

UK Recovery Handbook for Radiation Incidents 2008

Version 2

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ABSTRACT

In 2005, HPA published the UK Recovery Handbook for Radiation Incidents. The Handbook is designed to assist decision makers in the management of contaminated food production systems, drinking water and inhabited areas following an incident in which radioactive material is dispersed into the environment. It contains a compilation of reliable, consistent and comprehensive information to help users identify the important issues at stake and to evaluate timely and effective management options. Version 2 of the Handbook provides a major update to the guidance on the management of food production systems. In addition to supporting scientific information, it includes checklists for planning in advance of an incident, datasheets, advice on how to select and combine management options and a worked example. Sections dealing with radiation protection principles, drinking water and inhabited areas remain unchanged in version 2. A full update of the Handbook, version 3, will be available in hard copy, CD and PDF formats in spring 2009.

This file (2 of 8) contains the introduction section of the Handbook.

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UK RECOVERY HANDBOOK FOR RADIATION INCIDENTS: RECOVERY AND RADIATION PROTECTION

S Mobbs

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1 OVERVIEW

The aim of this section (Yellow) is to introduce the purpose and scope of the Handbook, to provide details of the nuclides and types of incidents considered and to provide an introduction to Recovery and Radiation Protection. Finally, guidance is given on how to use this Handbook.

2 THE RECOVERY PHASE

This Handbook is intended to guide decision-makers through the available recovery options following an incident dispersing radioactive material in the environment. This Handbook has been developed for use in the UK.

Following an incident there will be an initial emergency phase where urgent measures are required to protect individuals from short-term, relatively high risks, for example sheltering or evacuation from an area. This is followed by the recovery phase. Although there are no exact boundaries between the two phases, the recovery phase starts after the initial threat has been contained (there is no threat of further release) and continues until all those affected have resumed 'normal lifestyles'. Although this Handbook relates to the recovery phase, not the emergency phase, it may also be used in the emergency phase to provide useful information and advice. It should be noted that decisions made in the emergency phase may have implications for the options available in the recovery phase.

The main focus of the Handbook is to give guidance that is relevant for an accidental release from a nuclear site or weapons' transport accident. However, many recovery options will also be relevant to other radiation incidents e.g., a malicious release, even though the pattern of contamination would be different. However, it should be remembered that the relevance of the guidance may be limited for these other types of radiation incidents.

The main purpose of this Handbook is to provide generic information to aid prompt decision-making in the first few months after the incident occurs. On longer timescales it is likely that information specific to the particular incident would be gathered and used to refine the information provided here. This information would include the actual effectiveness and other consequences of the countermeasures observed for the specific situation. However it is envisaged that the Handbook would still act as a useful information source.

Identification of the optimum strategy cannot be achieved by considering technical and radiological protection issues alone, and other factors such as the acceptance by the affected community, social and legislative issues, etc, must also be considered. Where information was available public acceptability has been taken into account, e.g., for stakeholders consulted in the discussions about food production recovery options.

3 AUDIENCE AND OBJECTIVES

The audience of the Recovery Handbook for radiation incidents is expected to be primarily those organisations likely to be represented on the Recovery Working Group (RWG). A RWG will be convened as soon as it becomes clear that off-site contamination due to an accident is going to occur. This Group's responsibilities will include: the characterisation of the extent and nature of off-site contamination from the accident; identifying options and strategies for clean-up of contamination and disposal of wastes taking due account of the principles of justification and optimisation for intervention; identifying priorities, timescales and costs for the options being considered; proposing options for consideration by the Co-ordinating Committee and preparing plans for their implementation; advising on and assessing recovery monitoring so as to ensure that objectives and targets have been achieved; and maintaining records of recovery actions and providing briefings and information as necessary.

The RWG is a multi-agency group that consists of representatives of both local and central Government bodies; it would normally be chaired by the local authority but may be delegated to the Environment Agency (EA). Local organisations represented would probably include County, District and Unitary Councils, the police force and fire brigade, water companies and health authorities. Representation from national bodies may include the Health Protection Agency (HPA), EA or the Scottish Environment Protection Agency (SEPA), as appropriate, Food Standards Agency (FSA), Health and Safety Executive (HSE), Department of Environment, Food and Rural Affairs (Defra), Scottish Executive Environment and Rural Affairs Department (SEERAD), Department of Agriculture and Rural Development for Northern Ireland (DARD), Ministry of Defence (MOD) and the Drinking Water Inspectorate (DWI). For incidents affecting food production systems and agricultural land the Agriculture and Food Countermeasures Working Group (AFCWG) is expected to provide additional guidance to the RWG. The AFCWG is made up of non-Government and Government organisations including, for example, FSA, EA, representatives of the food industry, British Retail Consortium and the National Farmers Union. These and other stakeholders who could influence any strategic decisions on recovery should also be considered as potential audiences for the Handbook.

There are two main uses for the Handbook. Firstly, to assist organisations that would be part of the RWG in planning how they would respond to an incident involving the dispersion of radioactive material into the environment. Secondly, to aid the RWG make early decisions on planning recovery in the event of an incident.

The Recovery Handbook does not attempt to cover all the issues that could be of concern. In particular it does not address: pre-planning for radiological and nuclear incidents including pre-drafted press releases and standard answers; lists/details of contacts, contractors etc; responsibilities of organisations in the event of an incident; a communication strategy; example scenarios and examples of how to use the Handbook for different scenarios; links between response at different levels e.g. local, regional etc and between RWG, Steering Group, JHAG etc; or the wider socio-economic issues of blight, compensation, recovery of business, personal and private losses.

4 FRAMEWORK FOR DEVELOPING A RECOVERY STRATEGY

After an accident or incident involving radioactive contamination, there are two important aspects: protection of health and preservation of the quality of foodstuffs. However, the spread of contamination creates a complex situation because it affects health, agriculture, economics and involves nearly all sectors of the population.

International experience, especially in those countries affected by the Chernobyl accident, has demonstrated that the long term management and rehabilitation of contaminated territories is not a narrow radiological issue that can be dealt with largely or solely by technical means. Rather it is a broader issue of governance which must address all affected dimensions e.g. health, environmental, economic, social, cultural, ethical, political etc. The need to develop policy and broadly applicable arrangements for the long term management and rehabilitation of potentially contaminated areas is now broadly recognised.

Thus, what is needed is a coherent framework for the sustainable rehabilitation of living conditions in areas with long term contamination. This framework should provide a way of integrating and coordinating an approach involving all stakeholders and dimensions. This involves direct involvement of the public and local professionals.

In order to develop a recovery strategy, decision makers will need to follow the broad steps outlined in [Figure 1](#). Throughout this process, they will require a significant amount of information to support decisions on timely and effective actions and countermeasures. The Recovery Handbook is a compilation of reliable, consistent and comprehensive information to help users identify the important issues and evaluate the options. It is therefore particularly useful for steps 4, 7 and 8, but the Handbook is also intended to provide input for other steps.

Once the Handbook has been used to investigate options, the user may find it useful to compile a summary table, see for example [Table 1](#), to record the evaluation of options (step 8).

For agricultural and domestic food production and drinking water the central tenet is to reduce doses from ingestion pathways. For inhabited areas the central tenet is to reduce doses from external exposure and resuspension of contaminated material. In all cases, the eventual aim is the return to 'normal lifestyles', including the return of affected land to useful production.

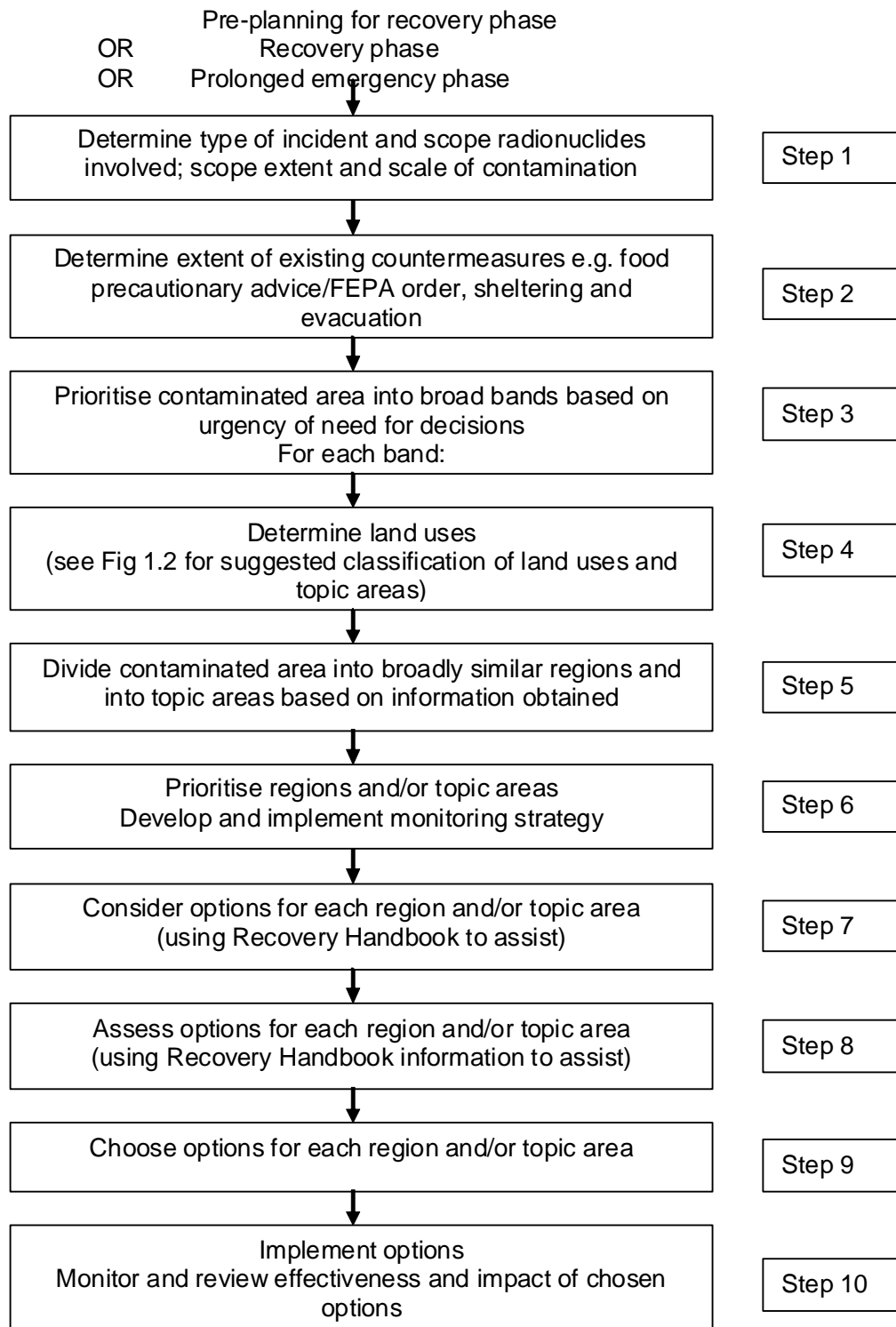


Figure 1: Broad steps in the development of a recovery strategy

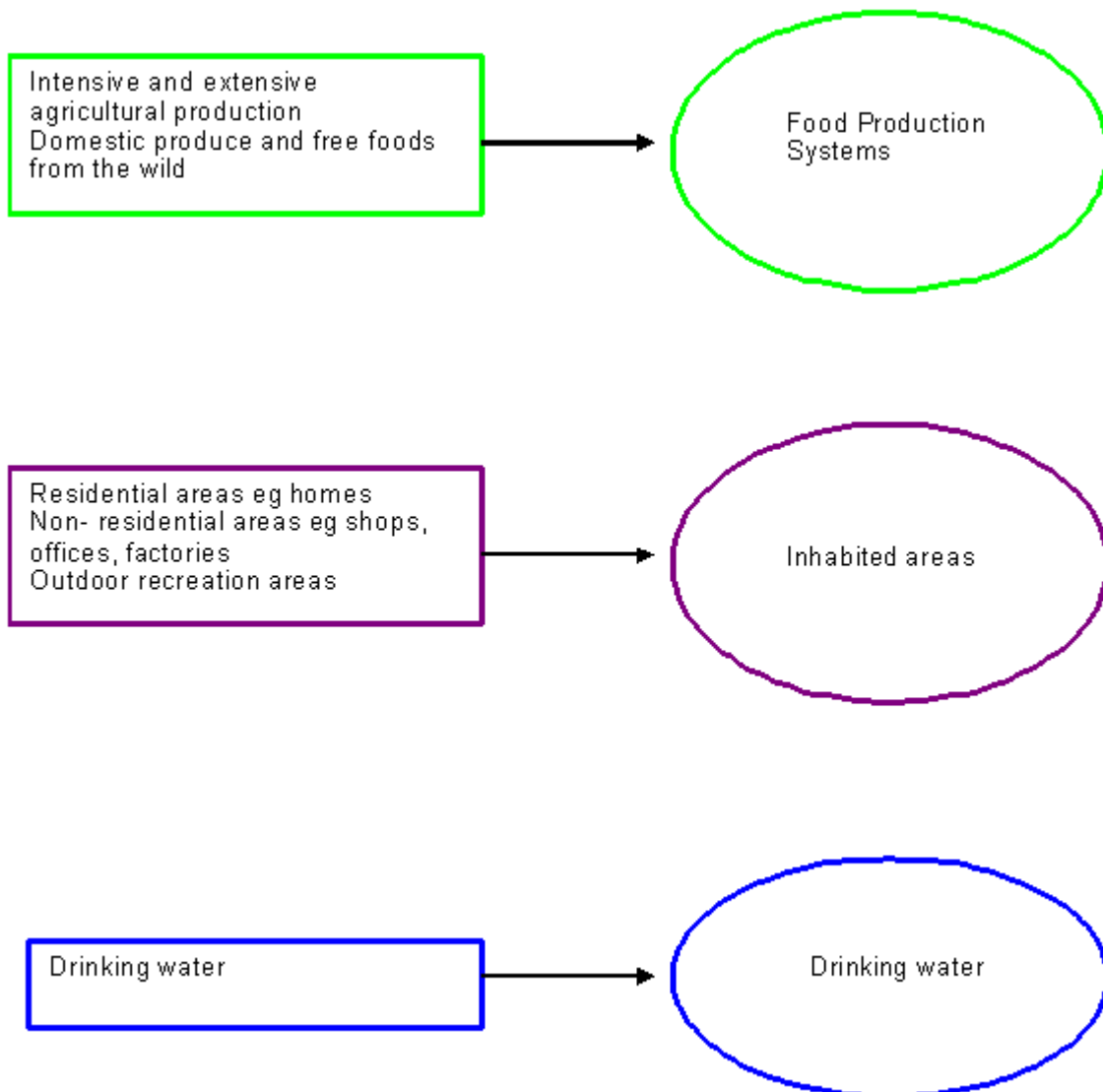


Figure 2: Suggested categories of land use and topics, and the corresponding sections of the Recovery Handbook

Table 1: Illustrative template for presenting information on recovery options

A: FRAMEWORK FOR DEVELOPING RECOVERY OPTIONS

OVERALL ADVANTAGES AND DISADVANTAGES OF PROPOSED RECOVERY PROGRAMME (showing example categories)

Advantages	Disadvantages
<i>Improved public perception</i>	<i>Recovery workers receive dose</i>
<i>Return to "normality" – however defined</i>	<i>Waste generation and associated issues of volumes, activities, transport, storage, disposal</i>
<i>Public reassurance</i>	<i>Societal disruption</i>
<i>Public dose savings</i>	<i>Environmental damage</i>
<i>Consideration of and protection for wildlife</i>	<i>Loss of earnings/livelihood</i>
<i>Limiting damage to people's livelihood</i>	<i>Monetary costs/claims for compensation</i>
	<i>Flexibility to apply subsequent recovery options may be reduced</i>

Notes and assumptions:

Describe factors such as different land use areas considered, description of potential options for each area considered, basic assumptions made regarding population habits etc, underlying guidance/advice used as a basis for options, priorities for recovery in different areas, justification for choice/decision, legal implications etc.

List general caveats e.g. No options should be chosen without associated monitoring to ascertain their effectiveness in removing contamination i.e. in-situ trials; All values are approximate and should only be used for scoping studies and comparisons between options.

B: POSSIBLE RECOVERY OPTIONS FOR FURTHER CONSIDERATION

AREA: A

LAND USE: E.g., Residential

Notes: Describe assumptions made – how area is defined, tools used etc

Criteria (NB Can be tailored as required)	Option 1	Option 2	Option 3
Effectiveness (approx amount of contamination removed)			
Approx dose reduction (external + resuspension, ingestion)			
Waste generation			
Resources			
Cost			
Doses to workers implementing options			
Other advantages			
Other disadvantages			
Time scale for implementation			
Justification for choice of option			
Legal implications			

Reproduce table for each area considered and for more options, as required

5 TYPES OF INCIDENT

Several types of incident can be identified, by which there is potential for radioactive contamination to be released into inhabited areas, agricultural areas or into drinking water supplies. As identified in [Section 2](#), the primary application of this Handbook is for accidental releases from a nuclear site or weapons' transport accident. However, many recovery options will also be relevant to other radiation incidents. Nevertheless, it should be remembered that the relevance of the guidance may be limited for these other types of radiation incidents. [Table 2](#) summarises the main types of incidents for which the guidance provided in the Handbook would be appropriate.

Table 2: Description of types of incident involving a release of radionuclides for which the Handbook is appropriate

Type of incident	Description
Accident at nuclear site	The processes within a nuclear reactor create many different radionuclides, with different decay emissions and a wide range of half-lives. Many of these could be released to the atmosphere in the event of an accident at a reactor, which would contaminate the environment around the site. The level of contamination would reduce with distance, but could be detected over very large areas. The accident could contaminate inhabited and agricultural areas, and could lead to contamination of water bodies. Although the most likely incident would not be a large release, it could cause widespread contamination.
Transport of nuclear weapons	This would lead to contamination of the environment with the material from which the weapon is constructed, which is likely to be highly enriched uranium or plutonium, together with small quantities of other actinides. There could be blast or fire damage in the immediate vicinity of the accident.

6 RADIONUCLIDES

There is a wide range of radionuclides that could be released in the types of incident listed above. This Handbook considers a total of 29 radionuclides, chosen on the basis of their radiological importance and relevance. The radionuclides considered and some basic properties are given in [Table 3](#). Some of these radionuclides decay into daughter radionuclides that are themselves radioactive. Unless indicated otherwise, the hazards from these daughter radionuclides are included in the values given for the parent. These included radioactive daughter radionuclides are listed in [Table 4](#).

Table 3: Radionuclides considered in the Handbook

Radionuclide ^a	Primary Hazard ^b	Half-life ^c	
⁶⁰ Co	Cobalt	Gamma	5.27y
⁷⁵ Se	Selenium	Gamma	119.8d
⁸⁹ Sr	Strontium	Beta	50.5 d
⁹⁰ Sr+ ⁹⁰ Y	Strontium/ Yttrium	Beta	29.12y/64h
⁹⁵ Zr	Zirconium	Gamma	63.98d
⁹⁵ Nb	Niobium	Gamma	35.15d
⁹⁹ Mo+ ^{99m} Tc	Molybdenum/ Technetium	Beta (Skin)	66h/6.02h
¹⁰³ Ru	Ruthenium	Gamma	39.28d
¹⁰⁶ Ru	Ruthenium	Beta (Skin)	368.2d
^{110m} Ag	Silver	Gamma	249.9 d
¹²⁵ Sb	Antimony	Gamma	2.77 y
¹²⁷ Sb	Antimony	Gamma	3.85 d
¹³¹ I	Iodine	Gamma	8.04d
¹³² Te	Tellurium	Gamma	78.2h
¹³⁴ Cs	Caesium	Gamma	2.062y
¹³⁶ Cs	Caesium	Gamma	13.1d
¹³⁷ Cs	Caesium	Gamma	30y
¹⁴⁰ Ba	Barium	Gamma	12.74d
¹⁴⁰ La	Lanthanum	Gamma	40.272h
¹⁴¹ Ce	Cerium	Beta	32.501 d
¹⁴⁴ Ce	Cerium	Beta (Skin)	284.3d
¹⁶⁹ Yb	Ytterbium	Gamma	32.01d
¹⁹² Ir	Iridium	Gamma	74.02d
²²⁶ Ra+	Radium	Alpha, gamma	1600y (²²⁶ Ra)
²³⁵ U+	Uranium	Alpha ^d	7.038 10 ⁸ (²³⁵ U)
²³⁸ Pu	Plutonium	Alpha ^d	87.74 y
²³⁹ Pu	Plutonium	Alpha ^d	2.41 10 ⁴ y
²⁴¹ Am	Americium	Alpha, gamma	432.2y
²⁵² Cf	Californium	Alpha, gamma	2.638 y

Notes:

a All daughters are taken into account, see [Table 4](#).

b Primary hazard when released into the environment. This may be different for foodstuffs and drinking water where external gamma hazard is not significant. See [Section 7.3](#) for explanation of alpha, beta, and gamma.

c Half-life: h = hours, d = days, y = years

d Additional minor contribution to exposure from gamma emissions. Can be ignored compared to internal pathway.

Table 4: Radioactive daughters included with the parent radionuclide

Parent radionuclide	Daughter(s) included
$^{90}\text{Sr}+^{90}\text{Y}$	^{90}Y
^{95}Zr	$^{95\text{m}}\text{Nb}$, ^{95}Nb
$^{99}\text{Mo}+^{99\text{m}}\text{Tc}$	$^{99\text{m}}\text{Tc}$, ^{99}Tc
^{103}Ru	$^{103\text{m}}\text{Rh}$
^{106}Ru	^{106}Rh
^{132}Te	^{132}I
^{131}I	$^{131\text{m}}\text{Xe}$
^{137}Cs	$^{137\text{m}}\text{Ba}$
^{140}Ba	^{140}La
^{144}Ce	^{144}Pr
$^{226}\text{Ra}+$	^{214}Pb , ^{214}Bi , ^{214}Po , ^{210}Pb , ^{210}Bi , ^{210}Po
$^{235}\text{U}+$	^{231}Th

7 RADIATION PROTECTION PRINCIPLES

Radiation protection criteria relevant to the different topic areas are dealt with in the corresponding sections, e.g. radiological criteria for agricultural food production are addressed in the agricultural food production section ([Food Production Systems, Section 1.9](#)). This section addresses general radiological protection principles.

7.1 Radiation protection principles and criteria

The International Commission on Radiological Protection (ICRP) is the primary international body for recommending radiological protection standards. Radiological protection legislation in most Western countries is based on ICRP recommendations. Its latest recommendations for an overall system of protection were issued in 1990 as ICRP Publication 60 (ICRP, 1991a). A consultative draft of proposed new recommendations was posted on the ICRP website in June 2004 and the comments received on this draft are also posted on the ICRP website. The timescale for publication of new formal recommendations is not yet clear.

HPA, Radiation Protection Division (HPA-RPD) (formerly known as the National Radiological Protection Board (NRPB)) has a statutory duty in the UK for providing advice on radiation protection and on the application of ICRP recommendations. HPA-RPD's advice is published in its *Documents* series. In particular, its response to ICRP's 1990 recommendations is published in *Docs 4 (1)* (NRPB, 1993a) and *Docs 4 (2)* (NRPB, 1993b). HPA-RPD's advice on intervention for the protection of the public in the event of an accidental release, relevant to recovery phase countermeasures is published in (NRPB, 1990; NRPB, 1994; NRPB, 1997).

7.2 Health effects

The health effects occurring as a result of exposure to radiation can be considered in two categories: stochastic and deterministic, see [Table 5](#). For exposures of up to a few hundred milliSieverts, it is the increased risk of incurring stochastic health effects that is of most concern.

Table 5: Health effects of radiation

Health effect	Characteristics
Stochastic	Relatively low exposures, an increased risk of incurring health effects in later life (e.g., cancer) or in subsequent generations. No threshold level assumed. Also assumed that the increase in risk of incurring these health effects is linearly related to the size of the exposure. This means that there is no threshold exposure below which the increased risk can be assumed to be zero.
Deterministic	Higher exposures, direct injuries (including death). Each type of deterministic injury has an associated threshold level. Following exposure above the threshold level, and in the absence of substantial medical intervention, the deterministic injury will occur. Below this threshold level it will not occur. These threshold levels vary, to some extent, between individuals and circumstances.

7.3 Types of radiation hazard

Radionuclides can differ markedly in the way in which they decay, in their behaviour in the body and in the environment and in their radioactive half-life. Consequently, the relative importance of different routes of exposure to radioactivity is also dependent on the radionuclide of interest. Exposure can occur via external irradiation, when the radionuclide is outside the body, or via internal irradiation, for which ingestion and inhalation are usually the processes of importance. Radioactive emissions can be divided into three types: alpha, beta and gamma. Each type has different properties, leading to different hazards. The most important property of radioactive emissions, with respect to the exposure of people, is their ability to penetrate matter both between the person and the source and also within the body.

7.3.1 Alpha particles

Alpha particles are easily absorbed and can generally be absorbed by a sheet of paper or by several centimetres of air. They can scarcely penetrate the dead, outer layer of human skin and are, therefore, not hazardous unless taken into the body through breathing or eating or through a skin wound.

7.3.2 Beta particles

Beta particles are more penetrating than alpha particles and can have a range of up to several metres in air. They can penetrate the outer layers of skin and may penetrate a centimetre or so of tissue, depending on their energy. Radionuclides that emit beta particles are therefore hazardous to superficial tissues of the body but generally not to internal organs unless they are taken into the body (e.g., through inhalation or

ingestion). In general, beta particles can be absorbed by up to a few metres in air (depending on their energy) or by a thin layer of plastic or glass. Further details on beta particles and shielding are given in [Purple section](#).

7.3.3 Gamma rays

Gamma rays are the most penetrating form of radiation. They can pass through the body, so radionuclides that emit them may be hazardous whether on the outside or inside of the body. They are difficult to shield against so the best protection is keep at a distance (see [Purple section](#) for more details).

7.4 Units

The amount of a given radionuclide in a particular material is normally expressed in terms such as activity or activity concentration. The basic unit of activity is the Becquerel (Bq). As mentioned in [Section 7.3](#), many different factors influence the hazard from a particular radionuclide. These different factors have to be taken into account in order to bring the effects of different radionuclides on to a common basis. This requires the calculation of a quantity generally referred to as “dose”, for which the basic unit is the Sievert (Sv). The IAEA and ICRP have published coefficients relating intakes of activity and dose, based on the results of extensive international research. In practical terms, doses arising from the presence of radionuclides in the environment are expressed in terms of milliSieverts (mSv), which is one thousandth of one Sievert, or microSieverts (μ Sv), which is one millionth of one Sievert.

7.5 Practices and Intervention

The current ICRP system distinguishes between two categories of exposure: practices and interventions. This approach has been endorsed by HPA-RPD for use in the UK, (NRPB, 1993a).

7.5.1 Practices

Practices are situations that are under control and that lead to increases in the exposure of individuals. Emphasis is on the control of the source of exposure and this can generally be planned for before commencing the practice. Examples of practices are the generation of electricity by nuclear power and the production of radioisotopes for medical or research usage. ICRP's principles of protection for practices (endorsed by HPA-RPD for use in the UK) are:

- i) No practice involving exposures to radiation should be adopted unless it produces sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes. (The justification of a practice.)
- ii) In relation to any particular source within a practice, the magnitude of individual doses, the number of people exposed, and the likelihood of incurring exposures where these are not certain to be received should all be kept as low as reasonably achievable, economic and social factors being taken into account. This procedure should be constrained by restrictions on the doses to individuals (dose constraints), or the risks to

individuals in the case of potential exposures (risk constraints), so as to limit the inequity likely to result from the inherent economic and social judgements. (The optimisation of protection.)

iii) The exposure of individuals resulting from the combination of all the relevant practices should be subject to dose limits, or to some control of risk in the case of potential exposures. These are aimed at ensuring that no individual is exposed to radiation risks that are judged to be unacceptable from these practices in any normal circumstances. Not all sources are susceptible to control by action at the source and it is necessary to specify the sources to be included as relevant before selecting a dose limit. (Individual dose and risk limits.)

In simpler terms, these principles may be phrased as follows: Radiation can cause harm and therefore any intended use should be worthwhile (Justification) and, this being the case, all reasonable steps should be taken to reduce exposures (Optimisation). Doses and risks from uses of radiation should be kept within pre-defined limits or constraints (dose and risk limitation).

7.5.2 Intervention

Interventions are situations where the sources, pathways and exposed individuals are already in place when a decision on control has to be taken. In such situations, protection can only be achieved by removing or modifying existing sources or pathways, or reducing the numbers of people exposed. HPA-RPD and ICRP (ICRP, 1991b) have recommended broadly similar principles governing the system of radiological protection for intervention. As expressed by HPA-RPD (NRPB, 1990) these are:

- i) Countermeasures should be introduced if they are expected to achieve more good than harm (The justification of intervention.)
- ii) The quantitative criteria used for the introduction and withdrawal of countermeasures should be such that the protection of the public is optimised. (The optimisation of intervention.)
- iii) Serious deterministic health effects should be avoided by introducing countermeasures to keep doses to individuals to levels below the thresholds for these effects.

In most cases, intervention cannot be applied to the source of the exposure and has to be applied in the environment and, particularly in the case of accidents, to an individual's freedom of action. Thus a programme of intervention will always have some disadvantages but should always be justified in the sense that it does more good than harm. It follows that the use of dose limits, or constraints, specified for practices as the basis for deciding on a level at which intervention is invoked might involve measures that would be out of proportion to the benefit obtained and, therefore, would conflict with the principle of justification. Thus, dose limits for practices (and, by inference, dose constraints) do not determine whether or not intervention should be undertaken. There will, of course, be some level of dose approaching that which would cause serious deterministic effects, where some form of intervention will be almost always required (see HPA-RPD principle iii). Since the thresholds for deterministic effects vary to some extent between individuals and circumstances, it is helpful, for emergency planning and

response purposes, to adopt robust threshold values that are lower than the known biological thresholds.

HPA-RPD has developed advice on appropriate radiation emergency planning thresholds (NRPB, 2005). This advice is provided in the context of emergency planning for people on-site at the time of an accident, but the recommended thresholds are equally applicable to the planning of protective strategies for members of the public in any location. These are reproduced in [Table 6](#). Clearly, no-one should be allowed into an area if there would be any chance of them receiving doses in excess of these thresholds, unless there was an overriding reason to do so, and they were suitably advised of the circumstances and appropriately trained.

Table 6: Emergency planning threshold doses for serious deterministic injuries*

Type of radiation	Dose (Gy)	Integration period
Beta/gamma emitters [~]	1 Gy whole body 2-3 Gy radiosensitive organs	Fractions of a second up to a few days
Alpha	1 Gy lung	Dose integrated to one year from acute inhalation

* These are thresholds recommended for the purposes of emergency planning; they are deliberately cautious compared with the likely biological thresholds for these injuries.

[~] These whole body thresholds should be reduced by up to a factor of 5 for fetal exposure during the first 21 weeks of development, see HPA-RPD advice [NRPB, 1993].

Clearly, intervention aims to avoid or avert exposure to radiation. Hence one important quantity in taking decisions on intervention is the level of dose averted by taking the remedial action (avertable dose). However, for actions undertaken during the recovery phase, HPA-RPD (NRPB, 1997) recognises that an equally important aim is to promote an early return to 'normal living'. Thus decision makers should consider, not only the expected consequences of implementing the strategy (e.g. the avertable dose, the costs, resources required, likely duration, level of disruption etc), but also how implementing this strategy will contribute to the re-establishment of 'normality', including, specifically, the criteria on which protective measures will be considered successful (and so can be terminated).

For situations requiring intervention, the concept of a level of dose, or directly measurable quantity, above which action should be taken, can be useful. Such criteria are termed action levels (ALs). Generic ALs may be developed before an accident (e.g. those adopted for food, see [Food production section](#)) or in the event of an accident, taking account of the specific circumstances.

7.6 Which system for the recovery phase?

Both systems are relevant for the recovery phase. The system of protection for intervention would be used in the process of deciding on the form and scale of the actions taken to recover from a radioactively contaminated environment. However, the workers undertaking any of the actions would be potentially being introduced to an additional source of radiation so their exposure would be controlled under the system of protection for practices. Similarly, the handling and disposal (away from the contaminated area) of any wastes produced during the recovery actions would be controlled under the system of protection for practices. The dose limits for practices are given in [Table 7](#).

Table 7: Dose limits for practices for workers and the public

Category	Effective dose (mSv y ⁻¹) ^a	Skin dose (mSv y ⁻¹) ^a	Lens of eye (mSv y ⁻¹) ^a
Workers	20	500	150
Members of the public	1	50	15

Notes:
a From ICRP 60 (ICRP, 1991a)

8 HOW TO USE THE RECOVERY HANDBOOK

The Handbook is divided into five colour coded sections, each representing a different topic area as follows:

Yellow	Section 1	Recovery and Radiation Protection
Green	Section 2	Food production systems
Purple	Section 3	Inhabited areas
Blue	Section 4	Drinking water

The first section (Yellow) introduces the recovery phase and radiation protection principles and summarises the broad steps in developing a recovery strategy (see [Figure 1](#)). It also helps the user to identify which of the other colour coded sections is the relevant section for further information on a particular topic area (see [Figure 2](#)). These colour coded sections (Green, Purple and Blue) contain text detailing legislative and radiological aspects, descriptions of the options, selection and look-up tables to assist in the choice of options, and a number of comprehensive datasheets. The order of these sections is arbitrary and does not indicate which section should be addressed first.

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