4 Restriction of Exposure to Radiation

Scope

1 Every employer, in relation to any work with ionising radiation, must take all necessary steps to restrict the extent to which their employees and other persons are exposed to ionising radiation to as low as reasonably practicable (ALARP). The measures which contribute to the restriction of exposure are fundamental to radiation protection as is the quality of information and training provided to employees to enable the measures to be effective. Since exposure to radiation will only occur when work with ionising radiation is necessary, it follows that if the use of radioactive material and ionising radiation can reasonably be avoided, measures to restrict exposure will not generally be necessary. Similarly, if work can be confined to the use of sealed sources of radioactive material or radiation generators (e.g. X-ray sets), the hazards associated with the possible spread of loose radioactive material (i.e. contamination) and the associated contamination control measures can be minimised or avoided altogether.

2 For the purposes of this Chapter, it is assumed that the particular practice using radioactive material or ionising radiation is necessary (i.e. justified). Chapter 3 gives details of the requirements for justification of practices involving ionising radiation.

Statutory Requirements

3 In addition to the general requirements of the Health and Safety at Work etc Act 1974 and the Management of Health and Safety at Work Regulations 1999, the following specific legislation applies directly:

a. Ionising Radiations Regulations 2017 (IRR17); and

b. Personal Protective Equipment at Work Regulations 1992.

Duties

4 Duties as detailed in Chapter 39 apply.

General Approach to Restricting Exposure

5 In general, the lower the activity of any radioactive sources or the lower the output of a radiation generator, commensurate with the work to be done, the easier it will be to ensure that exposure is adequately restricted. Similarly, where work requires the use of unsealed sources of radioactivity, measures to reduce the quantities routinely handled and to improve the immediate containment will make it easier to restrict exposure to external radiation and to minimise the possibility of internal exposure arising from any spread of contamination.

6 A hierarchy of control measures is used to restrict exposure. By using options in this order, the most robust and effective restrictions can be achieved. A summary is shown here, with further detail throughout this Chapter:

a. engineering controls e.g. safety locks, permanent shielding (like walls of a suitable thickness / material), containment, etc. (Para 50 – 56);

b. systems of work e.g. local radiation safety orders (Para 577 – 59); and

c. Personal protective equipment (PPE) e.g. appropriate gloves, masks, etc. (Para 59– 64).

7 All practicable options should be considered for each tier before moving down to the next, i.e. all practicable engineering / physical controls should be considered first before looking to systems of work to restrict exposure, and finally considering PPE.

8 Radiation monitoring data and personal dosimetry data provides a valuable tool for evaluating the success of control measures to restrict exposures. It should be possible to review working conditions against this data and to identify individuals whose exposures may not be ALARP because they are higher than those of colleagues doing similar work.

9 Systems of work – employers must ensure that working methods, local orders and work instructions take restriction of exposure into account. In the case of work in controlled and supervised areas, local orders must also satisfy additional statutory requirements (see Chapter 16).

10 Training – provision of general and site-specific information and training is a vital component of any arrangements for restriction of exposure.

11 Restriction of external radiation exposure – in addition to the general measures outlined above, a number of simple methods are to be employed and are to be covered in general radiation protection training and also in site specific briefs to employees as follows:

a. minimising the quantity of radioactive material kept in the working area;

b. in the case of X-ray radiography, using the minimum appropriate kV and mA settings;

c. provision of information e.g. diagrams showing variation of radiation levels in the work area;

d. minimising time spent in the vicinity of the source of radiation or in areas where radiation levels are higher;

e. maximising distance from the source;

f. use of shielding where reasonably practicable;

g. radioactive materials, including those in the form of sealed sources, must not be held or directly manipulated in the hand (or close to the hand) if it is practicable for the task to be completed by other means – for example, the use of tongs or tweezers unless the skin of the hand is unlikely to receive a significant dose and the employee is unlikely to become significantly contaminated;

h. dose sharing is not to be used as a primary means of restricting exposure to individuals. Rather, priority is to be given to improving engineering controls and other means of restricting exposure, including changing the methods of work; and

i. employers are to take particular steps to restrict the exposure of any employee who does not normally work with radiation to a (whole body) effective dose of less than 1 mSv per year. Similarly, doses to parts of the body are not to exceed the relevant limit for other persons.

12 Restriction of internal radiation exposure (contamination control) is normally only an issue where work with open radioactive sources (including some naturally occurring radioactive material) must take place or where the work has the potential to generate contamination (e.g. machining of materials with radioactive constituents). Also, some work activities may have associated reasonably foreseeable accidents with the potential to lead to damage to sealed radioactive sources and consequent release of contamination. In these cases, contingency plans (see Chapter 40) are to address contamination control. Where work must be carried out with unsealed sources or in contaminated areas, it will usually be necessary for the area to be designated as controlled or supervised (see below). Where contamination is likely to be an issue, employers are to address the following points and promulgate safety instructions and procedures as necessary (detailed guidance is provided at Annex A):

a. consult an RPA as to the requirements for contamination control and the need for area designation;

b. ensure that priority is given to the containment of radioactive substances to prevent dispersal. Where containment is not sufficient to give adequate protection, ventilation is to be provided;

c. ensure that work procedures and containment arrangements are such as to minimise the raising and spread of contamination – this must also address cleaning arrangements;

d. ensure that provision is made for the safe decommissioning or dismantling of equipment, in particular internal surfaces that may become contaminated;

e. ensure that local orders are drawn up with reference to the area concerned (see Chapter 16);

f. ensure that access to areas of contamination is appropriately controlled and that such areas are clearly demarcated;

g. ensure that the work conditions of an employee who is breastfeeding are restricted so as to prevent significant bodily contamination – in practice this will usually mean that they are to be excluded from entry to areas where there is a significant presence or risk of contamination;

h. identify and provide appropriate personal protective equipment (including respiratory protective equipment where appropriate);

i. provide and maintain suitable and sufficient washing, monitoring and changing facilities for persons who enter or leave contamination areas;

j. provide hygiene rules (no eating drinking, smoking etc) to minimise the possibility of employees being contaminated internally or externally;

k. ensure that contingency plans are drawn up and rehearsed which include plans to deal with the spread of contamination by breakage or spillage, with the removal of personal contamination and with the treatment of cuts or breaks in the skin (see Chapter 40);

l. ensure that arrangements for clearance and removal of items from contaminated areas are identified. MOD has adopted a nuclear industry code of practice entitled Clearance and Exemption Principles, Processes and Practices for Use by the Nuclear Industry. The RPA advice is likely to be based on this document. Units and establishments, in consultation with the RPA, are to develop a system of administrative controls and documentation to control the movement of potentially radioactive items or contaminated items;

m. ensure that arrangements for monitoring and exit of personnel from contaminated areas are identified and that advice is taken on the need for any routine sampling (e.g. urine sampling) of employees to be carried out for the purposes of dose assessment;

n. ensure that area monitoring arrangements including measurement and sampling within the area are identified and carried out and that monitoring is conducted outside the area to identify the possibility of any spread of contamination beyond the area concerned; and

o. ensure the prompt removal of contamination from personnel who become contaminated.

Radiation Dose Constraints and ALARP Investigations

Dose constraints

13 A dose constraint is an upper level of individual dose specified by the employer at the design or planning stage and is a level which ought to be achieved in a well-managed practice. For most non-nuclear work in MOD, it will not be necessary to set dose constraints, however, for specific projects such as decommissioning an active area, where exposure may be significant, then RPA advice is to be sought as to a suitable dose constraint to be used.

Formal ALARP investigations

14 In order to ensure that dose restriction methods are being effective, there is a statutory requirement for a formal dose level to be set by the employer, which, when exceeded, will trigger a formal investigation. MOD policy requires that a level no higher than 6 mSv in any calendar year be used. The RPA is to be consulted as to the setting of an appropriate investigation level.

15 If the effective dose to any individual exceeds the formal investigation level, a locally conducted investigation is to be carried out on behalf of the CO to determine that all reasonable steps are being taken to minimise radiation exposure and identify any additional measures which should reduce dose. One investigation is normally sufficient where a group of employees has been engaged in similar tasks in the same environment and have each received radiation doses in excess of formal investigation level. In the case of an unintended exposure (see below), reporting action is required external to the unit. This investigation is a statutory requirement (see paragraph 19 below).

16 Once an investigation level has been set and specified in local orders, the investigation, if this level is exceeded, becomes a statutory requirement. Investigation reports are to be retained – they may be required as input to further investigations or to demonstrate to the Health and Safety Executive (HSE) that an adequate investigation has been carried out. The procedures for and content of an investigation are covered in Chapter 14.

Notification and reporting of investigations

17 Where a whole-body dose resulting from an incident exceeds 6 mSv or other investigation level as set in local rules, there is a requirement for a statutory dose assessment (see Chapter 6) and a report to MOD authorities (see Chapter 14).

Radiation Dose Limits

18 In addition to the requirements to ensure that radiation exposures from ionising radiation are kept ALARP (by following the instructions and guidance elsewhere in this chapter and annexes), the employer must also ensure that statutory dose limits are not exceeded. Dose sharing is not to be used as a primary means of keeping exposures below dose limits. However, if a choice has to be made between restricting doses to individuals or groups of persons, priority is always to be given to keeping individual doses as far below dose limits as is reasonably practicable.

19 The statutory annual effective dose limit (sometimes described as the whole-body dose limit) from occupational exposure to ionising radiations for an employee of 18 years of age or above is 20 mSv in any calendar year. The total effective dose is the summation of the weighted equivalent dose in all tissues and organs of the body from internal and external radiation. Occupational exposure excludes the dose from any medical exposure (as defined under the Ionising Radiation (Medical Exposure) Regulations 2017 or from natural background radiations apart from workplace exposure to radon and its daughters.

20 In addition to the effective dose limit, there are separate dose limits to specific parts of the body as follows:

a. the equivalent dose received by the hands, forearms, feet and ankles or the skin is not to exceed 500 mSv in any calendar year; or

b. the equivalent dose received by the lens of the eye is not to exceed 20 mSv in any calendar year.

21 In addition to the limits for employees aged 18 years or over described above, there are separate annual limits for the following categories of person (the RPA can provide further advice as necessary):

a. trainees aged 16-18 (6 mSv effective dose); and

b. other persons, including individual members of the public (1 mSv effective dose).

22 There is also a special rule for dose limitation for employees who have been overexposed in a particular year. Further information is given in Chapter 6 and the RPA can provide further advice if need be.

23 Overexposure - the exposure of a person to ionising radiation to the extent that the dose received by that person causes the dose limit relevant to that person to be exceeded. The employer has a statutory requirement to inform the Health and Safety Executive of any person (other than a member of a visiting force described in part 1 of the Visiting Forces Act 1952 or a member of a visiting force attached to a headquarters or an organisation) who is believed to have exceeded a dose limit. The requirement for investigation, notification and reporting is covered in Chapter 14. The HSE may be expected to visit any establishment where an overexposure occurs.

Designation of Controlled or Supervised Radiation Areas

24 This section defines the requirements for designation of controlled or supervised areas, together with the requirements for demarcating and restricting access to such areas. This section does not apply to operational nuclear submarines where the requirements of BRd 4965 are to be followed.

Controlled areas

25 It is a statutory requirement that an RPA be consulted as to the implementation of requirements as to a controlled area (or make changes to the area or work to be carried out in that area). A controlled radiation area is to be designated whenever:

a. any person entering the area has to follow special procedures designed to restrict significant radiation exposure or prevent or limit the probability and magnitude of radiation accidents or their effects; or

b. any person working in the area is likely to receive an effective whole-body dose greater than 6 mSv in a year or an equivalent dose greater than three-tenths of the dose limits. (Annex E).

26 The Approved Code of Practice IRR17 states that an employer is to designate a controlled area in the following circumstances:

a. the external dose rate is liable to exceed 7.5 μSv / hr averaged over the working day;

b. the hands of an employee can enter an area and the 8-hour time average dose rate in that area exceeds 75 μSv / hr;

c. there is a risk of spreading significant contamination outside the working area;

d. it is necessary to prevent, or closely supervise, access to the area by employees who are unconnected with the work with ionising radiation while that work is underway; and

e. employees are liable to work in the area for a period sufficient to receive a whole-body dose in excess of 6 mSv a year.

f. Note - that an employer must not intentionally create, in any area, conditions that would require that area to be designated as a controlled area, unless that area is for the time being under the control of the employer.

27 In addition, an area is to be designated as a controlled area if the dose rate averaged over a minute exceeds 7.5 µSv / hr and:

a. site radiography is carried out; or

b. employees untrained in radiation protection are likely to enter that area, unless the only work with ionising radiation involves a radioactive substance dispersed in a human body.

Demarcation of controlled areas

28 Controlled areas are to be demarcated where practicable by the erection of effective barriers that are at least adequate to impede inadvertent unauthorised entry. Where this is not reasonably practicable, controlled areas must be delineated by some other suitable means. Controlled areas that are liable to contain high activity sealed sources are to be bounded by barriers that are secure against deliberate unauthorised entry (see Chapter 3). Use is to be made of permanent structures where practicable, such as walls of buildings, to provide such boundaries.

29 Suitably worded signs are to be posted at all boundaries to a controlled area stating that the area is a controlled area (see Annex B). The signs are to include details of the nature of the radiation sources and the risk arising from such sources. Such signs are to be supported by prohibition signs with the legend - No unauthorised entry.

Access to controlled areas

30 Access to controlled areas is to be limited to:

a. classified persons;

b. classified outside workers – further information is detailed in Chapter 38;

c. non-classified persons (i.e. an employee or non-classified outside worker) working under written arrangements applicable to the controlled area (see Chapter 5);

d. persons undergoing a medical exposure; and

e. visitors entering under written arrangements (see Chapter 5).

31 Classified persons who are required to enter a controlled area which is operated by an employer other than their own, are to provide their radiation passbook (see Chapter 38) to the RPS who is responsible for the controlled area.

Wearing of dosimeters in controlled areas

32 All classified persons entering controlled areas are to wear dosimeters issued by an Approved Dosimetry Service (ADS), normally the Dstl ADS. The type of dosimeter (for example, whole body TLD, skin / extremity TLD or neutron) is to be specified in the local orders.

33 Non-classified persons are to be issued with dosimeters where this is specified in the written arrangements (see Chapter 5). Where dosimeters are not issued to individuals, an alternative means of dose assessment is to be specified in the written arrangements.

34 Direct-reading dosimeters, normally an electronic personal dosimeter (EPD), are to be worn by all workers in areas where high radiation doses may be received, in order to manage the restriction of radiation dose on a day-to-day basis. Setting of appropriate dose and dose rate alarms can also greatly assist ALARP management.

35 Where a risk assessment (see Chapter 2) indicates that an accident or incident may occur in which the personnel involved could receive a dose in excess of 6 mSv (or greater than 3 tenths of any relevant dose limit as detailed in Annex E), IRR17 requires special arrangements for dosimetry and the rapid assessment of dosimeters by an ADS. In some cases, an additional dosimeter, known as an accident dosimeter, is required. Where a Non-classified person is not required to wear a dosimeter, an appropriate alternative means of accident dose assessment must be provided. Further details of accident dosimetry requirements are given in Chapter 6.

Permit-to-work

36 In circumstances where it would be possible for a person working in a controlled area to receive a significant proportion of a dose limit, or be exposed to a significant risk of contamination, entry is to be prohibited to all persons except those who have received written permission (permit-to-work) to enter the area, signed by a person authorised to do so on behalf of the CO / HoE. The permit-to-work is to contain the following information:

a. the name of the person or persons in respect of whom it is issued;

b. the name of the person directly responsible for the work to be carried out;

c. the place to which it relates, the designation of the area, and a description of the work to be undertaken;

d. the procedure to be followed, and the precautions to be taken to ensure that the doses received by each of those persons are kept to the minimum that is reasonably practicable and do not in any event exceed the appropriate dose limits;

e. the period for which it is valid; and

f. the date of issue.

37 Note - Some establishments, such as nuclear submarine establishments, operate a

system of Radiological Control Certificates. A radiological control certificate is considered to constitute a permit-to-work, if it includes the information detailed above.

Supervised areas

38 The RPA must be consulted on the implementation of requirements as to a supervised radiation area. A supervised radiation area is to be designated whenever:

a. it is necessary to keep the conditions of the area under review to determine whether the area should be designated as a controlled area, or

b. any person in the area is likely to receive an effective whole-body dose greater than 1 mSv a year or an equivalent dose greater than one-tenth of any relevant dose limits. (Annex E).

Signage of supervised areas

39 Supervised areas may be indicated by the use of suitably worded signs (see Annex B) stating that the area is a supervised area and details of the nature of the radiation sources and the risk arising from such sources. The requirement for posting signs is to be determined by the unit or establishment in consultation with the RPA.

Temporary designated areas

40 Areas in which radioactive materials are used occasionally or radiation emission is not continuous are only required to remain as controlled or supervised areas while the potential for radiation emissions exist and access is to be restricted accordingly.

Pregnant and breastfeeding employees

41 Following notification of pregnancy, access to controlled or supervised areas for a pregnant employee must be restricted such that the radiation exposure to the foetus is limited to an equivalent dose of 1 mSv or less for the remaining term of the pregnancy (see Chapter 6). An employee who is breastfeeding is to be excluded from entry to controlled areas where there is a significant risk of bodily contamination of that employee.

Safety signs

42 Safety warning signs and prohibition notices, used to mark controlled and supervised areas, are to conform to the Health and Safety (Safety Signs and Signals) Regulations 1996. Employers may add supplementary text or cautionary notices to make the sign appropriate to their situation, including text in the appropriate language of the host nation (or locally employed civilians) if units are overseas. Units and establishments are responsible for obtaining sufficient quantities of the required signs, either from commercial sources or manufactured locally. Examples of the types of sign that may be used are shown in Annex B.

Recording of designated areas

43 All controlled and supervised areas are to be shown on establishment plans. A copy of these plans, denoting such areas, is to be contained in local orders. In addition, copies are to be posted at the entrance to controlled and supervised areas whenever practicable and are to be routinely issued to the Fire Officer or their equivalent at each unit and establishment.

Monitoring of Designated Areas

44 Employers must ensure for each designated area that levels of ionising radiation are adequately monitored using suitable instruments and that working conditions in those areas are kept under review. For areas designated on the basis of external radiation, adequate monitoring is to include measurement of dose rates (averaged over a suitable period if necessary). For areas designated on the basis of radioactive contamination, monitoring is to include measurements of air activity and surface contamination where appropriate, taking into account the physical and chemical states of the contamination. In either case, the monitoring is to be sufficient to indicate whether levels of radiation and contamination are satisfactory for continuing work with ionising radiation.

45 Monitoring programmes are to be designed to indicate any reasonably foreseeable breakdown in controls or systems and to detect significant changes in radiation or contamination levels. Monitoring is necessary both inside and outside the boundaries of controlled and supervised areas, especially at the access / egress to contamination areas.

46 Employees are to be familiar with the correct operating procedures for monitoring instrumentation and how to interpret and record the monitoring results correctly.

47 It is a statutory requirement that the RPA is consulted regarding the regular calibration of equipment provided for monitoring levels of ionising radiation and the regular checking that such equipment is serviceable and correctly used. Monitoring equipment is normally to be tested and thoroughly checked at least once every year. Further detail on radiation monitoring instruments is at Chapter 8.

48 Guidance on monitoring of designated areas is at Annex C.

Monitoring of Non-Designated Areas

49 Monitoring of non-designated areas may also be necessary. This should also be designed to indicate any reasonably foreseeable breakdown in controls or systems and to detect significant changes in radiation or contamination levels. The requirement for monitoring non-designated areas will be identified at the risk assessment stage and is to be sufficient to indicate whether levels of radiation and contamination are satisfactory for continuing work with ionising radiation.

Engineering Controls, Design Features, Safety Features and Warning Devices

50 First and foremost, in any work with ionising radiation, employers are to take action to control the doses received by their employees and other persons by engineered means. Usually, the most effective restriction of exposure will be achieved by incorporation of control mechanisms at the design and construction stage of a project. These engineering controls and design features will usually be intrinsic to the equipment or facility, for

example the construction of suitable containment and shielding for sources and the incorporation of safety features which ensure that radiation sources are accessible to no greater extent than is necessary. Safety features are intended to help ensure the safe use of the equipment in both normal and failure modes.

51 Where reasonably practicable, work involving exposure to external radiation is to be done in a room, enclosure, cabinet or purpose-built structure which is provided with adequate shielding. In other cases, local shielding is to be used as far as reasonably practicable. Design is to be such that dose rates beyond the room, enclosure or cabinet do not exceed 7.5 μSv / hr for classified persons. If Non-classified persons or members of the public can access the area beyond the room or enclosure, the dose rates are to be sufficiently low to avoid the need to designate that area as a supervised area.

52 Where an employee could receive a dose in excess of any dose limit within several minutes, interlocks or trapped key systems are to be provided to ensure an exposure:

a. cannot commence while the access door, access hatch, cover or appropriate barrier to the enclosure is open;

b. is interrupted if the access door, hatch or barrier is opened; and

c. does not recommence on the mere act of closing the access door, hatch or barrier.

53 Where there is a risk of significant exposure arising from unauthorised or malicious operation of X-ray generators or source containers, the equipment is to be fitted with locking off arrangements to prevent its uncontrolled use. Similarly, the initiation of exposures is to be under key control or by some equally effective means so as to prevent unintended or accidental emission of a radiation beam or exposure of a source.

54 Sources of ionising radiation which can give rise to significant exposure in a very short time are to be fitted with suitable warning devices which indicate the status of equipment in normal operation and alert operators to faults or failures which might reduce the safety of the installation. For X-ray generators, other than those used for diagnostic radiology, the warning devices are to be automatic and fail-safe i.e. if the device fails, the exposure will not proceed. Warning devices must be able to be seen or heard by all those people who need to know the status of the equipment for protection purposes.

55 The employer must ensure that any engineering control, design feature, safety feature or warning device is properly maintained and, where appropriate, that thorough examinations and tests of such controls, features or devices are carried out at suitable intervals. Records are to be kept, sufficient to enable the employer to identify which controls, features or devices have been examined or tested and what action is required to maintain them and when the next test or examination is due.

56 In the context of this section, it is a statutory requirement for the RPA to be consulted on the following matters:

a. the prior examination of plans for installations and the acceptance into service of new or modified sources of ionising radiation in relation to any engineering controls, design features, safety features and warning devices provided to restrict exposure to ionising radiation; and

b. the periodic examination and testing of engineering controls, design features, safety features and warning devices and regular checking of systems of work

provided to restrict exposure to ionising radiation.

Safe Systems of Work

57 Once engineered features have been applied, it is important that they are supported by systems of work to be followed by employees and other persons when present in the vicinity of radiation equipment. Safe systems of work can include those specified in local orders, work instructions, method statements, detailed procedures and, where a significant exposure could occur in a short period of time, permit to work systems. The employer must take all reasonable steps to ensure that systems of work are applied and followed - in all cases, appropriate supervision is an essential feature.

58 In the case of high dose rate sealed source equipment, systems of work are to include a monitoring check to ensure that the equipment has been restored to a safe state before access to that area is permitted.

Personal Protective Equipment (Including Respiratory Protective Equipment)

59 Once engineering controls and the application of Safe Systems of Work have been applied, employers are to provide PPE to further restrict exposure where this is reasonably practicable. PPE must be adequate to provide the protection required and suitable for both the job and person who must wear it.

60 Any PPE provided by an employer to restrict exposure must comply with all applicable provisions in the Personal Protective Equipment at Work Regulations 1992. Respiratory protective equipment (RPE) must be of a type, or conform to a standard, approved by the HSE. The employer must ensure that appropriate accommodation is provided for personal protective equipment when it is not being worn.

61 Every person entering a controlled area designated on the basis of contamination is to wear any PPE provided for their use as specified in the local rules. The employer must take all reasonable steps to ensure that it is properly used. Detailed guidance on the requirements for use and maintenance of PPE are given in Annex D.

62 RPE, whether in the form of passive respirators, air-fed respirators, air-fed hoods or blouses, air-fed suits, or self-contained breathing apparatus, is to be worn as directed in local orders or as instructed by the RPS. Guidance on the requirements for use and testing of RPE is given at Annex D.

63 X-ray protective equipment (lead aprons and / or gloves), where appropriate, is to be worn by personnel in accordance with local orders. Such equipment is to be stored and maintained as detailed at Chapter 26. This equipment is designed for the protection of workers against low-energy X-rays (such as scattered radiation from diagnostic X-ray sets and similar sources); it affords little protection from higher energy X-rays (above about 150 kV), such as from industrial radiography equipment, and is not to be used for this purpose.

64 The employer must ensure that all PPE is, where appropriate, thoroughly examined at suitable intervals and is properly maintained and, in the case of RPE, a suitable record of the examination is made and kept for at least 2 years. The record must include a statement on the condition of the equipment at the time of the examination.

Records

65 The following records and retention periods are relevant to this Chapter:

a. all investigation reports are to be kept for at least 50 years from the date on which they were made;

b. routine and special monitoring surveys for designated areas are to be kept for at least 2 years;

c. records of all inspections, examinations maintenance and testing of engineering controls and respiratory protective equipment are to be kept and retained for at least 2 years from the dates on which the examinations were made; and

d. records are to be kept of all RPE training received by personnel – these are to be kept for a period of 2 years from ceasing work with RPE.

66 These retention periods are a requirement of IRR17. At the end of the above periods, an assessment on the relevance of retaining the document should be made in conjunction with the requirements of JSP 392 Volume 1 Chapter 3 and JSP 441 Managing Information in Defence.

ANNEX A to JSP 392 Chapter 4

Contamination Control Guidance

Restriction of Entry

1 Restriction of entry to controlled and supervised areas, including the need for signs and barriers, is addressed in the main body of this chapter and at Annex B. The RPA is to be consulted on the requirements as to controlled and supervised areas.

Containment and Prevention of Spread of Contamination

2 Work liable to give rise to a radioactive vapour, spray, dust or gas is to be conducted whenever reasonably practicable in a fume cupboard, glove box, tented enclosure or other suitable containment.

3 In order to prevent the spread of contamination the following is to be adhered to:

a. equipment provided specifically for the safe handling of unsealed radioactive substances is not to be removed from the controlled contamination area;

b. all tools and equipment used in the controlled contamination area are to be clearly marked and where necessary appropriately packaged and labelled;

c. the working area is to be kept free from articles that are not required; and

d. the total activity handled or stored in a controlled or supervised area, designated on the basis of potential for spread of contamination, is to be kept to a minimum. For laboratories designated as controlled or supervised areas, an activity limit is to be set and specified in local orders.

Personal Protective Equipment

4 Every person entering a controlled or supervised area, designated on the basis of contamination, is to wear the PPE provided for their use as specified in the local orders and instructions. The requirements for use and maintenance of PPE are given in Annex D.

Rules for Employees Working in Contamination Areas

5 In any contamination area the individual is not to:

a. eat, drink, smoke or any similar activity;

b. place their mouth in contact with any piece of apparatus (e.g. pipettes);

c. use personal pocket handkerchiefs. An adequate supply of suitable paper tissues is to be provided for the use of all persons and when used they are to be treated as radioactive waste; and

d. enter having any cut or other break in their skin unless it is covered so as to prevent entry of radioactive substances.

Treatment of Cuts or Breaks in the Skin

6 When any person entering a controlled or supervised area, designated on the basis of contamination, sustains a cut or other break in the skin they are to promptly inform a suitable person who can summon a first-aider trained in the treatment of contaminated wounds to ensure that appropriate first aid treatment is given. Any such injury sustained while working with radioactive materials is to be reported to the medical department and the person affected is to be sent for treatment. Investigation, notification and reporting of such incidents is covered in Chapter 14.

Cleaning of Designated Contamination Areas

7 Working areas are to be kept clear and uncluttered to prevent the build-up of contamination and facilitate clean-up in the event of a spillage. All controlled areas and equipment therein are to be cleaned often enough to keep the levels of surface contamination to a minimum, noting the requirement to keep total radiation exposures ALARP. The cleaning techniques used should, as far as practicable, avoid the spread of contamination and prevent unsealed radioactive substances becoming airborne.

8 Any articles and materials used for cleaning in controlled areas are to be appropriately marked and are to be used only for that purpose. When not in use they are to be treated as contaminated items.

Removal of Items from Designated Contamination Areas

9 No material or equipment is to be removed from a supervised or a controlled contamination area unless it has first been appropriately monitored for radioactivity. Unless the item can be cleared (see below) it can only be moved to another area, whether or not a controlled area, in accordance with written procedures for that movement (see Chapter 10). Transport of items off site must comply with the instructions in Dangerous Goods Manual.

10 The radioactive material or equipment is to be marked to indicate that it is radioactive. MOD Form 34D (see Appendix 1) is suitable for this purpose. Locally produced forms may be used but must contain at least as much information as is on this form. It must be understood that the arrangement to move a radioactive item within a ship or establishment does not confer approval for the item to be transferred to another establishment or contractor. Items to be transferred to other establishments or contractors are to meet the requirements for transport outside an establishment as detailed in the Dangerous Goods Manual.

Clearance of Radioactively Contaminated Items

11 Situations may arise where vehicles, materiel or equipment are suspected of being contaminated with radioactive material. Where practicable, any such items are to be quarantined until they can be monitored for radioactive contamination. The levels of contamination identified will dictate whether it is appropriate to dispose of, reuse or recycle the item and whether further controls or restrictions will be required. Advice on monitoring of such items and clearance levels for unrestricted use is to be sought from the RPA.

12 The MOD has adopted a Nuclear Industry Code of Practice (COP) entitled Clearance and Exemption Principles, Processes and Practices for Use by the Nuclear Industry. The RPA is likely to base their advice on the contents of this document.

Exit of Personnel from Contamination Areas

13 Protective equipment that has been worn in controlled or supervised areas is to be monitored, removed and placed in a receptacle or space provided for that purpose. Protective equipment is to be removed in such a way as to prevent as far as possible the spread of contamination. Normally, overshoes are to be removed at a clearly defined barrier, such that the wearer's personal shoes do not touch the ground on the contaminated side of the barrier and other protective equipment removed so that, as far as practicable, the outside surfaces are not touched with the bare hand. Following removal of protective equipment, personnel are to wash in facilities specifically provided for that purpose and undergo monitoring for contamination using contamination monitoring instruments that are provided. Where a person is found to be contaminated, decontamination procedures are to be followed (see Chapter 16 Annex C) and details of any contamination are to be provided on form S 1954 (see Appendix 2 to this chapter).

14 Where PPE is contaminated, it is to be placed in a receptacle designated solely for that purpose, and the RPS is to be informed. The equipment is not to be re-used until it has been decontaminated to a level advised by the RPA.

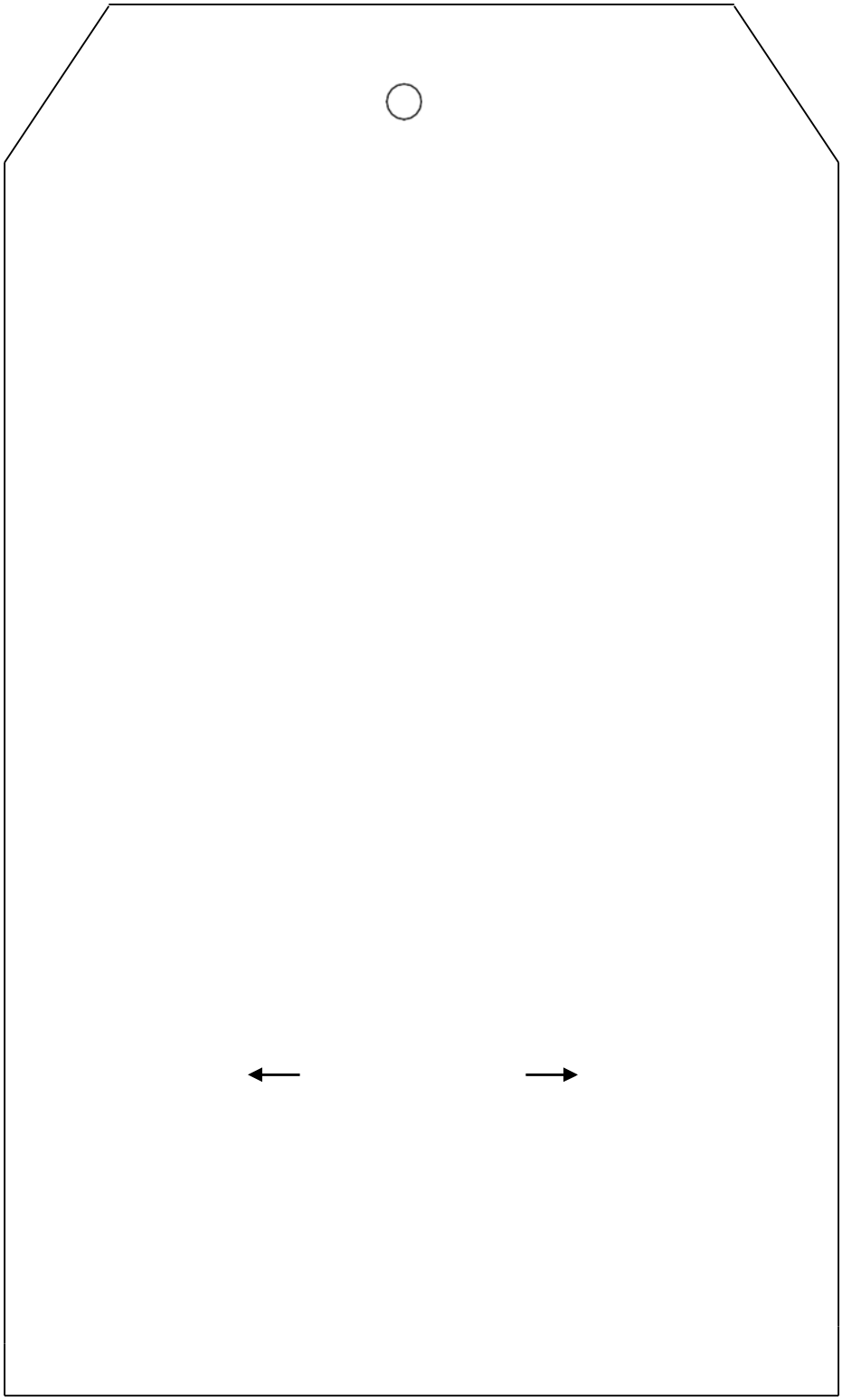
Air Sampling

15 Where there is a risk of airborne contamination, air sampling is to be carried out for the duration of the work. This is normally done using static samplers, but where high concentrations are expected in the immediate vicinity of the individual exposed personal air samplers which are designed to sample air from immediately beside the user’s face are to be used. If subsequent measurement of the filter paper activity gives a positive reading, it may be necessary to determine the associated committed dose and include it on the individual’s dose record, as advised by the RPA.

16 Air sampling should also be undertaken at the access / egress points to contamination areas to confirm there has not been a spread of contamination to areas not designated as contamination areas.

Chapter 4 Annex A - Appendix 1

MOD Form 34 D – Radioactive Transfer (Internal) Label



1 Actual size: 7in x 4 in; colour: yellow

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Chapter 4 Annex A Appendix 2

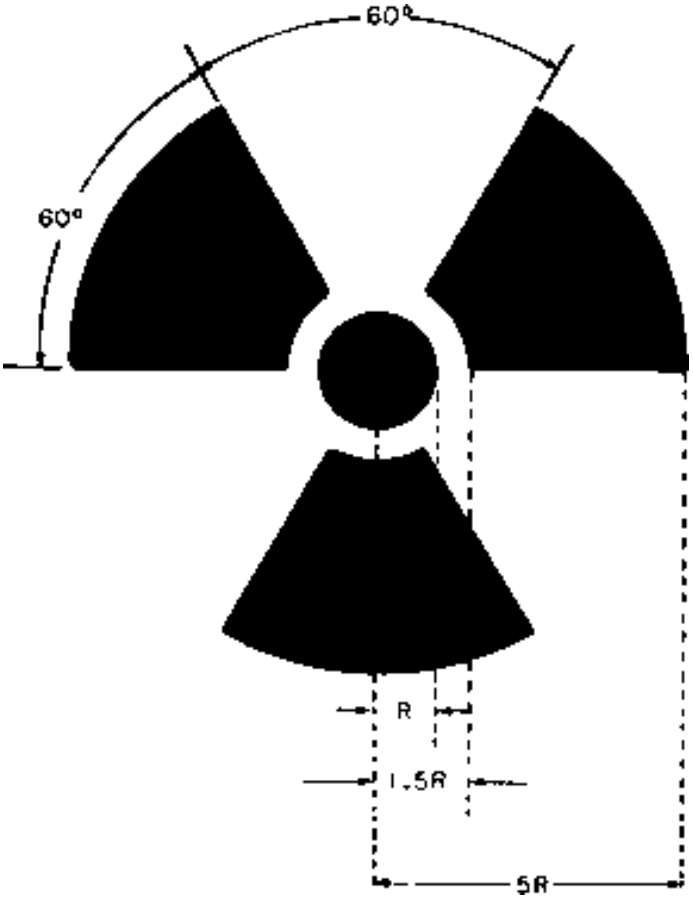
Symbol Used to Denote the Presence of Ionising Radiation

STANDARD PROPORTIONS OF TREFOIL SYMBOL

1. The areas shown in black shall be coloured and shall be placed on a yellow background (Colour No 309 of BS 381C) except in the case of Category I transport label, in which case the background shall be white. Any lettering necessary is to be in black.

2. The symbol shall be prominent on notices as is practicable and of a size proportionate with the size of the equipment or material to which it is affixed or attached, provided that the standard proportions are maintained and that the symbol can be seen from a safe distance.

3. The basic symbol shall be accompanied by additional symbols or words where necessary to particularise the danger.



S. 1954
(Revised 6/83)

Ship or establishment ……..

PERSONAL CONTAMINATION REPORT

To: The Medical Officer …… Date ……..
……..……
Copy to: ……..
……

Name and Initials	Service/Yard Number	Rank/rating/Grade	Department

1 Contamination Report by Monitor at (time)using (instrument)

Parts of body									
Levels in cps	α								
	βγ								

Cause of contamination ……..
……

2 Action taken to remove Contamination

Method	α *or* β, γ	Contamination levels (c.p.s.) after decontamination (time)								
		Parts of body								

Result sent to SURGERY/DECONTAMINATION CENTRE

Signature ……..

3 To be completed at Surgery/Decontamination Centre

Particulars of action taken by or recommendations of the responsible officer at the Surgery/Decontamination Centre	
RECHECK	The above named was re-monitored and found CLEAR/CONTAMINATED Date …….. Time …..... Signature …….. and rank
If person is found contaminated or recheck, give details	
FINAL CLEARANCE	The above named was re-monitored and found Date …….. Time ….. Signature …….. and rank

Chapter 4 Annex A Appendix 3 Personal Contamination Report

4. DEPARTMENT INVESTIGATION

Signature ……

Grade ……

Date ……

5. COMMENTS BY HEALTH PHYSICS DEPARTMENT

Date …….. ……
Health Physicist

040273 Rep S(PP)I (Y)

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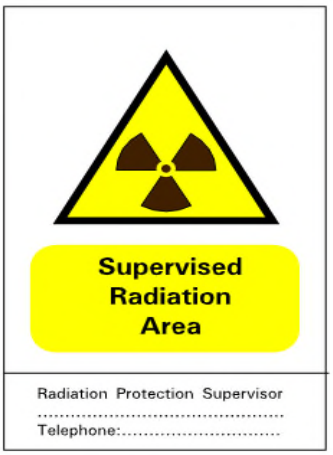
Annex B to JSP 392

Radiological Safety Warning Signs and Labels




Radiation Protection Supervisor
.....
Telephone:.....

Warning Signs and Labels

1 Radiation warning sign templates that can be adapted to local requirements are available from your Dstl RPA.

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Annex C JSP 392: Chapter 4

Monitoring of Designated and Non-Designated Areas

Responsibility for Monitoring Areas

1 The responsibility for monitoring rests with the employer in control of that area.

Purpose of Monitoring

2 The main purposes of monitoring are to:

a. check that areas have been (and remain) correctly designated where applicable;

b. help determine radiation levels and contamination from particular operations, so that appropriate control measures for restricting exposure can be proposed;

c. detect breakdowns in controls or systems, so as to indicate whether conditions are satisfactory for continuing work in that area; and

d. provide information on which to base estimates of personal dose for non-classified persons, outside workers and classified persons for whom a dose assessment could not be made by the Approved Dosimetry Service.

Adequate Monitoring

3 In order to establish whether adequate monitoring is being achieved, the following need to be considered:

a. what kinds of measurements are to be made (e.g. dose rates, surface or air contamination);

b. the nature of the radiation and the physical / chemical state of likely contamination;

c. where the measurements are to be made;

d. how frequently and on what occasions the monitoring is to be carried out, including measurements to be made as part of contingency arrangements;

e. method of measurement e.g. direct measurement with an instrument, collection of air samples, smear or wipe samples and what type of instrument to be used;

f. who should carry out the measurements and what training they need;

g. how to ensure that the equipment continues to work correctly;

h. what records are to be kept;

i. how to interpret and review the results;

j. the selection of action levels and what to do if they are exceeded; and

k. when the monitoring procedures must be reviewed.

Role of the RPA

4 The employer must consult the RPA about the implementation of requirements for controlled areas and supervised areas. These requirements include:

a. the type and extent of the monitoring programme;

b. the selection and suitability of instruments to be used for monitoring; and

c. the regular calibration and checking of monitoring equipment to ensure it is serviceable and correctly used.

Monitoring Record

5 Suitable monitoring records are to include the date, time and place of monitoring and confirm that, where applicable, controlled and supervised areas are correctly designated and show where levels are being approached which may require investigatory or remedial action to be taken. The results are to indicate the nature of the radiation or contamination being monitored. The monitoring records of the designated area shall be kept for at least 2 years from the date on which they were made. A summary of the information that should be included in a monitoring report is given below:

a. details of locations where measurements are taken;

b. the type of radiation or contamination detected, as appropriate;

c. the dose rate or contamination levels measured, as appropriate. These could be indicated on a diagram of the area;

d. the name and designation of the person actually undertaking the survey, together with the name and designation of the officer responsible for ensuring the proper conduct of the survey;

e. date and time of the survey;

f. details (type and serial number) of the instrument(s) used;

g. details of any significant unusual conditions observed during routine monitoring;

h. any action level and action required, following discussion with the appointed RPA; and

i. any other appropriate information.

Annex D to JSP 392: Chapter 4

Guidance on Personal Protective Equipment (Including Respiratory Protective Equipment)

Introduction

1 Where appropriate, personal protective equipment (PPE) (including respiratory protective equipment (RPE)) is to be provided to reduce the radiation exposure of personnel. PPE is to be regarded as supplementary to, and not as a substitute for, other measures for the control of sources of ionising radiation.

2 The different forms of PPE used by radiation workers are:

a. clothing and other items for personal protection against contamination;

b. RPE for protection against airborne particulate or gaseous radioactive materials; and

c. X-ray PPE (medical, dental and veterinary) – guidance on this type of PPE is not covered in this chapter (see Chapter 26).

3 PPE for use against external sources of energetic gamma radiation such as from Cobalt-60, is not practicable. Advice is to be sought from the RPA for protection from such sources.

Personal Protective Equipment for Controlled Areas Designated on the Basis of Contamination

4 Personnel entering such a controlled area are to wear the PPE specified in the local orders and provided for use. When leaving the controlled area, the equipment is to be monitored, removed and placed in a suitable location as detailed in the local orders. Any person finding PPE in poor repair is to inform the RPS.

5 Items of PPE worn in such areas is to be treated as potentially contaminated and is to be retained in an area separate from those in which personal clothing and other uncontaminated items are deposited.

6 The type of provision of PPE is to be agreed with the RPA. PPE must be sufficient to provide protection during normal operations and against any reasonably foreseeable accident within the controlled area. The normal type of PPE for controlled contamination areas would be an overall or laboratory coat, gloves, such as surgical gloves, cap and protective footwear or overshoes.

7 All PPE is to be clearly distinguishable from normal work clothing. Units and establishments having small numbers of regular wearers may mark the PPE to identify it

as belonging to named individuals.

8 All PPE is to be inspected and tested for damage at intervals specified in the local orders. PPE is to be replaced at appropriate intervals or is to be washed in segregated laundries designated for contaminated protective clothing only; in this instance consideration must be given to the need to dispose of the liquid generated by the laundry as radioactive waste.

9 PPE with contamination exceeding levels specified in local orders (as advised by the RPA), where the contamination cannot be removed by washing, is to be withdrawn from use and disposed of as radioactive waste as described in Chapter 12.

Respiratory Protective Equipment

10 Suitable RPE is to be provided where advised by the RPA or where, during normal or abnormal conditions, a significant airborne hazard exists.

11 For some work involving radioactive materials in low concentrations, such as thorium alloys or thoriated tungsten welding electrodes, RPE provided against the non-radiation hazard may provide adequate protection against the radiation hazard. Advice is to be sought from the RPA on the most suitable RPE for the radiation hazard.

12 An adequate assessment of the degree of respiratory protection required is to be made before any attempt is made to select the type of RPE to be used. For RPE in regular use, a full assessment is to be made prior to first use and thereafter reviewed regularly dependent upon the hazard. In selecting RPE the following factors are to be taken into account:

a. nature of the hazard (particulate, vapour or gas);

b. protection factor required;

c. ergonomic factors (reduced mobility, increased resistance to breathing, reduced field of vision, high air temperatures and high relative humidities);

d. when considering the need for wearing respiratory protection, the dose rate in the area is to be taken into consideration as wearing respiratory protection may impede work and result in a higher external radiation dose for a small saving in internal dose;

e. duration of wear;

f. potential for damage of RPE;

g. for respirators, closeness of fit to provide a good seal;

h. compatibility of use with other safety equipment that may need to be worn;

i. adequacy of facilities to maintain RPE; and

j. dangers from falling or tripping, particularly from heights.

13 It is a requirement to comply with relevant legislative requirements if RPE is provided for use against ionising radiations. This requires the equipment to be adequate and suitable. The term adequate refers to the ability of the equipment to protect the wearer. The term suitable refers to the correct matching of the equipment to the job and person. To select equipment, which is adequate and suitable, an assessment is to be carried out

and recorded. Advice on undertaking such an assessment is to be sought from the RPA.

14 Adequate training for the wearer of the RPE and their supervisor is described below. Refresher training is to be provided at no greater than an interval of 6 months for all wearers of RPE.

15 RPE intended for daily use is to be thoroughly examined before being brought into use to ensure that it is in good condition. After the initial examination the RPE can be used without re-examination for periods of up to one month. A system for regular inspection is to be set up and respirators are to be marked accordingly. In addition to the initial examination the user is to carry out a daily examination of the equipment prior to use.

16 RPE intended for routine but not daily use is to be kept in sealed packs and can be used for up to a year from the previous examination. It is however subject to the following requirements:

a. it is properly stored *(*see paragraph 21-22);

b. it is checked before use to verify that the pack has remained sealed and no deterioration has taken place; and

c. arrangements are made to withdraw it for examination within one month of its being brought into use.

17 For respirators kept in sealed packs it should be sufficient to see by examination of a representative sample that no obvious deterioration has taken place since last used, provided that a quality control check is carried out at least annually.

18 Worn and defective components are only to be replaced using spare parts supplied specifically for the RPE under repair. Simple replacement of the filter, cartridges and batteries can be made by the RPE wearer after suitable instruction.

19 After use the RPE is to be monitored for radioactive contamination. Equipment is to be decontaminated to a level that is as low as reasonably practicable. Where equipment cannot be fully decontaminated, the RPA is to be consulted on its retention or disposal.

20 RPE is to be cleaned and disinfected after each use. Disinfectants which adversely affect the RPE are not to be used. Advice on suitable disinfectants can be obtained from the manufacturer. Such disinfectants must be thoroughly rinsed from masks before they are used.

21 Stores holding RPE are to be designed to protect against dust, excessive moisture, heat (above 60°C), cold, UV light (including sunlight) or corrosive substances; and be kept secure from unauthorised personnel. In such stores, ready for use equipment is to be clearly segregated.

22 RPE not held in a designated store is also to be protected against the above deleterious effects.

23 A maintenance programme is to be drawn up for each type of RPE used. For positive pressure respiratory protective equipment, the examination is to include a check on the condition of the air supply. The maintenance programme and the frequency of the maintenance are to be based upon information supplied by the manufacturer and included in local orders.

24 RPE is to be replaced at intervals specified by the manufacturer, unless testing has

shown that the RPE continues to provide adequate protection for extended periods. Spare parts are to be clearly identified and labelled with the date beyond which they are not to be used.

25 Repairs are only to be carried out by adequately trained personnel. Personnel undertaking this work are to have received training on the maintenance and repair of the equipment by attending a training course appropriate to the equipment. Local training may be provided by personnel who have previously attended such a course or other appropriate training. Records are to be kept of all RPE training received by personnel. Details of this training are to be kept for a period of 2 years from ceasing work with RPE.

26 Records of all inspections, examinations maintenance and testing of respiratory protective equipment are to be kept and retained for 2 years from the dates on which the examinations were made. The record of examination is to contain the following or equivalent:

a. name of the establishment;

b. description of the respiratory protective equipment;

c. distinguishing number;

d. description of the examination carried out;

e. result of the examination;

f. details of any contamination;

g. statement on the condition of the RPE at the time of the examination;

h. name and rank or description of the person making the examination;

i. date of the examination; and

j. signature of the person examining the equipment.

27 Regular reviews are to be undertaken to ensure that use of the RPE is the most suitable means of control and the best RPE is being used. Regular audits are to be carried out to ensure that:

a. personnel are adequately trained;

b. RPE is being inspected, cleaned, maintained and tested at appropriate intervals; and

c. the record keeping system is operating satisfactorily.

28 Incidents involving failure or potential failure of the RPE are to be investigated and information gained from such investigations is to be used to further improve the effectiveness of the RPE. Such incidents are to be reported, where necessary, in accordance with the requirements in Chapter 14.

Use of General Service Respirators

29 General Service Respirators (GSR) are primarily intended for operational use rather than for use in routine work with radioactive materials and, as such, are not subject to a

formal approval by the HSE. However, they may be used in some circumstances e.g. trials of operational equipment. RPA advice is always to be sought regarding the use of the GSR for routine work with radioactive materials. Similarly, respirators connected to emergency breathing systems are intended for use in emergencies and should not normally be used for routine work.

Training for the Supervisor and Wearer of Respiratory Protective Equipment (RPE)

30 The following is the recommended training for persons wearing RPE and for persons supervising its use:

a. details of the hazard presented by the radionuclide;

b. explanation why RPE is needed for control;

c. criteria for type of RPE selected;

d. capabilities and limitations of the RPE;

e. arrangements for the use, maintenance and storage of the equipment and associated written procedures;

f. conditions that are likely to be encountered when wearing RPE;

g. behaviour required during use of the RPE;

h. emergency situations and remedial actions to be taken;

i. practice in putting on, wearing and removing the RPE;

j. checking the face fit of equipment which has a face piece, including the requirement for a fit test appropriate to the RPE;

k. practice in cleaning and inspecting equipment;

l. practice in replacement of parts requiring regular replacement during normal use (filters); and

m. instruction on the safe storage of the RPE.

Annex E JSP 392: Chapter 4

Annual Dose Limits

Table 1 Annual dose limits (in milliSieverts (mSv)

Part of body	Employees (18 years of age or over)	Trainees aged 16-18	Any other person
Whole body (effective dose)	20†	6	1*
Skin (equivalent dose)**	500	150	50
Hands, forearms, feet and ankles (equivalent dose)	500	150	50
Lens of the eye (equivalent dose)	20	15	15

NOTES

(1) †Employees (aged 18 years or over) are to be designated as classified persons (see Chapter 6) if they are likely to receive an effective dose in excess of 6 mSv or an equivalent dose in excess of three-tenths of the relevant dose limits in the table above. In practice, this means that only classified persons should be likely to receive doses approaching the dose limits

(2) *The dose limit for any person (not being a comforter or carer) who may be exposed to ionising radiation resulting from the medical exposure of another is limited to 5 mSv in any 5 consecutive calendar years.

(3) **The equivalent dose limit for skin is applied to the average dose over any area of 1 cm^2, regardless of the area exposed.

Dose limitation for overexposed employees

1 The dose limitation for the remainder of a calendar year for an employee who has been overexposed in that year and has not been withdrawn from radiation work by the recommendation of the appointed doctor, is the proportion of the calendar year remaining from the end of the dose assessment period multiplied by the appropriate annual dose limit.