

# NHS Emergency Planning Guidance

*The ambulance service guidance on dealing  
with radiological incidents and emergencies*

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emergencies*

DH Information Reader Box	
Policy HR/Workforce Management Planning Clinical	Estates Performance IM & T Finance Partnership Working
<b>Document Purpose</b>	Best Practice Guidance
<b>ROCR Ref:</b>	<b>Gateway Ref:</b> 13041
<b>Title</b>	The NHS Emergency Planning Guidance: The ambulance service guidance on dealing with radiological incidents and emergencies
<b>Author</b>	DH Emergency Preparedness Divison
<b>Publication Date</b>	23 Mar 2010
<b>Target Audience</b>	PCT CEs, NHS Trust CEs, SHA CEs, Care Trust CEs, Foundation Trust CEs, Medical Directors, Directors of PH, Directors of Nursing, PCT PEC Chairs, NHS Trust Board Chairs, Special HA CEs, Directors of HR, Directors of Finance, Allied Health Professionals, GPs, Communications Leads, Emergency Care Leads
<b>Circulation List</b>	Local Authority CEs, Ds of Social Services, NDPBs, Voluntary Organisations
<b>Description</b>	Best practice guidance describes the role of NHS Ambulance Trusts in planning, preparing and responding to radiation incidents and emergencies involving irradiated and contaminated people.
<b>Cross Ref</b>	NHS Emergency Planning Guidance
<b>Superseded Docs</b>	N/A
<b>Action Required</b>	N/A
<b>Training</b>	N/A
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First published 23 March 2010

Published to DH website, in electronic PDF format only.

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<b>The Ambulance Service – Prior risk assessment for dealing with radiological incidents in accordance with Ionising Radiations Regulations 1999 (IRR99)</b>	
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This material should be read in conjunction with the NHS Emergency Planning Guidance 2005. All material forming the guidance is web-based and prepared to be used primarily in that format. The web-based versions of the Guidance including underpinning materials have links to complementary material from other organisations and to examples of the practice of and approach to emergency planning in the NHS in England.

The web version of the guidance is available at:-

[www.dh.gov.uk/emergencyplanning](http://www.dh.gov.uk/emergencyplanning)

# Scope and Purpose

1. This document describes the role of NHS Ambulance Trusts in planning, preparing and responding to radiation incidents and emergencies involving irradiated and contaminated people. This includes deliberate acts that may cause infrastructure failure and/or mass casualties. This guidance does not cover routine work that the ambulance service may undertake which might involve exposure to ionising radiations, e.g. the transport of patients treated with nuclear medicines or work in radon affected areas. Plans and associated risk assessments to cover incidents and emergencies involving irradiated and contaminated people should be available at the local level and agreed with the Radiation Protection Adviser of the hospital trust ,or other premises involved.
2. It provides a strategic framework for local planning and links to resources that ambulance services may find useful. Individual services will need to draw up plans appropriate to their localities).
3. As far as possible, in planning to respond to radiation emergencies, Ambulance Trusts should build on arrangements that are already in place rather than develop a series of new, 'special' arrangements.
4. The NHS Emergency Planning Guidance gives the Chief Executive of each NHS organisation responsibility for ensuring that their organisation has a Major Incident Plan in place that will be built on the principles of risk assessment, co-operation with partners, emergency planning, communicating with the public and information sharing. The plan will link into the organisation's arrangements for ensuring business continuity as required by the Civil Contingencies Act (CCA). Planning for the needs of ambulance services in dealing with radiological incidents and emergencies forms part of that responsibility for Chief Executives of NHS Trusts particularly Ambulance and Acute Trusts.

In the context of this Guidance, the term NHS Trusts includes NHS Foundation Trusts.

# The Legal Framework

5. The following applies to all Ambulance Staff, including those who are members of Hazardous Area Response Teams (HART) and decontamination teams
6. The radiation guidance set out in this document aims to meet the requirements of The Health and Safety at Work Act 1974 and the requirements of the Ionising Radiations Regulations 1999 (IRR99) and the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR) as they apply to ambulance service emergency response operations.
7. HSE have advised  
  
***“that in situations where neither IRR99 nor REPPIR apply it would be good practice, when preparing contingency plans and training emergency responders, to base the advice regarding management of dose exposures/limits on REPPIR equivalents”.***
8. This means the reference levels listed in the section entitled Radiation Exposure Levels can be regarded as those accepted by HSE, who have the regulatory responsibility for radiation regulations at work.
9. These limits and exposure scenarios are supported by dynamic risk assessments see Annex 6.
10. The Health and Safety Executive (HSE) has agreed that this guidance shall be issued as an intermediate measure until the Ionising Radiations Regulations 1999 (IRR99) are amended. Application of the various regulations governing radiation scenarios is shown in Annex 1. This is the HSE’s interim response to clarify which regulations apply, because of gaps identified in IRR99.
11. The radiation guidance set out in this document also takes account of the requirements of the International Atomic Energy Agency Safety Series GS-R-2 “Preparedness and Response for a Nuclear or Radiological Emergency”.

[http://www-pub.iaea.org/MTCD/publications/PDF/Pub1133\\_scr.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1133_scr.pdf)

12. Ambulance staff will be permitted to enter a Radiation Controlled Area (RCA) <sup>1</sup>to treat a patient as necessary under the supervision of the site Radiation Protection Supervisor<sup>2</sup>and shall wear any additional dosimetry equipment required by the site.
13. It is the employer's responsibility, that is, the Ambulance Trusts, to deliver a full briefing about the radiation risks before a volunteer employee, wishing to do so, undertakes life saving intervention involving ionising radiation exposure. This should be covered in health and safety training given to ambulance staff. Such training must cover the characteristics of ionising radiations, health effects and measures to protect against exposure. The Ambulance Trusts should ensure that refresher training is provided as appropriate. To ensure the safety of all their staff, Ambulance Trusts need to understand the statutory dose limits and Ambulance service dose reference levels that apply to their staff attending any incident.
14. In these situations, the exposure to radiation is termed 'emergency exposure'. These staff shall be pre-identified as being permitted to be subjected to emergency exposures by their Trust and are subject to certain conditions. No single person is ever likely to experience an emergency exposure more than once in their lifetime. The Trust must ensure that such staff are provided with suitable and sufficient training in the field of radiation protection as described in the following section. The Trust should also ensure that staff are provided with appropriate equipment such as is necessary to restrict their exposure to radiation. The Trust should also arrange for medical surveillance by an appointed doctor or employment medical advisor to be carried out without delay in the event of a radiation emergency in respect of those staff who receive emergency exposures. Furthermore, Trusts must ensure that no staff under the age of 18 years, no trainee under 18 years and no female employee who is pregnant or breast feeding, is subject to an emergency exposure and that staff have agreed to be subject to emergency exposure.

## Training

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<sup>1</sup>Every employer needs to designate any area under his control as a Radiation Controlled Area, which following a risk assessment, has been shown to be an area where:

- it is necessary for a person who enters to follow special procedures designed to restrict exposure, or prevent or limit the probability of a radiation accident; or
- the exposure of any employee is likely to exceed 6mSv a year or three tenths of any relevant dose limit referred to in Schedule 4 of IRR99 for employees aged 18 and over
- 

<sup>2</sup> The site Radiation Protection Supervisors in this context are personnel identified by the site operator. Supervisors will work in cooperation with the site RPS. It is recognised that the term 'radiation protection supervisor' has different connotations and responsibilities in other services and organisations.



15. It is the Ambulance Trusts' responsibility to provide adequate radiological safety training to ambulance staff. This should be included in the routine health and safety training given to ambulance staff. Such training must cover the characteristics of ionising radiations, health effects and measures to protect against exposure. Ambulance Trusts should ensure that refresher training is provided at appropriate intervals.
16. To ensure the safety of all their staff, Ambulance Trusts need to:
- understand the Dose Limits (DL) and the Dose Reference Levels (DRLs) that apply to their staff attending any incident and understand the correct use of PPE including Respiratory Protective Equipment;
  - ensure training programmes contain personal protection advice for those ancillary workers (cleaners, vehicle workshop staff, technical and IT staff etc.) who interface with emergency ambulance staff and vehicles, and thus could be exposed to a contamination risk.
17. In the event ambulance staff are required to enter areas of elevated radiation levels or that are potentially contaminated, the exposure to radiation is termed '**emergency exposure**'. Staff who may receive a dose greater than 1 mSv during an incident shall be pre-identified i.e. CBRN responders or members of HART, as being permitted to be subjected to emergency exposures by their Trust and are subject to certain conditions. For general ambulance staff no single person is ever likely to experience an emergency exposure more than once in their lifetime. The Trust must ensure that such staff are provided with further appropriate training in the field of radiation protection and such information and instruction is suitable and sufficient for staff to know and understand the risks to health created by exposure to ionising radiation and the precautions, which should be taken.

## Operational Support

18. Dedicated Ambulance Radiation Protection Supervisors (RPSs)<sup>3</sup> should be appointed by each Trust to support the above operational concept. This will enable ambulance commanders via their RPS to contact HPA's Radiation Protection Division Radiation Protection Advisers, who are on-call 24/7. The RPA can provide radiological protection advice in support of operational matters. To further enhance the capability of each Ambulance Trust to respond effectively to incidents involving radioactive

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<sup>3</sup> Ambulance service personnel who have undertaken The Health Protection Agency approved course can be designated as Radiation Protection Supervisors. It is recognised that the term 'radiation protection supervisor' has different connotations and responsibilities in other services and organisations.

material, each RPS should have suitable radiation monitors available to them for dose rate and contamination measurements, similar to those held within hospital Emergency Departments.

19. It should be noted that this support will not be provided by HPA:

- for normal non emergency issues, for instance the transport of nuclear medicine patients. This is the role of the hospital health physicist.

## Radiation Exposure Levels

20. The occupational dose limits are detailed in the Ionising Radiations Regulations 1999. For ambulance staff the appropriate dose limit for the skin, extremities and eyes will apply, even in emergency situations. With the exception of life saving actions, the annual whole body dose limit will also apply.

21. For reference levels below refer to whole body doses (effective dose).

22. It should be noted that the EPD only measures external dose from penetrating radiation and that dose limits and dose reference levels are for all routes of exposure.

# Planning the Response

## Responsibilities

23. The Ambulance Trust is responsible for the alerting, mobilising and coordinating at the scene, of all NHS resources necessary to deal with a radiation incident or emergency.

24. The key strategic planning responsibilities in relation to a radiation incident or emergency for the Ambulance Trusts are:

- to protect the health, safety and welfare of all health service personnel on site from the specific hazards posed by a radiological incident
- to carry out an assessment for the health service of the incident using appropriate assistance from other emergency services, site operators or nominated scientific points of contact
- Notwithstanding operational controls, the principle is that life saving actions take precedence over decontamination. .
- to provide clinical decontamination of casualties where appropriate, and to support mass decontamination when required.

25. Further planning considerations and responsibilities of Ambulance Trusts include having in place arrangements to:

- contact an appropriately trained Radiation Protection Supervisor who has specialist radiological expertise, to provide advice on matters relating to the emergency and the required response of the Trust if appropriate.
- The HPA Has put in place arrangements to be able to contact a Radiation Protection Adviser
- Is providing appropriate training for nominated RPSs on radiological protection matters, and

## Preparations

26. Each Ambulance Trust is required to ensure that they have a Major Incident Plan that has been adopted as policy and authorised by the Chief Executive of the Trust.

27. In addition to the responsibilities described in the NHS Emergency Planning Guidance, Ambulance Trusts will need to consider the following as part of their plans:

- identify arrangements for Chemical, Biological, Radiological and Nuclear (CBRN) emergencies

- define the responsibilities of the trust for radiation incidents and emergencies, the operational objective and the process for implementation of the plan
- ensure control rooms have readily available and up to date telephone numbers to contact relevant agencies and experts for radiation incidents and emergencies. The ambulance services' radiation lead can provide support in supply of these contact details.
- create a message format to be used for notifying hospitals and other NHS agencies of a radiation incident and emergency
- identify special contingency arrangements for multi agency planning including nuclear operators, NARO, NAIR, RADSAFE, MOD, HPA, EA, local authority, GDS, CDG regulations, etc
- develop an ambulance control room procedures in the event of the activation of an Electronic Personal Dosimeter in line with Annex 1x 1.

28. Each Ambulance Trust should provide its staff with incident action cards that reflect the salient responsibilities listed in the trusts radiological incident plan in an aide memoir format including RPS contact details

29. Suitable Personal Protective Equipment (including respiratory protective equipment) for ionising radiation incidents shall be carried.

30. Each RPS should have access to a suitable and maintained radiation monitor capable of measuring dose rates and surface contamination arising from penetrating beta radiations (> 150 keV).

### **Arrival at the Scene of a radiation incident**

31. Ambulance Trusts must have personnel appropriately trained in dealing with a radiological incident.

32. Taking into account the requirements of the STEP 1-2-3 procedure, an analytical risk assessment must be made in partnership with other responding agencies. Examples of radiological risk assessment are in Annex 6.

### **Consideration for Managing the Treatment of Casualties at the Scene**

33. At the scene, the clinical need of those affected will need to be balanced against the radiological hazard presented.

34. Priority 1 patients with life threatening injuries should not have their treatment and transfer delayed for decontamination. However, it is recognised that the removal of clothing to assist in diagnosis and to provide clinical access, constitutes a form of decontamination. Clothing that has been removed should be treated as contaminated waste.

Treatment at the scene and whilst in transit should be in accordance with the protocols surrounding the wearing of EPD and the advice given by the trust RPS. The receiving hospital should be notified of the patient's contamination status prior to arrival.

35. All Priority 2 and 3 patients should be decontaminated as far as reasonably practicable before removal to a hospital.

36. All deceased should be left in situ or moved only in accordance with local protocols.

## **Communications**

37. Arrangements should be made by Ambulance Trusts to ensure all staff are kept fully informed about planning and preparing for a radiological incident.

38. This may include the identification of a radiological incident co-ordinator within each Ambulance Trust, whose role will be to:

- keep staff informed
- liaise with PCTs, Acute Trusts, SHAs, and other relevant partners including the Health Protection Agency
- communicate with the private and voluntary sector
- liaise with primary care services so that services including GPs are aware of likely restrictions on ambulance response, and hence may encourage care of patients in the home environment
- raise awareness of problems and direct people towards relevant information
- keep the Department of Health and other ambulance services informed about the local response, so that regional/national plans can be adjusted accordingly
- Liaise and work with local nuclear industry and Local Authority partners where appropriate to draw up plans for incidents involving a radiation site hazard.

39. In the event of a Major Incident being declared, normal Major Incident procedures should be followed, ensuring that any information on the radiological hazard is included in the message. Should it not be a Major Incident, yet radiological, then the fact that the incident involves radioactive materials or exposure to radiation should be passed to ambulance control and other appropriate NHS organisations.

# Dose Reference Levels (DRL)

40. **Reference Level One**:- **1 mSv** total for all staff per event . After such an event, a review will be held to examine exposures and identify any improvements in working practices to reduce potential exposures in future events;
41. This dose reference level applies to general ambulance staff who have not been identified for specialist roles such as HART role (see below) or decontamination providers.
42. **Reference Level Two** The maximum dose reference level for CBRN decontamination providers is **5 mSv** per event;
43. The Trust occupational health framework will ensure appropriate follow-up of staff after such an event and to identify actions to reduce exposure for future similar events.
44. This dose reference level shall apply to those ambulance staff who volunteer to be involved in decontamination roles.
45. **Reference Level Three** – the maximum dose for **life saving operations** where the casualty cannot be immediately removed from the area of high dose rate or contamination is **100 mSv**; ***all ambulance staff can volunteer to be exposed to this level provided that they have been fully briefed and understand the implications.***
46. Whilst Reference Level Three applies to all ambulance staff involved in life saving operations, contact with the Trust's Radiation Protection Supervisor should be made and advice sought from the 24/7 HPA Radiation Protection Adviser. In all cases the the principle of ensuring doses are kept As Low As Reasonably Practicable (ALARP) must apply.
47. **Annual Dose Limit (Whole Body) 20 mSv** – Under normal circumstances this would only be applied to the Hazardous Area Response Team (HART). Reference levels 1 and 2 would apply to other ambulance staff.

## HART Radiation Reference Levels and follow up actions

48. HART provide clinical support within the radiation hotzone for casualties.
49. With regards to ambulance services only male HART members will be permitted to enter the radiation hotzone during a CBRN event.
50. After such an event, a review will be held to examine exposures and identify any improvements in working practices.

51. When undertaking life saving intervention, all reasonable efforts shall be made to keep doses to ambulance staff 'as low as reasonably practicable' (ALARP) and below statutory dose limits.
52. If the patient cannot be immediately rescued or extracted from the hotzone to a reasonable distance away from the radiation source, the Trust's Radiation Protection Supervisor (RPS) who is trained to the required standard (RPS) for ionising radiation can decide if in the interest of saving the patient, higher doses are unavoidable. The Ambulance Radiation Protection Supervisor will consult with the Trust's RPA (HPA) before any team member can volunteer for situations where the DRL exceeds 20mSv. (see para 48).
53. Trusts shall ensure that appropriate occupational follow-up is put in place for staff receiving significant doses and a judgement is made whether they can participate in any future events involving ionising radiation.

### **General Ambulance Staff**

54. Ambulance staff who undertake actions in which the dose may exceed 20 mSv whole body annual dose limit shall be volunteers and shall be clearly and comprehensively informed in advance of the associated health risk, and shall, to the extent feasible, be trained in the actions that may be required.
55. Ambulance staff shall not normally be precluded from incurring further occupational exposure because of doses received in an emergency exposure situation if not excluded following the review process, except where the exposure exceeds 100mSv.
56. The Trust should arrange for medical surveillance by an appointed doctor or employment medical advisor to be carried out without delay in respect of those staff who receive emergency exposures. Furthermore, Trusts must ensure that no staff under the age of 18 years, no trainees and no female employee who is pregnant or breast feeding, is subject to an emergency exposure above 1 mSv and that staff who may exceed 1 mSv during an emergency have previously agreed to be subject to emergency exposure dose reference levels.
57. Examples of events that could give rise to exposure of ambulance staff are provided in Annex 6.

# Considerations for Managing the Transport of a Contaminated Casualty

58. Each Ambulance Trust should ensure that procedures are available to restrict the spread of contamination within the vehicle and to protect ambulance staff.
  
59. When all other considerations have been taken into account regarding the health, safety and welfare of patients, the public and responding staff, Ambulance Trusts shall not refuse to transport any casualty requiring life saving treatment (Priority 1) due to concerns over the ambulance and its equipment being rendered as unusable due to radioactive contamination. In the event that the casualty arises on a nuclear licensed site, the following documentation is listed on the website for the Department of Climate and Energy Change (DECC) as evidence of compensatory provisions.

[http://decc.gov.uk/en/content/cms/what\\_we\\_do/uk\\_supply/energy\\_mix/nuclear/issues/emergency\\_plan/neplg/neplg.aspx](http://decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/nuclear/issues/emergency_plan/neplg/neplg.aspx)



## UK Arrangements for Responding to Radiation Incidents

### Introduction

60. This section describes the UK arrangements for responding to radiation incidents including descriptions of the organisations involved.

### Nuclear Accident Response Organisation (NARO)

61. The Ministry of Defence (MOD) maintains a Nuclear Accident Response Organisation (NARO) to respond to an accident or incident, including one arising through terrorist acts, involving defence nuclear assets.

- The MOD is nominated by the Cabinet Office as the UK Lead Government Department to coordinate the Central Government response to a Defence Nuclear Accident, government response is coordinated through the Nuclear Accident Information and Advisory Group (NAIAG).

62. For fixed MOD sites local orders will be in place to integrate the Civilian Emergency Services (CES) response with that of the Base site. This will include providing advice and information to Ambulance Personnel from the incident site through all levels from operational Operational to Strategic.

63. For road convoys, HAZMAT and other safety information is available from the Convoy Command Team. A Royal Navy (RN) medic travels with some of the convoys and they will provide further information and assistance with casualties where possible. Where no Medic is carried the MoD Police are responsible for providing first-aid. Additional information will be faxed to the regional Ambulance HQ outlining self protection and casualty management information. Similar faxes will be sent to the local Emergency Departments

64. When the MoD moves material by rail it is accompanied by a team including a Health Physicist who can advise on the risks to responding personnel and casualties.

65. For air accidents involving MOD nuclear materials a response team (including a Doctor) will deploy by helicopter to assist the response to this incident. There may be a significant time gap between the incident and the response team arriving. To assist the MoD response in this period additional information will be faxed to the regional Ambulance HQ outlining staff protection and casualty management information and will be sent to the local Emergency Department, Police and Public Health Team. Advice from HPA will be sought through police Silver or Gold.

66. Further information is available in the **Local Authority And Emergency Services Information (LAESI) Edition 6:Defence Nuclear Materials Transport Contingency Arrangements** on the MoD website.

<http://www.mod.uk/NR/rdonlyres/226E622E-356E-4CB0-A2CD-979AE352B848/0/20080424LAESlv6U.pdf>

## **RADSAFE**

67. RADSAFE is a consortium of organisations that have come together to provide mutual assistance in the event of a transport accident involving radioactive materials belonging to a RADSAFE member. The RADSAFE plan evolved from a number of earlier emergency plans. RADSAFE ensures the early provision of advice and support to the emergency services. RADSAFE is activated by calling 0800 834153. Further information is available at <http://www.radsafe.org>

## **National Arrangements for Incidents Involving Radioactivity (NAIR)**

68. Radioactive sources are used for a wide variety of purposes in industry, medicine, research and teaching. Each year there are thousands of transport movements of radioactive material associated with these activities. The National Arrangements for Incidents Involving Radioactivity (NAIR) exist to provide protection to the public in the event of incidents arising from the use and transport of such radioactive materials in cases where no specific plans are available or existing plans fail to operate effectively. These may involve, for example, the discovery of real or suspect radioactive material in public places. NAIR is designed to provide the emergency services, and primarily the police, with rapid expert advice in situations suspected to involve radioactive material, where the public might be at risk and where no other expert advice is available. NAIR is coordinated by the HPA RPD but response comes from organizations across the UK as stages 1 and 2. Further information on NAIR is available on the HPA website [www.hpa.org.uk](http://www.hpa.org.uk) and searching for NAIR.

69. **Only the police may initiate a NAIR response by calling 0800 834153.** NAIR response is in two stages;

- Stage 1: A health physicist from a local establishment e.g. hospital is contacted and can provide initial advice
- Stage 2: The response would come from Radiation professionals from a nuclear site or similar establishment.

Note: During any response involving the above response plans, the Trust RPS may contact the HPA 24/7 on-call RPA for advice

## **NHS Emergency Planning Guidance: Glossary**

70. There is a glossary available to support the NHS Emergency Planning Guidance underpinning section on incidents involving radioactivity. This will be available at:

[www.dh.gov.uk/emergencyplanning](http://www.dh.gov.uk/emergencyplanning)

## Annex 1: Application of the various regulations governing radiation scenarios

Scenario	Applicable Legislation	Relevant dose limit	Comments
<p><b>A) Radiation accident</b> e.g. industrial radioactive gauge has leaked and contaminated the workplace/public space. Contaminated persons / casualties present.</p>	<p>IRR99-apply if workers involved in a “practice” e.g. decontamination (handling radioactive material).</p>	<p>If IRR99 apply then IRR99 Schedule 4 values (e.g. 20mSv Whole body)</p>	
<p><b>B) REPPIR declared emergency.</b> e.g. 1. Person(s) contaminated by an accident at a premises or during a transfer operation where REPPIR apply.  e.g. 2 Person(s) need to be rescued from a contaminated or high external radiation dose rate area as a result of emergency.</p>	<p>REPPIR – apply to premises or transfer operations where the maximum activity is greater than the REPPIR schedule value.  A Radiation Emergency must be declared where the dose to a member of the public offsite could exceed 5mSv</p>	<p>For all workers engaged in a “practice” IRR99 dose limits unless disapplied by REPPIR Regulation 15 for purposes of Intervention.</p>	
<p><b>C) Radiation Accident at REPPIR site</b>  e.g. An accident occurs on a premises to which REPPIR apply but the dose consequence to a member of the public offsite is less than 5mSv so a Radiation Emergency cannot be declared.</p>	<p>IRR99</p>	<p>For all workers engaged in a “practice” IRR99 dose limits (Schedule 4)</p>	
<p><b>D) Dirty Bomb (CBRN)</b></p>	<p>The question of whether IRR99 applies will be a matter of fact e.g. decontamination of a patient.</p>	<p>For all workers engaged in a “practice” IRR99 dose limits</p>	<p>Potential interim Solution Where IRR99 does not apply –use of controls <b>equivalent</b> to IRR99 or REPPIR to manage/limit exposures as a matter of <u>best practice</u>.</p>

<b>D) radionuclide patient</b> – e.g. Radionuclide therapy out-patient requires emergency ambulance/paramedic after leaving the hospital	IRR99 applicable to workers dealing with these patients	For all workers engaged in a “practice” IRR99 dose limits	
<b>E) Lost/Orphan Sources</b>	Application of IRR99 will depend upon the particular circumstances	For all workers engaged in a “practice” IRR99 dose limits	Interim Solution Where IRR99 does not apply – use of controls equivalent to IRR99 or REPIR to manage/limit exposures as a matter of <u>best practice</u> .
<b>F) transport</b> – e.g. an incident involving a vehicle or form of transport resulting in a radiation exposure to the public.	IRR99 & other regulations (air, road, rail).	For all workers engaged in a “practice” IRR99 dose limits	
<b>G) Nuclear Device (CBRN)</b>	Not an IRR99 matter	For all workers engaged in a “practice” IRR99 dose limits e.g. during remediation.	Nuclear events are managed separately.
<b>H) Other</b> -e.g. Satellite incorporating a Radioactive substance (e.g. as a power source) crashes in the UK, possible public & emergency service exposure.	REPIR requires only that LAs have arrangements to provide the public with information and advice on any radiation emergency.	For all workers engaged in a “practice” IRR99 dose limits	Emergency services not covered.  Interim Solution where IRR99 does not apply - use of controls equivalent to IRR99 or REPIR to manage/limit exposures as a matter of <u>best practice</u> .

## Annex 2

# Control Room Guidance

## Generic Control Centre Protocol for Ambulance Staff Reporting an EPD Alarm Signal

1. Ask staff to review the site and check the battery alarm or if return to base indicator has activated (due to incorrect programming). Start log
2. Record the dose rate either **millisieverts per hour (mSv/h)** or **microsieverts per hour ( $\mu$ Sv/h)**, the exact location when the alarm activated, how long since the alarm was triggered, the time of the reading and the names of the ambulance staff.
3. Contact the duty Radiation Protection Supervisor and appraise.
4. Advise staff to check the alarm by means of another dosimeter if possible. A good indication of an alarm caused by other means is to remove the first EPD that alarmed from the scene.
5. If the dose-rate exceeds  $100\mu\text{Sv/h}$  then the ambulance crew should, if practicable, move to a safe distance from the source until the EPD stops alarming.
6. Advise staff to remember Distance and Shielding. A brick or concrete wall may contribute to dose reduction as will increasing their distance from the source.
7. Advise staff to consider PPE if contamination is suspected (the HPA RPA can provide advice on this).
8. Contact Police and Fire and Rescue Service if they are not already aware of this incident.
9. If the incident is considered to be solely a radioactive contamination event ; treat as per powder incident (it is unlikely that there would be a sufficiently high enough external dose to trigger an EPD alarm, However decontamination is the treatment priority unless life saving actions are required). Consider Special Operations Response Team, Hazardous Area Response Team or Fire Service Assistance.
10. Advise staff that if it is exposure solely due to external irradiation then once a person has been removed from the source of radiation, they do not pose any risk to others who may come into contact with them.

11. Where possible, it is advised to remove the patient as soon as possible and carry out further treatment in a safer environment if reasonable to do so.
12. Where there are delays removing patients from near the source, time, distance and shielding should be the protection criteria. Advise staff that dose sharing should be the last consideration.
13. In consultation with the Radiological Protection Supervisor ensure that dose reference levels and dose limits are adhered to.
14. Ensure an adequate hot debrief takes place post incident, calculate the increase in total dose during the incident, it may be necessary to consult medical advice either via HPA if involved, local Emergency Department or occupational health. Prepare a post incident report for Director of Operations and the Emergency Planning Risk Management and Health and Safety departments.
15. Remember to inform all involved that incident has ended.

## Dose Reference Levels

**Reference Level One**:- 1 mSv total for all staff per event . After such an event, a review will be held to examine exposures and identify any improvements in working practices to reduce potential exposures in future events.

This dose reference level applies to general ambulance staff who have not been identified for specialist roles such as HART role (see below) or decontamination providers.

**Reference Level Two** The maximum dose reference level for CBRN decontamination providers is **5 mSv** per event.

The Trust occupational health framework will ensure appropriate follow-up of staff after such an event and to identify actions to reduce exposure for future similar events.

This dose reference level shall apply to those ambulance staff who volunteer to be involved in decontamination roles.

**Reference Level Three** – the maximum dose for **life saving operations** where the casualty cannot be removed from the area of high dose rate or contamination is **100 mSv/**.

Whilst Reference Level Three applies to all ambulance staff involved in life saving operations, contact with the Trust's Radiation Protection Supervisor should be made and advice sought from the 24/7 HPA Radiation Protection Adviser. In all cases the the principle of ensuring doses are kept As Low As Reasonably Practicable (ALARP) must apply.

**Annual Dose Limit (Whole Body) 20 mSv** – Under normal circumstances this would only be applied to the Hazardous Area Response Team (HART). Reference levels 1 and 2 would apply to other ambulance staff.

HART provide clinical support within the radiation hotzone for casualties from both the public and other responding agencies.

With regards to ambulance services only male HART members will be permitted to enter the radiation hotzone during a CBRN event.

After such an event, a review will be held to examine exposures and identify any improvements in working practices



**Operations Managers (Communications Unit)  
Guide to Electronic Personal Alarm (EPD) Activation**

**If an EPD alarm activates and wearer contacts control**

**Which Alarm? If Battery/Fault; Radiation Protection Supervisor does NOT have to be informed**

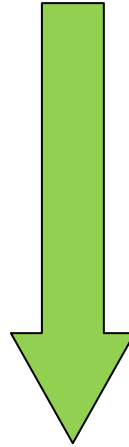


**Battery Alarm**

*Intermittent, slow tone. The battery icon will show in the display panel:*

**ADVISE CREW TO CHANGE BATTERY IN NEXT 10 HOURS,**  
spares on station, operations managers or communications unit.

**NO FURTHER ACTION REQUIRED**

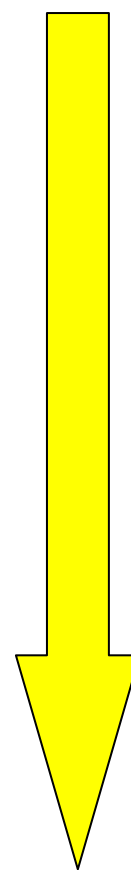


**THE UNIT DISPLAYS A FAULT**

*Slow intermittent tone together with fault and an error message on the display:*

Advise the crew to take note of the current dose (if possible) and return unit to Emergency Planning Department with a brief report of circumstances surrounding fault, if concerned they can sign a temporary unit out of the communications unit, filling in the paperwork with the spare EPD's

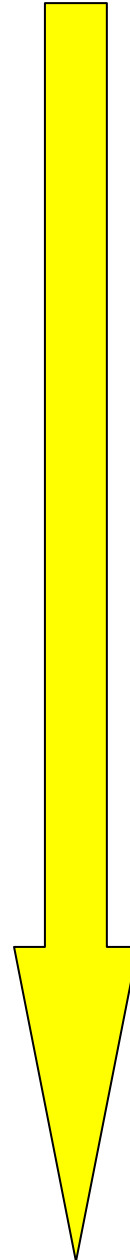
**NO FURTHER ACTION REQUIRED**



**If the dose rate alarm activates (alarm 1);** *Fast intermittent double beep, high tone*

Contact the duty Radiation Protection Supervisor (RPS). Start a log entry. Ensure that you are appraised by the duty RPS once he/she has discussed the incident with the crew. If you haven't heard from the duty RPS within 15 minutes please contact them for an update

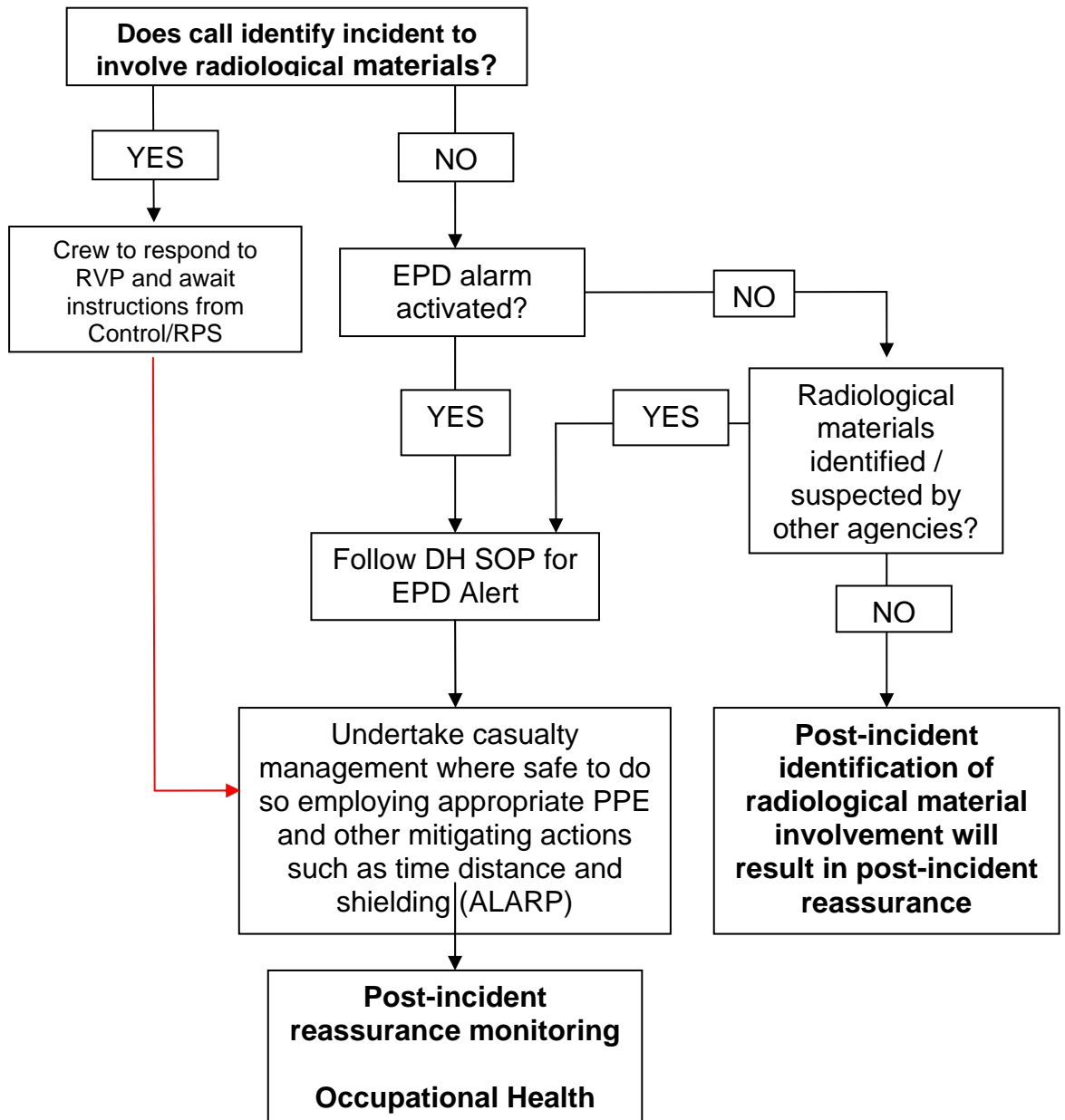
**Update/Stand-down from Duty RPS required**



**IF TRAINING AND GUIDANCE IS FOLLOWED STAFF SHOULD NEVER FIND THEMSELVES IN A SITUATION WHERE THE SECOND OR THIRD ALARMS ACTIVATE UNLESS RESPONDING AS HART OR CBRN RESPONDERS**

**AS SOON AS ANYONE WEARING A DOSIMETER ENTERS AN ENVIRONMENT WHERE 100u sv/h IS PRESENT THE FIRST ALARM WILL SOUND THUS ALLOWING THE SITUATION TO BE MANAGED BASED ON THE DOSE ACTION LEVELS SET BY THE DEPARTMENT OF HEALTH**

## INCIDENT RESPONSE ALGORITHM



**Table showing time to reach dose rate**

Dose rate	Time to reach dose			
	1 mSv	5 mSv	20 mSv	100 mSv
Microsieverts per hour				
10 $\mu$ Sv/h	4 days	20 days	80 days	More than 1 year
100 $\mu$ Sv/h	10 hours	2 days	8 days	40 days
500 $\mu$ Sv/h	2 hours	10 hours	2 days	8 days
Millisieverts per hour				
1 mSv/h	1 hour	5 hours	20 hours	4 days
10 mSv/h	6 mins	30 mins	2 hours	10 hours
50 mSv/h	1 min	6 mins	20 mins	2 hours
100 mSv/h	20 s	3 mins	10 mins	1 hour
500 mSv/h	4 s	20 s	2 mins	10 mins

## Annex 3

### Nuclear sites

With any 999 call from a Licensed Nuclear Site require, Ambulance Control shall ascertain if any casualties:

- are contaminated with a radioactive material or not
- are within a controlled radiation area or not.

If neither applies then continue with normal procedures

If casualty is within controlled area/ potentially contaminated, ascertain if the casualty can be decontaminated. The Nuclear site will confirm this has been carried out by means of the nationally agreed hand-over form in Annex 4

If contaminated, consideration needs to be given to the control of contamination and the Trust should already have procedures for dealing with this event

Do treat the patient as normal when wearing PPE

Handover Form with casualty

If the casualty has been contaminated and decontamination has not been possible, put on the disposable suit and suitable respiratory protective equipment.. Do not eat drink or smoke until advised otherwise after handing over the patient at the receiving hospital

Casualty handover

If taken to the casualty on the site, make sure you are wearing your EPD but this is only a precautionary measure as most areas of the site are safe to attend when there is no accident declared.

It is intended that this framework is supported by a certificate of contamination/decontamination. Work is in progress to develop this form with Nuclear Emergency Arrangement Forum and it will be published as soon as it is available.

## Annex 4

### An example of a casualty monitoring handover form

Annex 1

#### CASUALTY MONITORING RESULTS FORM

CONTACT TELEPHONE No 0151- 473 –

Casualty Family Name \_\_\_\_\_ Casualty Given Name \_\_\_\_\_

Date of Birth \_\_\_\_\_ Sex  M  F Works Reference No. \_\_\_\_\_

Date of Event \_\_\_\_\_ Location of Event \_\_\_\_\_

Description of Event \_\_\_\_\_

Name of Radioactive Substance \_\_\_\_\_

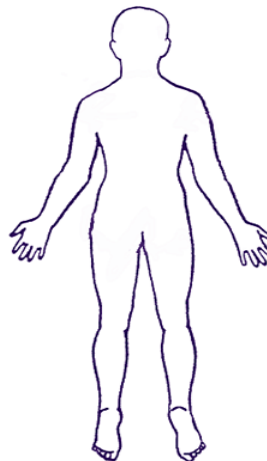
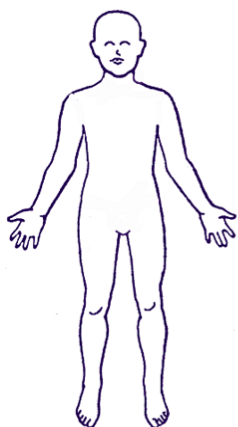
Type of Ionising Radiation  alpha  beta  gamma

Time Decontamination Began \_\_\_\_\_ Time Decontamination Ended \_\_\_\_\_

Contaminated Clothing Removed  Y  N

#### SURFACE CONTAMINATION MONITORING OF CASUALTY

INDICATE AREAS OF CONTAMINATION ON THE CASUALTY BY MARKING THE BODY DIAGRAMS BELOW WITH A LETTER FROM ONE OF THE TABLES BELOW AND PLACE THE READING OBTAINED IN THE BOX BELOW THE LETTER. (The same letter can be used on the Body Diagrams where readings are found to have the same numeric value.) IF CASUALTY IS TO BE TRANSFERRED TO HOSPITAL RAM GENE SHOULD ALSO BE USED.



BODY LOCATION											
	A	B	C	D	E	F	G	H	I	J	K
RAM GENE c.p.s.											
Electra DP2 Bqcm <sup>-2</sup>											
Wound Probe Bqcm <sup>-2</sup>											
Mini Rad dose rate at 30 cm from casualty $\mu$ Sv/hr											

**CASUALTY CONTAMINATION STATUS**

<b>Green</b>	No radioactive contamination present	
<b>Amber</b>	Radioactive contamination has taken place but has been removed and is no longer externally detectable.	
<b>Red</b>	Radioactive contamination has been detected and remains by virtue of injury	

Decontamination carried out by:  
Monitoring carried out by:

Sign:  
Sign:

Print:  
Print:

## Annex 5

Department of Health, Health Protection Agency and Ambulance Trust advisers working together with other advisers where this has been appropriate have identified the following categories of possible exposure, the staff groups and the levels that they could possibly be exposed to:

### **Radiation Exposure Examples**

#### **Radionuclide patient**

Those patients undergoing radionuclide therapy or diagnostic procedures after treatment may require an emergency ambulance. It is very unlikely that these patients would trigger the dose rate alarm on the EPD but in any such event Contact Control for advice. **This is not a radiation emergency**

#### **Orphan sources**

Incidents involving orphan sources (a radioactive source that has fallen out of regulatory control) may result in significant external exposures or internal exposure if the material has leaked from the source.

#### **Transport**

Radioactive materials destined for road, rail, sea or air transport are subject to international requirements (IAEA) on packaging and labelling. The risk the nuclide poses and its form determine packaging. In the event of a transport accident, there remains the risk of external / internal exposure but consequences should be limited if the material has been correctly packaged. It should be noted that vehicles carrying radioactive material may have a dose rate of 2 mSv/h on the surface (side) of the vehicle under normal circumstances.

#### **CBRN**

For example, the deliberate release of radiological materials in order to cause harm or financial damage (criminal act). Radiological severity depends on nuclide, radioactivity and activity involved with the material and the method of release.

#### **Industrial sites**

Radioactive materials may be used in research or for process control. Each radiation employer must assess the risks from its use of ionising radiation and have sufficient contingency plans in place to deal with reasonably foreseeable events. These plans should also assist ambulance staff in recovery of any casualties. Note that the risk from sources used on these sites is generally low.

#### **Licensed nuclear sites**

For example; This involves attending patient that have become ill or injured at a fixed nuclear site (with no nuclear accident) and a set of

categories have been established. These are shown below. Local ambulance emergency planners should ensure they have developed in collaboration with each site, a response plan that provides the duty of care to the patient and maintains the safety of the responder.

**Category 1.** A worker is injured and requires an ambulance, there is no radiation exposure at nuclear site and the patient been certified that he is not contaminated.

**Category 2.** -A worker was injured and was contaminated through contact with a source but has been successfully decontaminated at site. The ambulance crew will be able to remove the patient at a level that would not be causing harm.

**Category 3.** The casualty is contaminated but has critical injuries requiring life saving measures and immediate removal to hospital. This could result in the ambulance being contaminated. Ambulance crew may be exposed to a level of radiation and this will need to be managed within the permitted reference levels.

Handover - The licensed nuclear site's health physics team should provide assistance to ambulance crews to;

- i Provision of suitable PPE for area that they need to access,
- ii provision of appropriate radiation monitoring in the area to ensure safety of ambulance crews and advice on keeping doses ALARP,
- iii advice to the crews to restrict the spread of contamination whilst transporting the casualty to hospital and
- iv advice to be provided to the hospital on the radiological status of the patient (areas of fixed/ loose contamination and nuclide information plus instructions on dealing with any contaminated materials resulting from the treatment of the casualty)



## Annex 6

### The Ambulance Service – Prior Risk Assessment for dealing with radiological incidents Ionising Radiations Regulations 1999

#### **A. INTRODUCTION AND SCOPE**

The Health and Safety Executive (HSE) have determined that the Ambulance Service are subject to the Ionising Radiations Regulations 1999 (IRR99) when responding to certain types of radiation incident. These Regulations require a prior radiological risk assessment to determine what measures are required to restrict radiation exposures, and this Annex is intended to provide such an assessment.

HSE have produced a list of accident scenarios for which IRR99 may apply, and also other scenarios for which IRR99 do not strictly apply, but for which the IRR99 controls represent best practice. This document contains radiation risk assessments for each of these scenarios. The following points should be noted:

- Each of the incident scenarios can only be considered in a generic way. In the event of an actual incident, the radiological conditions may be different to those assumed and are likely to change as the incident develops. Thus, it will always be necessary to obtain specific information and follow a dynamic risk assessment process.
- This document deliberately focuses on operational issues. As well as meeting the requirements of IRR99, the aim is to provide practical information, in a condensed form, for use in the event of a radiation incident.
- Regulation 7 of IRR99 requires a prior radiological risk assessment that considers both “normal operations” and accident conditions. The distinction between these two conditions is blurred in respect of emergency response. Nevertheless, there are considered to be two main potential accident scenarios:
  - the transfer of contamination to Ambulance staff, equipment and vehicles; and
  - an unexpectedly high external radiation dose being received by Ambulance personnel.

These are considered in the following section.

- The Approved Code of Practice to IRR99 identifies matter to consider in the risk assessment (Paragraph 44), and the outcomes of the assessment in terms of protection measures to be taken (Paragraph 45). A summary of how each of these issues is addressed is given in the appendix.

## **B. BASIC PROTECTION MEASURES**

There are a number of protection measures that apply in respect of **all** radiation incidents:

- Ambulance staff will have received suitable training, as described in the main Guidance document.
- Operational support will be provided by an Ambulance Service Radiation Protection Supervisor (RPS) and, as required, by the Ambulance Radiation Protection Adviser (RPA, which is the Health Protection Agency, Radiation Protection Division).
- Safe working procedures, as described in the Guidance, will be observed. This includes compliance with the Dose Reference Levels, which include a consideration of the IRR99 dose limits (Regulation 11), and also the IRR99 Dose Investigation Level (Regulation 8(7)) as well as the provisions in REPPIR.
- The Ambulance Service will **not be** responsible for designating any controlled or supervised areas.
- Ambulance staff are not designated as classified persons. This is based upon a consideration of previous doses (which have been negligible) and also an assessment of the likelihood of receiving doses above 6 mSv from the scenarios described in this risk assessment. Responding Ambulance staff will wear Electronic Personal Dosimeters (EPDs) to help demonstrate that doses are properly restricted.
- Ambulance staff will use standard (medical) protective clothing when treating casualties. In addition, ambulance staff have FFP3 masks, which will be worn as appropriate to the assessed radiation risk.

## **C. ACCIDENTS DURING INCIDENT RESPONSE (CONTINGENCY PLANS)**

### **Contamination of Ambulance personnel, equipment and vehicles**

- The individual risk assessments give information on when casualties are likely to be contaminated. Where possible, measures should be taken to decontaminate casualties prior to treatment.
- Priority 1 patients with life threatening injuries should not have their treatment and transfer delayed for decontamination. However, it is recognised that the removal of clothing to assist in diagnosis and to provide clinical access, constitutes a form of decontamination. Clothing that has been removed should be treated as contaminated waste.
- Treatment at the scene and whilst in transit should be in accordance with the protocols surrounding the wearing of EPD and the advice given by the trust RPS.
- The following precaution should be observed where practicable.
  - The spread of contamination to personnel can be avoided through normal good hygiene practice. For example, disposable gloves (changed frequently) are generally very effective.
  - The spread of contamination to vehicles can be avoided through the use of plastic sheeting, etc. which can subsequently be disposed of.
  - Any items (including clothing) that may have become contaminated should be bagged, labelled and set aside for subsequent analysis and disposal.
  - The different contamination monitoring resources for each incident are described in the individual risk assessments, and requests for assistance should be made as required. If there is any doubt, consult the RPA.
- The receiving hospital should be notified of the patient's contamination status prior to arrival

### **Unexpectedly high radiation exposure**

The Guidance document sets out different dose reference levels and EPD procedures, and also provides data to help predict the accumulation of external dose.

The individual risk assessments provide an indication of where high dose rates might be encountered: special care should be taken when planning the Ambulance response in such situations.

In the event that a dose reference level is exceeded, the procedures given in the main Guidance document should be followed.

## **D. RISK ASSESSMENTS FOR DIFFERENT RADIATION INCIDENT SCENARIOS**

Based on the list provided by HSE, the following risk assessments have been produced.

- RA1. Radiation accident on non-nuclear premises<sup>4</sup>**
- RA2. Radiation accident (non REPPIR) on nuclear premises**
- RA3. Radiation Emergency (REPPIR)<sup>5</sup>**
- RA4. CBRN – Radiological Dispersal Device (RDD)**
- RA5. CBRN – Emplaced Device**
- RA6. CBRN – Improvised Nuclear Device**
- RA7. Transport accident**
- RA8. Accident while transporting nuclear medicine patients**
- RA9. Lost/Orphan sources**
- RA10. Other scenarios**

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<sup>4</sup> This may include industrial premises (e.g. gauging devices in factories, industrial radiography, etc.); hospitals (e.g. radiation therapy machines) and research and teaching establishments.

<sup>5</sup> REPPIR principally relate to nuclear sites, but there are a number of other REPPIR sites (i.e. that have substantial quantities of dispersible radioactive materials) which the emergency services should already be aware of.

## RA1. Risk assessment for radiation accidents on non-nuclear premises

### A. Radiation Hazard

#### NATURE OF THE RADIATION SOURCES

A wide range of radiation sources could potentially be involved. Many sources are of low activity and the potential hazard is very low. However, very high activity source can be found in applications involving irradiation (e.g. sterilisation of products, cancer treatment), and high activity sources are used in non-destructive testing (industrial radiography).

Source users have to comply with IRR99: unless the accident directly involves the source, radiation exposures should be well controlled. Users should also have contingency plans for dealing with accidents, i.e. to restrict exposures during the initial response.

#### RADIATION LEVELS

##### External radiation (dose rates)

In most cases accessible dose rates will be low (a few  $\mu\text{Sv/h}$ ) and not sufficient to trigger an EPD. However, if there is a loss of shielding (or access is required inside a shielded area) very high dose rates ( $\text{mSv/h}$  or higher) could be present within a few metres of the source.

##### Internal radiation (contamination)

Normal contamination levels, e.g. in research labs are typically very low. An accident could result in damage to a source, causing localised contamination levels that could be significant. Note, however, that high activity sources are Special Form, and are designed to withstand severe accidents.

#### POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)

In most cases, doses to responders should be negligible, and DRL 1 (1 mSv per event) is relevant.

The worst scenarios would involve treating casualties close to unshielded high activity sources, for which DRL3 (100 mSv) for life saving operations is relevant.

### B. Control measures

#### ACTIONS NEEDED TO CONTROL EXPOSURES

- Follow the operational procedures in the Guidance (Radiation).
- Liaise with site owners to confirm:
  - whether the accident involves a radioactive source
  - whether their Contingency Plans are being followed
  - that they have assessed the dose rates and contamination levels present
- If access is required in high dose rate areas, ask whether local shielding can be provided. Otherwise assess whether patients can be moved, in accordance with operational procedures.
- Ambulance staff should observe site safety procedures when entering and leaving designated areas, including any special PPE provided by the site.
- Seek further advice from RPA if required.

## RA2. Radiation accident (non REPPiR) on nuclear premises

### A. Radiation Hazard

#### NATURE OF THE RADIATION SOURCES

This will depend on the type of site, and on the location and nature of the accident. In many cases, accidents on nuclear sites **do not** involve radiation sources. In some cases, however, significant amounts of radioactivity can be involved, with both internal and external radiation hazards present.

Nuclear sites users have to comply with IRR99 – and access to radiation areas should normally be well controlled. The site should also have extensive contingency plans for dealing with accidents, i.e. to restrict exposures during the initial response, and these should include the arrangements for access by emergency responders.

#### RADIATION LEVELS

##### External radiation (dose rates)

Outside of designated radiation areas, accessible dose rates will be low (a few  $\mu\text{Sv/h}$  at most) and EPDs are unlikely to alarm. In designated areas, dose rates will probably be higher – up to a few hundred  $\mu\text{Sv/h}$  (EPD may alarm). However, if there is a breach in the shielding (or access is required inside a shielded area) very high dose rates ( $\text{mSv/h}$  or even  $\text{Sv/h}$ ) could be present.

##### Internal radiation (contamination)

Even during normal operations, a wide range of contamination levels can be present depending on the designation of the area – C2 indicates a low-level contamination area, C3 and C4 contain higher levels. In the event of an accident, high contamination levels (in the area, and on the patients) are possible.

#### POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)

In most cases, doses to responders should be negligible, and DRL 1 (1  $\text{mSv}$  per event) is relevant. Where a response is required in designated areas, especially high dose rate areas, then DRL 2 (5  $\text{mSv}$  per event) may be more appropriate.

The worst scenarios would involve treating casualties in high dose rate areas, for which DRL3 (100  $\text{mSv}$ ) for life saving operations is relevant.

### B. Control measures

#### ACTIONS NEEDED TO CONTROL EXPOSURES

- Ambulance services should have already developed specific response arrangements in consultation with the nuclear site operator, and these arrangements take primacy. These arrangements should normally include the following precautions:
  - Liaise with nuclear site operators Health Physics team to confirm whether the accident involves a radioactive source/radiation area and the level of radiation risk.
  - If access is required in high dose rate areas, ask whether local shielding can be provided. Otherwise assess whether patients can be moved, in accordance with operational procedures.
  - Ambulance staff should observe site safety procedures when entering and leaving designated areas, including any special PPE provided by the site.
  - Where a risk of contamination has been identified, the Ambulance responders should request contamination monitoring from site Health Physics – for patients, responders, equipment and vehicles, as required.
- Seek further advice from RPA for matters outside the agreed contingency arrangements.

## RA3. Radiation Emergency (REPPIR)

### A. Radiation Hazard

#### NATURE OF THE RADIATION SOURCES

By definition, a REPPIR emergency is capable of delivering doses above 5 mSv off-site, e.g. due to the release of a plume of radioactivity. Exposures can occur from both external radiation and inhalation.

The most severe radiological conditions might be expected on-site, i.e. close to the release point, although this is not always the case (in some cases the activity is released upwards, and returns to ground level some distance away).

REPPIR require extensive pre-planning for such emergencies, including liaison with emergency responders. Ambulance services should have detailed plans for responding (REPPIR, REG 14).

#### RADIATION LEVELS

##### External radiation (dose rates)

In most REPPIR scenarios the external dose component is significant. Dose rates on site may vary from low to very high (see RA2). Off-site, dose rates should be lower – in most cases a few tens of  $\mu\text{Sv/h}$  or less (unlikely to trigger an EPD).

##### Internal radiation (contamination)

In the event of a REPPIR emergency, high contamination levels (airborne and on surfaces) are possible on site, especially in the vicinity of a release. Off-site, airborne contamination levels may be significant in the plume (note that the wind direction, wind speed and release duration are important factors), and deposition from the plume (especially if it is raining) can lead to ground contamination.

#### POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)

On site, there may be significant dose rates and airborne contamination levels, and doses of the order of a few mSv are possible. HPA assessments of off-site doses to emergency responders from emergencies at UK nuclear sites have produced estimated doses of 1 mSv or less.

The initial aim should be to comply with DRL1 (1 mSv per event), although in especially serious emergencies higher doses (up to 20 mSv) may need to be considered. The worst scenarios would involve treating casualties close to unshielded high activity sources, for which DRL3 (100 mSv) for life saving operations is relevant.

Off-site, dose should be substantially lower with DRL1 (1 mSv per event) being appropriate in most cases. Exceptionally, DRL2 (5 mSv per event) might need to be considered.

### B. Control measures

#### ACTIONS NEEDED TO CONTROL EXPOSURES

- Follow the REPPIR procedures established for the site and the operational procedures in the Guidance (Radiation) and
- On site, follow the actions listed in RA2.
- Off-site:
  - Where practicable plan to avoid deploying staff in the immediate area of the plume
  - Observe any contamination control measures implemented as part of the REPPIR arrangements. However, note that ground contamination may be widespread, and it may be impractical to prevent the spread of activity.
- Seek further advice from RPA as required.

## RA4. CBRN –Radiological Dispersal Device (RDD)

### A. Radiation Hazard

#### **NATURE OF THE RADIATION SOURCES**

Involves the dispersion of radioactive materials, for example using a conventional explosive or other means of dispersal. A range of radioactive sources could be utilised, for example from industrial or medical applications. The primary aim is the dispersion of radioactive contamination – airborne and surface. High dose rates are less likely, although there could be localised “hot spots” due to source fragments.

#### **RADIATION LEVELS**

##### **External radiation (dose rates)**

Dose rates will be highest for the non-dispersed (and unshielded) source. Post-detonation source fragments could give high dose rates (a few mSv/h) within a few metres.

##### **Internal radiation (contamination)**

Contamination may be widespread, but the most significant levels would be expected within a few hundred metres.

#### **POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)**

Doses to responders outside the cordon should be low, and DRL 1 (1 mSv per event) is relevant. Where a response is required inside the cordon, especially where significant residual radioactivity is present, DRL 2 (5 mSv per event) may be more appropriate.

### B. Control measures

#### **ACTIONS NEEDED TO CONTROL EXPOSURES**

- Follow the operational procedures in the Guidance (Radiation).
- Liaise with the Police and other emergency responders to confirm:
  - whether the explosion involved a radioactive source
  - whether the source has been identified, and whether the dose rates and contamination levels present have been determined
  - what cordons have been established, and what are the arrangements for monitoring and decontamination of persons leaving the cordon (including casualties)
- In the absence of specific information, all casualties close to the explosion should be assumed to be contaminated, and the relevant operational procedures followed.
- Where a risk of contamination has been identified, the Ambulance responders should request contamination monitoring (several monitoring resources may be available, co-ordinated by HPA via Gold/Silver command) – for patients, responders, equipment and vehicles, as required.
- Seek further advice from RPA if required.

## RA5. CBRN – Emplaced Device

### A. Radiation Hazard

#### NATURE OF THE RADIATION SOURCES

Involves the covert placement of a radioactive source, i.e. to deliver an external radiation exposure to persons. A range of radioactive sources could be utilised, but to be effective the source needs to be a high activity gamma (or maybe high energy beta) emitter. Unless the source is damaged, there should be no contamination or internal radiation exposure.

#### RADIATION LEVELS

##### External radiation (dose rates)

Dose rates could be very high (mSv/h up to Sv/h) within a few metres of the source – close to the unshielded source (within a metre) extremely high dose rates (>Sv/h) could be present. At a few hundred metres, dose rate should not exceed a few  $\mu$ Sv/h.

##### Internal radiation (contamination)

Not significant

#### POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)

Doses to responders outside the cordon should be negligible, and DRL 1 (1 mSv per event) is relevant. Where a response is required inside the cordon, especially close to the source, DRL 2 (5 mSv per event) may be more appropriate.

The worst scenarios would involve treating casualties close to a high activity source, for which DRL3 (100 mSv) for life saving operations is relevant.

### B. Control measures

#### ACTIONS NEEDED TO CONTROL EXPOSURES

- Follow the operational procedures in the Guidance (Radiation).
- Liaise with the Police and other emergency responders to confirm:
  - whether the source has been identified, and whether the dose rates (and the absence of contamination) have been determined.
  - what cordons have been established, and what are the arrangements for treating people (who may have been exposed, and might require medical treatment) removed from the area.
- Any casualties from the area may be treated as **not** contaminated, unless given information to the contrary.
- Where a risk of contamination has been identified, the Ambulance responders should request contamination monitoring (from Fire and Rescue, AWE/DSTL, or HPA, as appropriate) – for patients, responders, equipment and vehicles, as required.
- Seek further advice from RPA if required.



## RA6. CBRN – Improvised Nuclear Device

### A. Radiation Hazard

#### **NATURE OF THE RADIATION SOURCES**

Involves an immediate “blast” – including intense gamma and neutron radiation– which is sufficient to cause fatalities and serious radiation injuries. It also produces radioactive fallout in the form of airborne radioactive dust. Subsequent deposition of this dust may give rise to further radiation injuries (e.g. skin burns). Long-term contamination is likely to affect a wide area.

#### **RADIATION LEVELS**

##### **External radiation (dose rates)**

Extremely high during the early phase. Activation and fallout will result in elevated dose rates subsequently –which may remain high for a period of time after the detonation.

##### **Internal radiation (contamination)**

Contamination is likely to be significant and widespread.

#### **POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)**

Difficult to predict – much will depend on the type of device and the response required. However, there may be significant dose rates and airborne contamination levels, and doses of several mSv are certainly credible. Initially, the aim should be to comply with DRL2 (5 mSv per event), although higher doses (up to 20 mSv) may need to be considered. The worst scenarios would involve treating casualties close to the point of explosion, for which DRL3 (100 mSv) for life saving operations is relevant.

### B. Control measures

#### **ACTIONS NEEDED TO CONTROL EXPOSURES**

IRR99 do not apply to this scenario, although the operational procedures in the Guidance (Radiation) still represent good practice that should be observed where practicable.

This scenario involves a multi-agency response, with strategic decisions being taken at a national level. Ambulance service should liaise with other agencies, as required, to determine the appropriate response arrangements.

Advice may also be sought from the RPA as required. (Note: HPA will, in any case, be involved in assessing the radiological risks from such an event, and will have established its own Emergency Operations Centre).

## RA7. Transport accident

### A. Radiation Hazard

#### NATURE OF THE RADIATION SOURCES

A wide range of radiation sources could potentially be involved. Many sources are of low activity and the potential hazard is very low, even in a severe accident. Information on the sources should be obtainable from the transport documentation. If not, the packages and labels provide a broad indication of the hazard. For example, TYPE B packages are used for higher activity sources (and are designed to withstand severe accidents). TYPE A packages contain lower activity sources, but are more likely to be damaged.

Carriers have to comply with the Carriage of Dangerous Goods Regulations, and undamaged packages represent a very low hazard to emergency responders. Carriers should also have contingency plans for dealing with transport accidents.

#### RADIATION LEVELS

##### External radiation (dose rates)

Surface dose rates can be determined from the package labels. The Transport Index (TI) is the dose rate at 1 metre (in  $\mu\text{Sv/h}$ ) divided by 10. For example, a TI of 1 indicates  $10 \mu\text{Sv/h}$  at 1 metre from the intact package.

In most cases dose rates will be low (a few  $\mu\text{Sv/h}$  or less) a short distance away from the vehicle. However, if there is a loss of shielding (unlikely with a TYPE B package) very high dose rates ( $\text{mSv/h}$  or higher) could be present within a few metres of the source. If an EPD is triggered at this distance, loss of shielding is likely.

##### Internal radiation (contamination)

Packages are required to be free from external contamination. However, an accident could result in a leaking package, causing localised contamination which could be significant. Note, however, that high activity sources are Special Form, and are designed to withstand severe accidents.

#### POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)

In most cases, doses to responders should be negligible, and DRL 1 (1 mSv per event) is relevant.

The worst scenarios would involve treating casualties close to unshielded high activity sources, for which DRL3 (100 mSv) for life saving operations is relevant. This level of dose would however be considered extremely unlikely.

### B. Control measures

#### ACTIONS NEEDED TO CONTROL EXPOSURES

- Follow the operational procedures in the Guidance (Radiation).
- Liaise with the carriers to confirm:
  - the radioactive sources involved
  - whether their Contingency Plans are being followed (and also RADSAFE where appropriate)
- Liaise with the Police to determine whether they have invoked NAIR. The NAIR representative will be able to check the dose rates and contamination levels.
- If access is required in high dose rate areas, consider whether the vehicle could be moved to reduce the dose rates, or whether some local shielding (e.g. another vehicle) can be used to provide some protection. Otherwise assess whether patients can be moved, in accordance with operational procedures.
- Seek further advice from RPA if required.

## **RA8. Accident while transporting nuclear medicine patients**

### **A. Radiation Hazard**

#### **NATURE OF THE RADIATION SOURCES**

Nuclear medicine patients have been administered with a radioactive material – normally intravenously or orally (can be in liquid or capsule form). Although the radioactive materials tend to have a short half-life, patients will typically be discharged with some residual internal contamination.

Hospitals have to comply with Medical Exposure Regulations and IRR99. Consequently, there are restrictions on how much radioactivity can be administered to patients, and how much residual activity can be present in those discharged. The risks to Ambulance personnel from such persons are very low.

#### **RADIATION LEVELS**

##### **External radiation (dose rates)**

The most commonly used radioactive materials are gamma emitters, and it is normal for gamma dose rates to exist around patients. Dose rates in the vicinity of patients prior to the expected discharge date can trigger an EPD alarm. At the time of discharge these dose rates should be no more than a few (or at most a few 10's of)  $\mu\text{Sv/h}$  at a distance of 1 metre.

There are certain treatments (e.g. therapy with I-131) where dose rates close to patients might be sufficient to trigger an EPD alarm, and this may remain the case for a few weeks after the treatment.

##### **Internal radiation (contamination)**

The patients do not represent a contamination hazard unless there is vomiting, bleeding, urination, etc. In such cases, the contamination represents a very low hazard (and is typically short lived).

#### **POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)**

Doses to Ambulance service personnel should be negligible, This does not represent an incident response, and the "per event" DRLs do not apply. Notwithstanding this, a dose investigation level of 1 mSv per year would be appropriate.

### **B. Control measures**

#### **ACTIONS NEEDED TO CONTROL EXPOSURES**

- Follow the operational procedures in the Guidance (Radiation).
- If there is a spill, for example due to vomiting, it should be cleaned up using normal good hygiene precautions.
- As appropriate, liaise with the relevant Medical personnel (e.g. from the department where the radioactivity was administered) to confirm the radionuclide and activity. If required, confirmatory contamination monitoring should be requested from Medical Physics.
- Seek further advice from RPA if required.

## RA9. Lost/Orphan sources

### A. Radiation Hazard

#### **NATURE OF THE RADIATION SOURCES**

Radioactive sources are occasionally discovered in the public domain. Typical examples include scrap yards and national borders, which increasingly have radiation detection systems installed. It is unlikely that such an event would coincide with the need for an Ambulance response.

A wide range of sources could potentially be found, although in practice these have tended to be either very low activity, or else sources within shielded containers.

#### **RADIATION LEVELS**

##### **External radiation (dose rates)**

In the worst case scenario, dose rates could be very high (mSv/h up to Sv/h) within a few metres of the source. However, it is much more likely that dose rates will be low (a few  $\mu$ Sv/h at most).

##### **Internal radiation (contamination)**

Contamination could be present, although this tends to be very localised, i.e. is present on surfaces that have been in contact with the source.

#### **POTENTIAL DOSES AND DOSE REFERENCE LEVELS (DRLs)**

Doses to ambulance should normally be negligible, and DRL 1 (1 mSv per event) is relevant. The worst scenarios would involve treating casualties close to a high output source, for which DRL3 (100 mSv) for life saving operations is relevant.

### B. Control measures

#### **ACTIONS NEEDED TO CONTROL EXPOSURES**

- Follow the operational procedures in the Guidance (Radiation).
- Liaise with the site owners, the Police and other emergency responders to confirm whether the source has been identified, and whether the dose rates and contamination levels have been determined
- Any casualties from the area may be treated as **not** contaminated, unless given information to the contrary.
- Where a risk of contamination has been identified, the Ambulance responders should request contamination monitoring, normally from the NAIR responders or (if available) the site RPA (also from HPA, if assisting) – for patients, responders, equipment and vehicles, as required.
- Seek further advice from RPA if required.

## **RA10. Other scenarios**

There may be other scenarios involving radiation sources that are not covered in RA1 to 9. One example is the unplanned return of a radioactive-powered satellite to Earth (for which a national response plan exists), although there may well be other accident scenarios that are unforeseen at this time.

In the event of such an accident, one or more of the existing risk assessments 1 to 9 is likely to provide a suitable basis for determining the appropriate control measures - at least initially. Thus, it is recommended that advice is sought from the RPA regarding:

- which of the existing risk assessments most closely describes the accident that has occurred; and
- the modifications required to produce a scenario-specific risk assessment, and what additional precautions, if any, are required to the control measures.

## Appendix to Ambulance Service Risk Assessment

### Requirements of the Approved Code of Practice to IRR99

Paragraph 44 of the Approved Code of Practice to IRR99 recommends that the following matters should be considered when carrying out a prior radiological risk assessment. The parts of this document, plus the Ambulance Service Guidance (Radiation) that correspond to these matters are listed in the table below.

Nature of the radiation source	In each RA, Part A
Estimated radiation dose rates to which anyone can be exposed	In each RA, Part A
Likelihood of contamination arising and being spread	In each RA, Part A
Results of previous personal dosimetry or area monitoring	n/a
Advice from manufacturers or suppliers	n/a
Engineering control measures and design features	n/a
Any planned systems of work	AS Guidance
Estimated levels of airborne and surface contamination	In each RA, Part A
Effectiveness and suitability of personal protective equipment	AS Guidance
Extent of unrestricted access to working areas where dose rates or contamination levels are likely to be significant	In each RA, Part A
Possible accident situations, their likelihood and potential severity	This document , Part C AS Guidance
The failure of control measures or systems of work	This document, Part C
Steps to prevent identified accident situations or limit their consequences	AS Guidance

Paragraph 45 of the ACoP states that the risk assessment should enable the radiation employer to determine the following outcomes. Again, the relevant parts of this document, plus the Ambulance Service Guidance, are indicated in the table below.

What action is needed to ensure that radiation exposures are as low as reasonably practicable (ALARP)	AS Guidance In each RA, Part B
What engineering controls, design features, safety and warning devices, and systems of work are needed	Systems of work in AS Guidance
Whether it is appropriate to provide personal protective equipment	AS Guidance
Whether dose constraints for planning purposes are needed	AS Guidance In each RA, Part A
The need to alter the working conditions of any female employee who declares she is pregnant or breastfeeding.	Specific guidance for HART teams.
A dose investigation level to check that exposures are ALARP	In each RA, Part A
What maintenance and testing schedules are required	n/a
What contingency plans are necessary	AS Guidance
The training of classified and non-classified employees	AS Guidance (non classified persons)
The need to designate specific areas as controlled or supervised and the need for local rules	This document, Part B
The actions needed to ensure restriction of access for controlled or supervised areas	This document, Part B
The need to designate certain employees as classified persons	This document, Part B
The need for individual dose assessment	AS Guidance
The responsibilities of managers	AS Guidance
An appropriate programme of monitoring or auditing of arrangements.	AS Guidance

