a suitable radiation store.

# 9. Emergencies

If you suspect that a package containing radioactive materials has been lost or stolen, immediately contact the SRPS, URPO (01865 270811, office hours) and University Marshal (01865 289999 at any time). Initiate a search for the package.

The URPO will notify the Police, EA and HSE

#### **APPENDIX 2B**

# WRITTEN ARRANGEMENTS FOR TRANSPORT OF SOURCES WITHIN THE DEPARTMENT (DENYS WILKINSON, CLARENDON, AND ROBERT HOOKE BUILDINGS)

#### SRPS: Georg Viehhauser

# Note that the arrangements described here allow only for transport within the department between the buildings listed above. All other transport needs permission by the URPO.

- 1. Closed sources can be moved between the different buildings of the Physics Department after consultation with the SRPS.
- 2. A record of the move needs to be made in the source records of the locations from where the source and to where the sources is moved.
- 3. The source must be transferred using double containment and packed in such a way that it will withstand any reasonably foreseeable accidents *en route* without damage e.g. being dropped. The containers should be sufficiently robust for the intended source transfer and shock absorbent material (e.g. bubble wrap) used as appropriate.
- 4. The internal container should display the radiation warning sign and legend "radioactive", together with the following note:

"This package contains low risk radioactive sources used in University of Oxford Physics Department teaching experiments. In the event of an accident involving this package or on discovery of this package, please contact [details of identified physics emergency contact] and/or University Security Services (01865 289999)".

- 5. The source must remain under direct supervision throughout the transport. If the source is transported within a setup, this applies to the setup.
- 6. Once the source has reached its destination the SRPS has to be notified.
- 7. For short term use in another building (e.g. a lecture) where the source will remain under the continued supervision of the member of Physics department using the source, it is not necessary to create a source record for the destination. Where the source will be loaned to the other department or will remain on that premises for a longer period of time, the source should be entered into the destination building source record.

#### 8. Emergencies

In the event of any incident or accident involving the radioactive source, the appropriate contingency plans contained in Appendix 1 of the Physics Department local rules should be followed.

In the event that a source is involved in an incident outlined in 4 above, a member of the Physics department must attend site to return the source to a secure store within the DWB. The URPO must be informed on 07922 197171. The URPO or his representative must attend

site if significant damage to the inner container or contents of the package are suspected.

If you suspect that a radioactive source has been lost or stolen, immediately contact the SRPS, URPO (01865 270811, office hours) and University Marshal (01865 289999 at any time). Initiate a search for the package. The URPO will notify the Police, EA and HSE.

# APPENDIX 2C WRITTEN ARRANGEMENTS FOR GENERAL WORK WITH SEALED RADIOACTIVE SOURCES

### SRPS: Georg Viehhauser

- 1. Radioactive sources should be held in the locked radiation store when not in use.
- 2. When a source is removed from store, an entry should be made in the store ledger (the source record) that the source has been removed; where to; by whom; and when. When the source is returned to store, it should be signed back in. *Note:* In the Physics Teaching Lab, the removal and return of the source should be recorded using the card system above the store.
- 3. Never handle a radioactive source directly. If the source is mounted on a handle, use the handle. Otherwise, use tweezers to manipulate radioactive sources.
- 4. Never attempt to open a sealed radioactive source or do anything which would jeopardize its integrity.
- 5. Sources removed from the store for benchtop experiments should be continuously supervised during use.
- 6. Mobile sources removed from the store for installation in equipment for extended periods should be securely mounted within the equipment such that they cannot be readily removed. A radiation warning sign with legend "radiation risk" or equivalent) should be displayed on the equipment to alert individuals of their presence. The accessible radiation dose rate around the equipment should be measured and must not exceed 2.5 μSv per hour, without obtaining the advice of the URPO. Whilst installed in the equipment, a weekly check of the continued presence of the radioactive source should be made (by measuring a dose rate or the continued function of the equipment/ experiment) and recorded.

## 7. Emergencies

If you suspect that a radioactive source has been lost or stolen, immediately contact the SRPS, URPO (01865 270811, office hours) and University Marshal (01865 289999 at any time). Initiate a search for the package. The URPO will notify the Police, EA and HSE.

If a source has been damaged, restrict access to the area and immediately notify the SRPS and URPO.

Comprehensive contingency plans for all reasonably foreseeable incidents are contained in Appendix 1 of the Physics Department local rules.

#### **APPENDIX 2D**

# WRITTEN ARRANGEMENTS FOR WORK WITH RADIOACTIVE SOURCES IN THE TEACHING LAB

# RPS: Giles Barr, Jeffrey Lidgard SRPS: Georg Viehhauser

- 1. The supervised area referred to in these rules is the main nuclear physics teaching laboratory area on the mezzanine of the undergraduate teaching laboratory and the area of the teaching accelerator.
- 2. At least one demonstrator must be present when students are in the lab.
- 3. All demonstrators must be registered as radiation workers. The RPSs will have film badges. It is not necessary for the other demonstrators to wear film badges.
- Students working on regular experiments within the teaching lab (NP01, NP03, NP04, NP05, NP08, NP09, NP10) do not need to be registered as long as they do only work covered by the instructions for this specific setup.
- 5. All students get a short introduction to safety with radioactive sources, the handling of sources in their experiment, and the use of the sign-out system for sources at the beginning of the lab. Students will confirm that they have been given this instruction by signature.
- Sources may only be in the source cupboard or installed in the experiment in which it is being used or being carried between the two. Sources may never be taken outside the supervised area as defined above without the approval of the SRPS,
- Almost all the sources you will use are in plastic containers. DO NOT open these containers. Tongs are provided to enable you to handle the sources at a distance and take advantage of the inverse square law.
- 8. Except where required by a running experiment, sources must be returned to the source cupboard overnight and over the lunch hour, except where the same source will be used again immediately after lunch.
- The surface dose rate of any piece of teaching equipment containing radioactive sources must not exceed 2.5 μSv per hour without written approval of the URPO.
- 10. The equipment should be operated in accordance with the manufacturer's instructions or relevant experimental procedures. Students must not attempt to interfere with or dismantle any piece of equipment containing a radioactive source. If a source appears to be leaking, or damaged, do not touch it, do not let anyone else touch it, and ask a demonstrator to call the Senior RPS and URPO (contact details can be found on the yellow Emergency card displayed in the Teaching Laboratory).
- 11. Only the sources designated in the course manuscripts for each experiment may be used in that

experiment. Only one source may be used by an experimental group at a time.

- 12. The source sign-out tag must be used to record which experimental group has the source. If a source is passed from one experimental group to another, the sign-out tag must be updated immediately by a member of each group.
- 13. Maintenance of the equipment (e.g. source changeover) should only be carried out by individuals who are registered radiation workers and have received appropriate training in the procedures and associated health and safety requirements.
- 14. A monthly check of the continued presence of the radioactive source should be made (by measuring a dose rate or by the continued function of the equipment/experiment) and recorded.
- 15. When using the Cobalt 60 (AI-7107 & AI-7108) and the Sodium 22 (EY208) sources they must only be manipulated by the handles, and then only sparingly and with circumspection. Shielding, even lead, is not useful; only distance and time can be used.
- 16. When operating experiment NP05:
  - 16.1 Hold the source holder handle were the source label indicates 'Hold here' with fingertips this maintains a distance of 15cm between the hand and the source. Do not allow the source to come in contact with any part of the body or any person maintaining as much distance as possible during manipulations.
  - 16.2 Keep at least 50cm (the area marked in red) from the source at all times except when manipulating the source or adjusting the detectors then maintain a distance of at least 15cm which is approximately the distance from the handle end labelled 'Hold here' to the centre of the vertical part holding the source.
- 17. When operating experiment NP11:
  - 17.1 Only Strontium 90 source serial number SR19912 will be used with this experiment.
  - 17.2 The source must be kept fully enclosed in the shield provided at all times except when in use on the sensor unit then the source must remain in top part of the shield.
  - 17.3 The source may be manipulated by hand provided when transferring the top part of the shield with the source to the sensor unit this manipulation time must be kept to a minimum. Under no circumstances should the source be manipulated in such a way as to come in to contact with any part of the body and should always face down with the shield between the source and the operator use tweezers to hold the bottom part when separating the shield if this is needed.
  - 17.4 Keep at least 30cm (the area marked in red) from the source at all times except when manipulating the source.

#### 18. Emergencies

In the event of any incident or accident involving the equipment, the appropriate contingency plans contained in Appendix 1 of the Physics Department local rules should be followed.

# APPENDIX 2E WRITTEN ARRANGEMENTS FOR WORK WITH RADIOACTIVE SOURCES IN THE OPMD (ROPERT HOOKE BUILDING)

RPS: Jaya John John SRPS: Georg Viehhauser

- 1. These arrangements cover specific procedures for working with sealed sources in the Oxford Physics Microstructure Detector facility (OPMD) in the Robert Hooke Building.
- 2. Everyone working with sealed sources in these labs must be registered as radiation workers and receive a briefing from the RPS or a delegate.
- 3. When not in use, sources must be kept locked in the source safe inside the OPMD class 10k cleanroom. The keys for the safe and related padlocks must be stored in the key safe when not in use.
- 4. Sources may only be used for experimental work inside the OPMD cleanroom. Sources may not be taken outside the cleanroom without the approval of the SRPS.
- Never attempt to open a sealed radioactive source or do anything which would jeopardize its integrity. If you notice any damage to a source, immediately notify the RPS, SRPS and URPO -see 8. Emergencies below.
- 6. Follow this procedure for working with the sources:
  - 6.1. Obtain the keys from the key safe in the gowning room of the OPMD.
  - 6.2. Make an entry in the source accountancy book (kept on top of the safe, class 10k area) indicating where the source will be used: in the class 10k or the class 100 area. Unlock the source safe, obtain the source and lock the source safe again.
  - 6.3. Never handle a radioactive source directly. The <sup>55</sup>Fe sources may be carried in their shuttered aluminium holders, with the shutters closed. The <sup>90</sup>Sr source must be carried using the tongs kept in the source safe. Take the source to the work bench where it will be used.
  - 6.4. If the source is used on a bench the source must be secured within the experimental setup against removal and a sign indicating "work in progress with a sealed source of radiation" must be placed by the bench during the work.
  - 6.5. When the work with the source is completed:
    - 6.5.1. If using an <sup>55</sup>Fe source in a shuttered aluminium holder, close the shutters. Return the source to the source safe. Make another entry in the source accountancy book, noting the return of the source to the safe. Lock the safe.
    - 6.5.2. Remove any "work in progress with a sealed source of radiation" bench signs.

- 6.5.3. Return the keys to the key safe in the gowning area.
- 7. A monthly check of the continued presence of the radioactive sources must be made by the RPS or a delegate and recorded in the source accountancy book.

#### 8. Emergencies

If you suspect that a radioactive source has been lost or stolen, immediately contact the RPS, the SRPS, URPO (01865 270811, office hours) and University Marshal (01865 289999 at any time). Initiate a search for the source. The URPO will notify all authorities concerned.

If a source has been damaged, restrict access to the area and immediately notify the RPS, SRPS and URPO.

# APPENDIX 2F LOCAL RULES FOR WORK WITH THE Am/Be NEUTRON SOURCE IN 514a

# RPS: Jeffrey Lidgard SRPS: Georg Viehhauser

These local rules concern only the use of the Am/Be source in 514a. The use of other sources in this room is covered in appendix 2C.

- 1. SAFE ACCESS: Access to 514a should be coordinated with the RPS. 514a should be locked at all times when vacant.
- 2. SOURCE MOVEMENT: The source must not be removed from the safe, nor should the safe and source be moved from its current location without consultation with the SRPS.
- 3. OPENING THE SAFE: The safe should be locked at all times. The key to the safe is kept by the teaching lab.

The safe provides a tray which is directly above the source, which can be used for neutron irradiation of small samples. This may only be done by teaching lab staff, or after consultation with the RPS.

Other experiments requiring close proximity to the source must be coordinated with the RPS. Such experiments should be designed such that the safe door can be shut when the experiment is not being monitored. Workers will take extra precaution not to spend excessive time in front of the safe with the door in the open position.

- SAFE SHIELDING: The safe and shielding inside the safe were designed to provide sufficient protection from neutrons and gammas and should not be modified unless coordinated with the SRPS.
- 5. TOP SHIELDING: The shielding on top of the safe was designed to allow additional radiation flux above the safe by pulling a slab of plastic (the "shutter") out of place. This slab of plastic should remain in the position that provides maximal protection when the additional flux is not needed.

## 6. Emergencies

If you suspect that the radioactive source has been lost or stolen, immediately contact the RPS, the SRPS, URPO (01865 270811, office hours) and University Marshal (01865 289999 at any time). Initiate a search for the source. The URPO will notify all authorities concerned.

If the source or the safe has been damaged, restrict access to the area and immediately notify the RPS, SRPS and URPO.

In the event of any incident or accident involving the source, the appropriate contingency plans contained in Appendix 1 of the Physics Department local rules should be followed.

April 2018

#### **APPENDIX 2G**

# WRITTEN ARRANGEMENTS FOR WORK X-RAY DIFFRACTOMETERS INCLUDING MAINTENANCE / OPEN BEAM WORK

#### **DESIGNATION OF AREAS**

Controlled<sup>1</sup> or supervised<sup>2</sup> areas need not be designated during routine use of the x-ray diffraction equipment since inherent engineering controls (incl. shielding & collimation) and safety features (e.g. safety interlock devices) effectively prevent access to the inside of the cabinets where high radiation dose rates exist.

A temporary controlled area<sup>#2</sup> will be designated during any procedures which require the equipment's normal safety features to be defeated, such as beam alignment work. In these circumstances, an additional task-specific risk assessment is required and specific written arrangements prepared in consultation with the URPO. The extent of the controlled area will be defined and delineated using appropriate signs and additional access restriction arrangements will be in place.

#### 1. INVESTIGATION LEVEL

- 1.1 The University has set a dose investigation level of 1 mSv body dose<sup>3</sup>. The Department and Safety Office will investigate any cumulative recorded radiation dose in excess of this figure during a year. External whole body exposures above this investigation level are not reasonably foreseeable during x-ray diffraction experiments since accessible radiation dose rates around the equipment do not exceed 1 mSv per hour.
- 1.2 During work where access to the open beam is required, significant partial body exposures (i.e. to the skin and eye) are possible if poor procedures are adopted, potentially even radiation injuries. This work must be subject to a task-specific risk assessment and the preparation of specific written arrangements in consultation with the URPO. Only specific individuals, having received appropriate training, are authorised to undertake such work. See section 7 of these local rules.

#### 2. AUTHORISED USE

2.1 Only registered radiation workers who have received appropriate training in radiation safety<sup>4</sup> and have received specific training in departmental procedures and instruction in safe use of equipment by the SRPS or x-ray RPS are permitted to work with ionising radiation.

<sup>&</sup>lt;sup>1</sup> Controlled areas are areas where radiation safety procedures should be followed because of the potential for access to radiation levels above 7.5 microsieverts per hour (body) or 75 microsieverts per hour (hands).

<sup>&</sup>lt;sup>2</sup> Supervised areas are those where routine risks of exposure are not significant but would nonetheless benefit from being kept under review should; for example, if more significant exposures are possible in the event off an accident, incident or reasonably foreseeable failure.

<sup>&</sup>lt;sup>3</sup> The investigation level provides sufficient protection against significant x-ray exposure of the foetus during pregnancy. Consequently, no specific controls are required to protect female workers.

<sup>&</sup>lt;sup>4</sup> See section 4.4 and appendix 6 of University Policy S1/12.

- 2.2 Before any apparatus that is a potential source of ionising radiation is brought into the laboratory, the written authorisation of the Senior Radiation Protection Supervisor or his approved deputy must be obtained.
- 2.3 The SRPS must be informed of all proposed new work with ionising radiation or changes of methods/techniques. The SRPS will notify the URPO in advance of commencing any new work.
- 2.4 No work with radiation generators should be carried out unless a risk assessment<sup>5</sup> has been carried out.
- 2.5 Users must not make any attempt to override or tamper with the cabinet interlocks.

#### 3. PERSONAL PROTECTION

- 3.1 All persons should take care to ensure that their own and others' exposures to ionising radiation are as low as reasonably practicable.
- 3.2 If you consider that you might have received a radiation exposure *greater than expected* notify the SRPS, informing them of the circumstances of the potential exposure e.g. equipment, operating parameters, proximity, duration of exposure etc.

#### 4. WRITTEN ARRANGEMENTS FOR X-RAY DIFFRACTION WORK

#### Routine experimental use

- 4.1 Equipment should be operated in accordance with manufacturer's instructions and user training provided by the Department.
- 4.2 Users must make no attempt to override or tamper with the cabinet interlocks.
- 4.3 If access to the X-ray setup is required while the beam is on (shutters closed) users must use the yellow monitors in the X-ray lab when opening the access door to verify that there is no increase in count rate due to a potential malfunction of the shutter. In case there is a malfunction of the shutters the X-ray equipment must be shut down and the RPS (Mohamed Cheddi) must be notified.

#### Maintenance engineers

- 4.4 Visiting service engineers must provide copies of method statements, systems of work for any work they intend to undertake on the x-ray equipment. This documentation should state clearly the hazards associated with the work; whether any safety features will be compromised; and what actions will be taken to restrict their own or Oxford personnel exposures
- 4.5 Before work is allowed to commence, the departmental RPS should be provided with confirmation that any of the requisite control measures identified by the information supplied in 4.4 (above) have been implemented.

<sup>&</sup>lt;sup>5</sup> A generic risk assessment has been prepared for routine work with x-ray diffractometers (RSID7). See ionising radiation guidance pages on the Safety Office web site. Further task-specific assessments will be required for matters outside the scope

4.6 Prior to leaving site, the service engineers should be required to provide confirmation that they have left the equipment and all safety systems in fully working order.

of this assessment e.g. specific maintenance procedures.

## 5. ROUTINE MONITORING & SAFETY CHECKS

- 5.1 The continued function of cabinet safety interlocks and warning devices should be checked at monthly intervals and the results recorded.
- 5.2 Measurements should be made at 3-monthly intervals of radiation dose rates around each cabinet. Results should be recorded.
- 5.3 Failures of safety devices or unexplainable increases in dose rate should be reported to the SPRS. The equipment should be taken out of service until the equipment service engineers have carried out the necessary remedial work and the equipment has been declared safe to return to service.
- 5.4 Further to the above checks, in the event that any safety feature or warning device is found to have failed to function during routine operations, it should be taken out of service until the equipment service engineers have carried out the necessary remedial work and the equipment has been declared safe to return to service.

### 6. <u>CONTINGENCY PLANS</u>

The likelihood of incidents which would result in a significant risk to members of staff, emergency services personnel or members of the public is very low. However, in the event of an incident, the actions detailed in these contingency plans should be followed to ensure that radiation exposures are as low as reasonably practicable.

Nothing in this plan precludes action which needs to be taken to save life or assist an injured person. However, where such action is required in the presence of high radiation dose rates, this should be done under radiation protection supervision where possible.

When implementing any contingency plan, a record of names of all persons involved, their locations with respect to radiation sources in the laboratory and times of exposure should be kept to enable an assessment of doses to be made.

Specific contingency plans are provided for the following reasonably foreseeable incidents:

- 1. Equipment faults/failures
- 2. Personal exposures
- 3. Fire in the building
- 4. Breakdown of controls

**Note:** In the event of an emergency, actions assigned to the SRPS in these plans may need to be undertaken by the RPS. Also, actions assigned to the URPO in these plans may need to be undertaken by a person deputising for him. If the URPO is unavailable then the emergency call-out list should be used to obtain assistance.

#### 6.1 Equipment faults/failures

For example, loss of shielding, failure of safety features (interlocks, warning lights), errant beams, beam termination failure etc.

• In the event of any safety-related equipment faults, remove the power supply and do not re-

use the equipment until service engineers have corrected the fault.

### 6.2 Personal exposures

- Anyone who considers they may have received a significant radiation exposure should notify the SRPS as soon as possible.
- The exact details of the exposure (operating parameters, distances, exposure times, part of body, witnesses etc) should be recorded.
- The URPO should be notified forthwith. Following notification, an investigation of potential exposures will be undertaken by the URPO and SRPS.

# 6.3 Fire in the building

- On hearing the fire alarm, follow normal fire procedures for the laboratory.
- If the fire has affected the part of the building in which the radiation generators are situated, it must be assumed that the equipment may have been damaged. The advice of the URPO should be sought prior to using the x-ray generators.

## 6.4 Breakdown of controls

The RPS should notify the SRPS of any breakdown in procedural controls whether or not they resulted in significant radiation exposure. For example, the use of x-ray sets by unauthorised/non-registered staff. The SRPS should investigate all notified incidents to review whether existing procedures remain sufficient. The advice of the URPO should be sought.

# APPENDIX 2H WRITTEN ARRANGEMENTS FOR USE OF RADIOACTIVE SOURCES IN LECTURES / PUBLIC DEMONSTRATIONS

#### SRPS: Georg Viehhauser

- 1. Radioactive sources must not be used in hands-on interactive demonstrations. Sources must only be handled by Physics department staff who are registered radiation workers. Members of the public must not be allowed to handle radioactive sources.
- 2. No sources must be used in lectures/demonstrations if the dose rate accessible to the audience would exceed 2.5 microsieverts per hour.
- 3. Complete source details (Isotope, activity, serial number) for all sources used in the demonstration should be retained by the demonstrator.
- 4. The demonstrator must vigilantly maintain continuous supervision of the radioactive source at all times. Whenever they are not being continuously supervised, irrespective of the length of time, sources must be securely locked away in a suitable store/cabinet.
- 5. In demonstrations involving larger groups (and particularly children), where it may not be possible to sassily restrict access by inquisitive hands, only one source must be used at any time; other sources being safely out of reach of the audience (but still under the control of the demonstrator) or locked away.
- 6. At least one demonstrator must be present at all times.
- Sources must be returned to the DWB secure store as soon as practicable after completing the demonstration. Sources must not be left on another premises, unless in a suitable radiation store under that premises source records, and with the prior authorisation of the URPO.

#### 8. Emergencies

In the event of any incident or accident involving a radioactive source, the appropriate contingency plans contained in Appendix 1 of the Physics Department local rules should be followed.