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Nuclear Emergency Planning and Response Guidance

Part 1 – Preparedness

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Contents

1. Introduction

Purpose and structure of this guidance

1.1.1 The Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR) and the supporting guidance aim to establish a framework for the protection of the public through emergency preparedness for radiation emergency with the potential to affect members of the public, from premises and specified transport operations.

1.1.2 The UK Concept of Operations (ConOps) for nuclear emergencies at fixed sites recognises that from the outset the response to a radiation emergency will require both a local and a national response, with the two being fully integrated.

1.1.3 This Guidance provides the context within which planners and responders need to approach radiation emergencies. The document is structured into three parts Part 1: Preparedness, Part 2: Response and Part 3: Recovery. In addition, the Concept of Operations provides high level direction from the outset.

Concept of Operations

1.1.4 The *Nuclear Site Emergency Response Concept of Operations 2015* provides high level guidance on strategic objectives and how local and national responders will co-ordinate their activities. Setting and communicating clear, unambiguous and achievable strategic objectives in planning, response and recovery is a priority as these should form the basis for shaping and guiding plans.

Part 1 Preparedness

1.1.5 Part 1 describes how to prepare for responding to nuclear emergencies. It is aimed at those who are responsible for drawing up nuclear emergency plans or who may be involved in their implementation, either in exercises or a real emergency.

Part 2 Response

1.1.6 Part 2 describes what nuclear emergency responders should consider in order to deliver an effective and nationally consistent response to any radiation emergency at a nuclear site. It outlines *what* needs to be covered in response activity but does not specify *how* it is to be done in other than general detail because the local arrangements will vary in some measure from place to place subject to the nature and dispersal of resources that will be required to deploy an effective response. Flexibility will be the governing factor when dealing with complex and time critical issues at the local level of response.

1.1.7 Part 2 brings together response guidance from previous iterations of the NEPLG Consolidated Guidance with good practice from local on-site and off-site emergency arrangements and from wider national emergency response arrangements including learning from the Civil Contingencies Act 2004 (CCA) and more recent emergency services Joint Working doctrine. It is consistent with the emergency response duties and associated guidance set-out in the CCA, Devolved Administration guidance and industry specific regulatory requirements covered by REPPIR and the Nuclear Installations Act 1965.

Part 3 Recovery

1.1.8 Part 3 describes the process by which areas affected by the emergency can return to a state that community representatives and stakeholders have determined acceptable and enables a return to a lifestyle where the incident is no longer a dominant influence

Context - civil contingencies planning

1.2.1 The CCA, and accompanying non-legislative measures (collectively referred to as the CCA Regulations), delivers a single framework for civil protection in the United Kingdom.

1.2.2 Emergency response arrangements in the UK under the CCA regulations, including in Scotland which has its own guidance (Preparing Scotland, 2012), are now well established and provide a solid basis for responding to any radiation emergency.

1.2.3 This Guidance provides the context within which planners and responders need to approach nuclear emergencies. All civil nuclear licensed nuclear sites in the UK are required by the Office for Nuclear Regulation (ONR) to provide a safety case. The safety case provides information on both the likelihood of radiation emergencies and the potential scale of radioactive releases in the event they were ever to occur, which in turn informs emergency planning, response and recovery.

Why and how nuclear EP is different

1.3.1 Planning for radiation emergencies has much in common with other potential hazards. However these types of emergency have some features that do need special consideration. These are highlighted in this guidance.

1.3.2 The effectiveness of nuclear emergency plans is not determined by their ability to eliminate totally any additional radiation exposure but is instead measured by their ability to reduce by quite small amounts any additional lifetime risk of cancer. Moreover the plans must achieve this without causing other detriments to those affected people that could outweigh these relatively modest reductions in lifetime risk.

1.3.3 Research into radiation emergencies has identified that one important driver of these types of health impacts is a higher than justified level of anxiety and concern among the public. This is exemplified by:

- People not at any significant risk believing they or their loved ones have in fact been exposed to harmful radiation;
- Members of the public stigmatising people that they perceive to be in some way tainted, perhaps by exposure to radioactivity.

1.3.4 To minimise this type of health impact plans need to prioritise the provision of timely and credible information and its delivery over a potentially wide area via routes and agencies likely to be trusted. It needs to be recognised that people in areas completely unaffected by any radiation release and at considerable distances from the site of the emergency may well be just as susceptible to this type of stress-related health impact as those in the vicinity of the site. More information on Warning and Informing can be found in Part 2: Response.

1.3.5 Emergency plans need to set down in advance the conditions under which countermeasures should be considered. This is necessary to ensure that, on the one hand, countermeasures are enacted promptly when needed but, on the other hand, are not introduced if their potential benefit would be less than the detriments (including health risks) they could cause. National guidance on the use of short term or urgent

health protection countermeasures is provided through the “Emergency Reference Levels” (ERLs) defined by Public Health England (PHE).

Legislative Context

1.4.1 REPPIR is the primary legislation covered within this guidance. Annex A provides a summary of REPPIR’s off-site emergency planning process. There are also other specific duties set out in other legislation (see Annex B for details).

2. Understanding Nuclear Risk

Summary

2.1.1 This Chapter provides the context within which planners and responders need to approach nuclear emergencies.

2.1.2 The risk of radiation emergencies at nuclear plants is just one of the many types of risk that are considered by Government and published within the UK National Risk Register (NRR)[1].

2.1.3 Planning for radiation emergencies has much in common with other potential hazards. However, there are some features of radiation emergencies that do need special consideration. This chapter provides this context.

Nuclear risks

2.2.1 The government aims to ensure that all organisations have clear and effective risk assessment processes in place. The risks the UK and its citizens face are continually changing and the government monitors the most significant risks over the next 5 years through the National Risk Assessment (NRA). This is a confidential assessment, conducted every two years that draws on expertise from a wide range of departments and agencies of government. The NRR is the public version of the assessment. The risk of radiation emergencies at nuclear power plants is just one of the many types of risk considered.

2.2.2 In the context of safety and emergency planning the term *"risk"* refers to the likelihood of some level of harm occurring. The term *"hazard"* is used to describe the potential nature and scale of some harm that is being considered irrespective of the likelihood that this harm will actually arise.

2.2.3 The hazard presented by nuclear facilities to members of the public offsite comes from the possibility that radioactive materials within the facility could be released into the environment and travel to areas where people could then become exposed to harmful levels of radiation. A key objective is therefore to prevent the release of any significant quantity of radioactivity into the external environment.

The likelihood of radiation emergencies in the UK

2.3.1 All major civil or defence UK nuclear facilities are subject to rigorous independent regulation by the Office for Nuclear Regulation[1] (ONR) whose mission is to hold UK nuclear operators to account on behalf of the public[2]. One aspect of this is that ONR requires that the philosophy of "defence-in-depth" is properly applied. This safety philosophy involves providing multiple "safety barriers", any one of which will prevent or mitigate an accidental release of radioactivity.

2.3.2 Provided that at least one of the multiple safety barriers remains intact, the prime objective of preventing radioactivity release will be achieved. It is

[1] The MOD internal regulator, the Defence Nuclear Safety Regulator (DNSR) leads on regulating nuclear safety at UK defence sites.

[2] ONR also regulates a number of UK defence-related nuclear sites and works with the Ministry of Defence's safety regulator which follows an equivalent regulatory approach to ONR.

however a regulatory requirement for all UK licensed nuclear sites that, despite the strenuous efforts made to prevent releases, plans are provided to deal with the effects of radiation emergencies.

2.3.3 This UK regulatory system was introduced after the serious emergency in 1957 at the Windscale (defence-related) nuclear reactor in Cumbria. Since then the UK's approach to ensuring nuclear safety has been very effective and there have not been any radiation emergencies at UK nuclear plants that have required plans to be activated to protect the public. UK nuclear operators and their independent safety regulator ONR both share the objective of ensuring that this safety record is sustained.

2.3.4 Annex C: Risk Assessment provides more detail on some of the specific safety goals that are set by ONR for licensed UK nuclear installations. This Annex shows that, if the goals set by ONR are met in full for a nuclear site, the likelihood of an radiation emergency occurring that could justify any short term or urgent offsite actions to protect the public would be around 1 chance in 100,000 per year, or even less. For perspective, emergencies of this low likelihood fall at the lower limit of events considered to be worthwhile including within the UK National Risk Register.

The scale of radiation emergencies to be considered by planners

2.4.1 The safety cases that have to be prepared for all licensed nuclear sites in the UK (and which are required in order to address the safety goals set by ONR) provide information on both the likelihood of emergencies and the potential scale of radioactive releases in the event they were ever to occur. For all such installations there will be a range of severity, with small releases of radioactive materials relatively more likely than large releases.

2.4.2 These safety cases are used to identify what are the worst emergency at a particular site that could be considered to be "reasonably foreseeable". It is for this scale of event that detailed emergency plans must be prepared according to UK regulations[3] [See Annex B]. These regulations require operators to perform a Hazard Identification and Risk Evaluation (HIRE) and send a Report of Assessment to the regulator. ONR then determines the area offsite where people would be likely to be affected and for which the relevant local authority must prepare an offsite emergency plan.

2.4.3 The term "reasonably foreseeable" could, in everyday English, convey that an event is actually quite likely, or is perhaps even expected, to happen. As applied in the context of nuclear emergency planning, however, this term is used very differently. Here the worst "reasonably foreseeable" event would be one which was less than likely but realistically possible. Nevertheless in the UK detailed emergency plans are based on these very unlikely events.

2.4.4 All emergency planners recognise that what is planned for in detail seldom turns out to be exactly what happens on the day. Detailed plans are based on a very unlikely scale that is the worst "reasonably foreseeable" for that site. Though a real radiation emergency is likely to be of a smaller scale than the larger impacts anticipated in the detailed plan. But all emergency plans need to be flexible so they can be adapted in an emergency to an event.

[3] The Radiation Emergency Preparedness and Public Information Regulations (REPPIR)

2.4.5 It is nevertheless good practice to consider how the detailed plans could, if ever necessary, be adapted to support the response to an even more severe emergency. In nuclear emergency planning this is known as the principle of "extendibility" (see section 3.6 for Guidance on Extendibility).

The possible impacts of a radiation emergency

2.5.1 The impacts of a radiation emergency include those on health and wellbeing, the food chain and drinking water as well as those on business, economy and infrastructure.

2.5.2 Experience shows there are two categories of public health impact that can follow from an event where a nuclear site invokes offsite emergency plans. The first category is possible health effects due to the public being exposed to radioactive materials. The second category is health effects that are not related to radiation exposure but occur instead as the result of stresses (mainly psychological but possibly also physical) that the public experiences.

2.5.3 International studies of the 3 most important civil nuclear emergencies[4] (all of which took place overseas) have shown that the second category of health impact (i.e. stress-related effects) is likely to account for the majority (and in some cases all) of the public health impacts observed.

2.5.4 Planners and responders to radiation emergencies therefore need to keep both radiation and stress-related health impacts in mind as they prepare for and respond to these types of event.

Stress-related health impacts

2.6.1 Given their potential importance, it is worthwhile understanding the main contributors to stress-related health impacts in nuclear emergencies.

2.6.2 Research into radiation emergencies[5, 6, 7] has identified that one important driver of these types of health impacts is a higher than justified level of anxiety and concern among the public. This is exemplified by:

- People not at any significant risk from the emergency believing they or their loved ones have in fact been exposed to harmful radiation; and
- Members of the public stigmatising people that they perceive to be in some way tainted, perhaps by exposure to radioactivity.

2.6.3 To minimise this type of health impact, plans need to prioritise the provision of timely and credible information and its delivery over a potentially wide area via routes and agencies likely to be trusted. It needs to be recognised that people in areas completely unaffected by any radiation release and at considerable distances from the site of the emergency may well be just as susceptible to this type of stress-related health impact as those in the vicinity of the site. Part 2 – Response provides further information on Warning and Informing.

[4] These emergencies are Three Mile Island (1979) in the US, Chernobyl (1986) in what was then the Soviet Union, and Fukushima (2011) in Japan.

[5] http://www.threemileisland.org/downloads/188.pdf

[6] http://www.unscear.org/docs/reports/2013/13-85418_Report_2013_Annex_A.pdf

[7] http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/Appendices/Fukushima--Radiation-Exposure/

2.6.4 Experience reveals that another cause of these types of stress-related health impacts has been poorly conceived decisions or advice on radiation protection. This can lead to people suffering more harm from the actions taken to protect them than any benefit these actions deliver in terms of reduced radiation exposure.

Radiation health impacts

2.7.1 Radiation health risks in an emergency are directly related to the additional radiation dose members of the public receive as a result. We refer to the *additional* radiation dose because everyone is exposed continuously to natural sources of radiation and so receives some level of radiation dose quite normally in everyday life.

2.7.2 Radiation doses are measured in units called "Sieverts". On average individuals living in the UK receive 2.7 millisieverts (2.7mSv) of radiation dose every year, although the amount varies considerably between people according to the geology in the area where they live and whether or not additional doses have been received from other sources, including medical (e.g. X-rays, CT scans) or lengthy aeroplane flights. As an example, a person living in Cornwall each year typically receives 6.5mSv more than the average UK citizen due to the different geology in that area of UK[8].

2.7.3 International advice is that no member of the public should be permitted to receive an additional dose of more than 1mSv per year from the normal day-to-day operation of nuclear facilities. However it is important to understand that this 1mSv per year limit does not represent a threshold above which radiation becomes dangerous. Indeed, as explained above, people living in some parts of the UK continuously receive radiation doses several times this level simply due to local geology. Instead the 1mSv per year limit reflects a standard that it is considered all practices involving additional radiation exposure of the public should be able readily to achieve and it ensures any additional risk to the public is very low indeed.

2.7.4 Although very high radiation doses (i.e. around 1000 times the dose limit referred to above) can lead to serious short term health impacts, it is very unlikely that these high levels of exposure would ever be reached by members of the public offsite as the result of a UK radiation emergency. Neither of the two most serious emergencies (at Chernobyl in 1986 and at Fukushima in 2011) resulted in doses to members of the public offsite that were large enough to give rise to these types of short term radiation health effects. The safety requirements for nuclear facilities licensed in the UK are such that radiation emergencies large enough to cause short term health impacts among people offsite must be made so unlikely they are not "reasonably foreseeable".

2.7.5 In the absence of doses sufficiently large to cause short term health impacts, the principal harmful effect of additional doses of radiation is to increase the risk of cancer in later years. Although a relationship between radiation and cancer risk has only been confirmed at relatively high doses, international consensus is that it is prudent to assume that any radiation dose could increase cancer risk with the increase being directly related to the size of the radiation dose received.

[8] See www.gov.uk/government/publications/ionising-radiation-dose-comparisons/ionising-radiation-dose-comparisons#comparison-of-doses-from-sources-of-exposure

2.7.6 Cancer is one of the most common causes of death in the UK and over their lifetime the "average" UK person has around a 1 in 5 chance of dying as a result of it. This can be expressed as a lifetime risk of 0.2 or 20%. Using the internationally accepted risk factor for radiation, an additional 1mSv dose would increase this lifetime risk of a fatal cancer from 20% to 20.005% – i.e. a dose at this limiting value would represent only a very small increase to the lifetime cancer risk all UK citizens face.

Radiation Exposure Pathways in an Emergency

2.8.1 A person may be exposed to radiation and receive an additional radiation dose as the result of an emergency in 3 main ways:

- External exposure to a radiation source outside the body;
- Internal exposure from radioactive particles small enough to be inhaled; and
- Internal exposure from radioactive particles taken into the body with contaminated food or drink.

2.8.2 All these exposure pathways[9] need to be considered within emergency plans.

2.8.3 When radioactive material enters the body it may pass through relatively quickly or the body may retain the material for some time. This retention time is determined by the chemical nature of the material rather than its radioactivity. For example, the human body tends to store iodine in the thyroid gland and this happens whether the iodine is natural or in one of its radioactive forms. Other radioactive materials that may potentially be released in radiation emergencies, for example the inert radioactive gas krypton, pass through the human body quickly without being absorbed. This retention time is important because it affects the radiation dose that results from inhaling or ingesting a particular radioactive material.

2.8.4 Another relevant factor is the length of time for which a radioactive material will continue to emit radiation. This varies very considerably according to what is called the "half-life" of the material. A shorter "half-life" means that the radiation is emitted at a higher rate and that the material will become non-radioactive or stable more quickly. Materials with a long half-life emit radiation at a slower rate but remain radioactive for longer periods."

2.8.5 Emergency plans provided to protect the public must therefore take into account the types of material that could be released and the likelihood of them being inhaled or ingested following an emergency at the facility. They must recognise the need to differentiate between the risks from short term exposure and from potential radiation doses accumulated over longer periods of time. [Link to Emergency Plans part of Guidance]

Countermeasures to Reduce Radiation Exposure in an Emergency

2.9.1 There are 6 main types of protective action or health protection countermeasures that may be applied to reduce the risk of additional radiation exposure in a radiation emergency (information on applying countermeasures can be found in the Response document of this guidance). Not all countermeasures are

[9] For further information on pathways see - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/432742/PHE-CRCE-018_Inhabited_Areas_Handbook_2015.pdf

applicable to all nuclear sites. These 6 types can be divided into 2 groups: “short term” and “longer term” measures. They are listed below:

Short Term

- Evacuation from the area – this takes people away from an area where they could receive *external* exposure and *internal* exposure due to either inhalation or ingestion of radioactive material.
- Sheltering inside buildings – this provides a degree of shielding against external radiation exposure (the amount depending on the thickness of the building; tents and caravans are unlikely to provide adequate shelter) and reduces the exposure to inhaled particles (provided the building is relatively airtight and radioactive materials do not seep into it over a lengthy period).
- Consumption of non-radioactive iodine in tablet form (stable iodine is a countermeasure around power producing sites) – this can significantly reduce the exposure to radioactive iodine because once the body is “flooded” with non-radioactive iodine, any radioactive iodine inhaled or ingested will be expelled more quickly. This countermeasure is only relevant to facilities where radioactive iodine is a potential source of hazard.

Longer Term

- Controls and advice on the consumption of contaminated food or drink – this reduces exposure to ingested radioactive materials consumed over a prolonged period of time.
- Relocating people from areas where the dose rate from deposited radioactivity could lead to a significant additional exposure over a period of weeks, months or years.
- Decontamination of areas to reduce the levels of radioactive material that have been deposited on the ground in areas downwind.

For further information on the use of countermeasures during an emergency, see Part 2 - Response.

The role of Emergency Reference Levels in risk reduction

2.10.1 Emergency plans need to set down in advance the conditions under which the health protection countermeasures listed above should be considered. This is necessary to ensure that, on the one hand, countermeasures are enacted promptly when needed but, on the other hand, are not introduced if their potential benefit would be less than the detriments (including health risks) they could cause. National guidance on the use of short term or urgent countermeasures is provided through the “Emergency Reference Levels” (ERLs) defined by Public Health England (PHE).

2.10.2 The ERLs set out the scale of radiation dose reduction (i.e. benefit) that would be sufficient to justify the use of a particular type of countermeasure in response to a nuclear emergency. Because the potential impacts from introducing a particular countermeasure will vary according to the circumstances in which they are invoked, PHE provides a range of ERL doses for each type of countermeasure. The low end of this range represents the scale of dose reduction that would justify use of that countermeasure under conditions where the detriments of the countermeasure were least – i.e. the circumstances for enacting the countermeasure were at their most favourable. Conversely the

upper ERL in the range for a particular countermeasure is the level of dose reduction that PHE advises would be likely to justify that countermeasure even when its implementation could be more challenging.

2.10.3 To illustrate the above approach it is worth considering the example of the sheltering countermeasure. Within its ERLs PHE advises that this countermeasure should start to be considered if its use could reduce the dose a person might otherwise receive as a result of the emergency by 3mSv or more: i.e. PHE set 3mSv as the lower ERL for sheltering. The upper ERL is set by PHE at 30mSv meaning that sheltering should be initiated in virtually any case if it could reduce the additional dose by at least this level. However, although 3mSv is set as the lower ERL, an additional dose at this level is far too small to cause any acute (short term) effect on a person. A 3mSv dose is actually less than one third of the additional exposure that the National Health Service estimates results from a single CT scan of the abdomen (a health procedure that NHS advises patients involves a possible 1 in 2000 or 0.05% additional lifetime risk of dying from cancer[10]).

2.10.4 For perspective, without this additional risk, the lifetime risk of dying from cancer for an average person in the UK is around 1 in 5 (or 20%); so the benefit derived from avoiding a 3mSv exposure is in practice quite small. The Table below illustrates the risk benefits from two types of urgent health protection countermeasures (sheltering and evacuation) if actions are taken at the lower ERL.

Exposure	Dose (mSv)	**Additional Lifetime Risk**	
CT scan of abdomen	10	1 in 2000 additional risk to patient	0.05%
Lower ERL for sheltering	3	1 in 6700 risk averted by action	0.015%
Lower ERL for evacuation	30	1 in 670 risk averted by action	0.15%

Table 1. Illustration of the risk benefits associated with dose-saving at ERL levels

2.10.5 Both the scale and nature of the health risks considered in drawing up nuclear emergency plans make the approach to countermeasures in these plans rather different to some other types of emergency. In most other emergency situations short term, urgent countermeasures are taken to protect people from a source of harm that could otherwise have a short term or even immediate health impact (e.g. sheltering from a toxic chemical release or evacuating from a burning building). In a nuclear emergency the objective of emergency plans goes beyond protecting people from short term health impacts which, as explained above, are actually most unlikely to be a concern. Instead their focus is to reduce so far as reasonably practicable any additional lifetime health risks that could result from levels of radiation exposure that would be far too low to present any short term hazard. This difference in approach means that the effectiveness of nuclear emergency plans is not determined by their ability to

[10] See https://www.gov.uk/government/publications/medical-radiation-patient-doses/patient-dose-information-guidance

eliminate totally any additional radiation exposure but is instead measured by their ability to reduce by quite small amounts any additional lifetime risk of cancer. Moreover the plans must achieve this without causing other detriments to those affected people that could outweigh these relatively modest reductions in lifetime risk.

2.10.6 Radiation risk is not the only source of health risk to members of the public. Therefore it is particularly important that any countermeasures are implemented with due consideration to the potential impact on how this will be perceived by the public.

2.10.7 Experience from overseas radiation emergencies has shown that the perceived threat may be a more important cause of health impact than any radiation doses received due to members of the public far removed from any actual radiation hazard believing themselves to be at significant risk. In some cases this was found to have been exacerbated by poor advice and/or confusion during the response.

2.10.8 Providing prior information to the public on the possible consequences of a radiation emergency and on the planned approach to countermeasures together with delivery of timely, consistent and convincing communication during a real emergency are all essential measures to help reduce this significant type of health risk.

2.10.9 It is important that those preparing plans and responding to a reasonably foreseeable radiation emergency recognise that people who may live far beyond the areas actually affected may still believe themselves to be at risk. Because of this, these people could be at the same risk of suffering stress-related health effects as those local to the plant (who may also be more familiar with the plans). Public communication during the response to radiation emergencies must therefore address the needs of a very wide audience. The only practical way to achieve this is through a communications plan that uses the broadcast and social media effectively (see section 2 – Response for more information on Warning and Informing).

2.10.10 Additionally, emergency plans that enable decisions on countermeasures to be taken promptly and which follow the philosophy set out by PHE in their ERLs should enable the right balance to be achieved between securing a genuine dose reduction and potentially causing other detriments through these protective actions that could outweigh any overall benefit to health.

The importance of delivering a co-ordinated response

2.11.1 All major emergencies require plans to be capable of delivering a co-ordinated response across a range of different organisations. In the event of an offsite radiation emergency, multi-agency co-ordination becomes even more critical because in these types of event it is likely that people far removed from the local area could well believe themselves to be at risk. If the anxieties within this larger population are not taken properly into account in the planning and response, experience shows they could become a significant driver of stress-related health impacts.

2.11.2 This knowledge is one of the factors leading to the approach set out in the UK's ConOps for nuclear emergencies. The ConOps for nuclear emergencies recognises that from the outset an offsite nuclear emergency must trigger both a local and a national response, with the two being fully integrated. The ConOps

summarises the range of organisations involved in the response to a nuclear emergency and explains how a co-ordinated response will be delivered.

2.11.3 An important objective of ConOps joint approach is to address from the outset any widespread public concern in the immediate aftermath through co-ordinated and consistent communications aimed at building public trust in the multi-agency response. If this can be achieved, it will be much easier for the actual impacts to be addressed through the more focused local response in the area affected. The importance of this co-ordinated national and local approach was illustrated by the Three Mile Island emergency where confusion resulted in unnecessary voluntary public evacuation[11].

Different time phases in a radiation emergency

2.12.1 The 3 radiation exposure pathways explained earlier in this chapter were:

- External exposure from radiation sources outside the body;
- Internal exposure from radioactive particles small enough to be inhaled;
- Internal exposure from radioactive particles taken into the body with contaminated food or drink.

2.12.2 In a radiation emergency it is necessary to consider how this may lead to each of these types of exposure to radioactive material.

2.12.3 The plans for responding to a nuclear emergency are triggered by the site operator making the appropriate "declaration". Immediately after this the notification chain to alert all those required to assist in the response begins. As explained above this will involve both local and national notifications.

2.12.4 Before an emergency all the radioactive material produced within the nuclear facility will be kept safely contained and, if necessary, shielded so that none of the 3 pathways above are significant. Once off site nuclear emergency has occurred there would be two distinct phases during which public health countermeasures decisions need to be taken:

- The "acute" / response phase when the conditions within the facility are not fully under control and a release of radioactivity may be occurring or be imminent;
- The phase that follows the restoration of controls within the facility that enable the release of radioactivity to be terminated or (if a release has not occurred) the threat of an imminent release to be removed and when longer term countermeasures are relevant.

2.12.5 These 2 phases are illustrated in Figure 1. The differences between these phases need to be taken into account by planners.

[11] See http://www.threemileisland.org/downloads/188.pdf

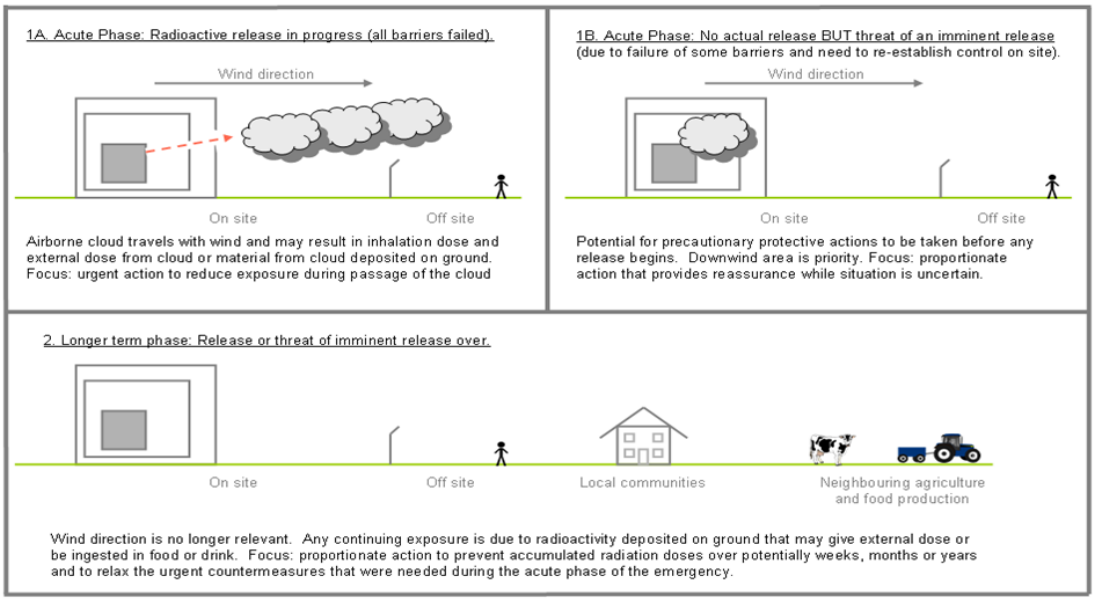


Figure 1. Representation of different phases of a radiation emergency

Acute / Response Phase (see frames 1A and 1B in Figure 1)

2.13.1 Whatever its precise nature, a radiation emergency would be the result of the failure of some or all of the barriers that are provided to prevent the release of radioactive material into the environment. If all the barriers have failed (see Scenario 1A above) and if the radioactive material is in a form which enables it to be dispersed, a release of radioactive material into the environment will take place. This release could begin with little or no warning or may take some time to develop.

2.13.2 If the radiation emergency has not caused all the barriers to fail, there should be no actual release of radioactivity into the environment but the reduction in safety margins may warrant an emergency being declared because of concerns that a release is now more likely (see Scenario 1B in the Figure 1).

2.13.3 In both these cases, during the acute / response phase those responding to the emergency need to take urgent decisions on countermeasures since delays in these decisions could significantly affect the benefit of any actions taken.

2.13.4 During an airborne release of radioactive material the most important exposure route is likely to be inhalation of radioactive materials present in the “cloud” that travels downwind at the speed of the prevailing wind slowly dispersing with distance and so gradually resulting in a lower level of exposure.

2.13.5 Although it is likely to be less significant, there will also be the potential for exposure from external radiation “shine” from the radioactive material within the “cloud” as it passes. Some of the radioactive material airborne in the “cloud” may settle out and be deposited on the ground and this material may result in a continuing external source of radiation exposure (“shine”) after the cloud has passed. Any deposited material may also contaminate food or drinking materials and so present the risk of exposure through ingestion over a prolonged period.

2.13.6 Depending on the nature of the radiation emergency the release of radioactive materials could be a single prolonged or multiple intermittent releases and continue over a period of hours; it is also possible for the release to be short and sharp – a "puff" which takes place over a short period and then ends.

2.13.7 The urgent, short term actions taken to protect the public in this acute / response phase of the emergency must therefore take into account:

- Whether the release has started or is imminent;
- How long any release might last;
- The local wind direction and any forecast for how it might change;
- What scale the release is or might be in future; and
- What is the dominant exposure route.

2.13.8 The operator's plans will cover the provision of advice on all these aspects in this first acute / response phase of the emergency. It is important for all those involved to recognise that the site operator is likely to be the only reliable source for much of this important information.

Countermeasures during the Acute / Response Phase of an Emergency

2.14.1 Three countermeasures are relevant to reducing radiation exposure in this phase:

- Advice to the public to shelter inside buildings;
- Advice to the public to evacuate; and
- Advice to the public to take stable iodine tablets[12]

2.14.2 Those responsible for decisions on protective actions would always need to take into account the known facts of the situation on the day and, in the first hour or two where some elements of information may not yet be available, use their best judgement. However, the following considerations would need to be borne in mind:

- Sheltering can be implemented more quickly than evacuation but is much less effective if the release is prolonged over several hours; and
- Evacuation is most effective if it can be completed before a release begins. It can still be beneficial if a release has started but account should be taken of increased radiological hazards of this. Evacuation is not advisable if the release is very likely to end before the evacuation is complete. The routes by which people are evacuated should always take note of the wind direction.

2.14.3 For radiation emergencies at operating nuclear reactors, exposure to radioactive iodine is likely to be the dominant source of exposure during the acute / response phase. For these radiation emergencies stable iodine tablets provide an extremely important and effective countermeasure and should always be considered. For other types of radiation emergency they are unlikely to be relevant.

[12] This countermeasure is only relevant to sites with operating reactors.

The use of precautionary countermeasures during the acute/response phase – an example

At operating fixed civil reactor sites (and some other sites) in the UK, the strategy for public protection during the first, acute / response phase of an emergency is built around precautionary actions that would be taken before a more detailed assessment of any offsite radiation hazard. The precautionary actions taken would only apply over a defined area, relatively close to the site and the countermeasures advised would be sheltering and, for operating reactor sites the use of pre-distributed stable iodine tablets.

At first sight this approach might appear to be at odds with the messages earlier in this Chapter on the importance of an assessment of benefits and detriments using PHE's ERLs.

However the strategy at these sites is in fact still based on this principle, albeit with the assessment carried out ahead of any actual emergency. The benefits of issuing advice almost immediately during an emergency and not waiting for a fuller assessment of what level of radiation hazard exists is that those living closest to the site, who could be the most affected, receive clear advice quickly. As a result they do not have the stress of waiting for advice and, furthermore, what they are told should be familiar to them from the prior information they will have received. Neither sheltering nor taking pre-distributed stable iodine should entail significant health detriments.

The potential dis-benefit is that these actions may in fact prove not to have been warranted in terms of any radiation dose averted. However, when this was considered by the appropriate organisations involved in developing detailed plans, it was judged that the use of these precautionary measures was for these particular sites a justified and worthwhile strategy.

Longer term countermeasures phase (see frame 2 in Figure 1)

2.15.1 At some point during the emergency actions will be successful in restoring safety margins and if necessary terminating any offsite release of radioactivity. This marks the transition to the longer-term countermeasures phase of the emergency.

2.15.2 In this phase there would be no ongoing release of radioactivity or threat of such a release. Urgent health protection countermeasures implemented during the acute/response phase would initially still be in force but their continued validity would need to be considered for the new situation.

2.15.3 Because urgent, short term actions would have already been taken and because the facility on site would now have been returned to a proper degree of control, there would be less urgency for decisions on dose mitigation during this phase of the emergency. Nevertheless, it would still be important that clear advice was given without undue delay so as to provide continued reassurance to those affected and so mitigate the potential non-radiation health impacts that could arise from stress and uncertainty.

2.15.4 The focus in this phase is therefore on longer term sources of exposure in the form of radioactive material deposited on the ground or resulting from the consumption of contaminated food or drink. In both cases the aim would be to

reduce the additional dose that could be *accumulated* over relatively long periods of time (i.e. weeks or months) through taking proportionate protective actions that will lead to a greater long term health benefit than would be any detriment resulting from the protective action. Getting this balance right is likely to be one of the most important issues for all those involved since experience has shown that, once protective actions have been announced, it is very difficult in practice to scale them back without leading to additional worry and stress, even in those situations where experts agree the actions are not in fact warranted.

2.15.5 Paragraph 2.10.4 Table 1 explains that in the event of a nuclear emergency, urgent, short-term health protection countermeasures might be introduced in order to counteract quite modest health risks – for example evacuation might be advised to prevent a person's lifetime cancer risk increasing by a relatively small proportion from 20% to 20.15%. Actions taken during the long term countermeasure phase should consider whose health would be impacted by the following issues:

- Possible contamination to the food chain and water sources,
- Economic impacts,
- Non contamination issues as highlighted earlier such as mental and social wellbeing and the fear and stigma related to perceived risk of exposure to ionizing radiation.

2.15.6 Mitigation of these impacts should be undertaken as soon as possible. Under conditions where more time is available for further countermeasures to reduce wider detriments, these should be considered.

2.15.7 Controls and advice on food are likely to be the most extensive longer term countermeasure in radiation emergencies. This is in part due to the relatively low level of detriment associated with placing restrictions whose impact is to require people to obtain their food from alternative sources since in countries like the UK such alternative sources are likely to be readily available. However, the impact on farmers and other food producers should be considered and support may be required due to the potential loss of livelihoods.

2.15.8 The evidence from past radiation emergencies is that food controls and advice could well be the most important countermeasure in terms of reducing public health impacts from radiation. Milk restrictions were the only countermeasure required after the 1957 Windscale emergency; and the absence of similar measures after Chernobyl is assessed to have been the cause of the only observed, radiation-linked, public health impact[13].

2.15.9 The maximum permitted levels in food and feed specified for initial use within the European Community following a nuclear emergency, would (typically) restrict additional ingestion doses to less than 1mSv per year – i.e. their benefit would prevent anyone incurring an increase in their risk of fatal cancer of more than 2 chances in 1 million per year. Another way to illustrate the scale of benefit from food controls imposed at the European maximum permitted levels is

[13] From the World Health Organisation
http://www.who.int/ionizing_radiation/chernobyl/backgrounder/en/

that it would reduce radiation exposure over a year by about the same amount as avoiding around 6 return flights between the UK and America.

2.15.10 It is also important to explain that an area in which it may be necessary to provide advice or impose controls on the production of food will not necessarily present any significant radiation hazard to the people or animals living there. This is because the body is much more sensitive to radioactive materials that may be consumed in a concentrated form within food (and particularly milk) than it is to radiation emitted by deposited material in the environment that remains outside the food chain. This means that people and animals can safely continue to live in areas where food production may need to be controlled.

2.15.11 In some types of nuclear emergency it might also be necessary to consider other longer term actions to reduce external exposure to deposited radioactivity now present in the environment after the release has ended. The area over which such actions could be justified would be likely to be much smaller than the areas affected by food controls for the reasons given above.

2.15.12 In such circumstances the initial action would be to ask people to move out of the affected areas (if they had not already been evacuated as part of urgent, short term countermeasures). In the longer term countermeasures phase, there would however be much less urgency for people to leave because the objective in this phase would be to prevent accumulated exposure to relatively low levels of radiation that would only be significant if continued over a period of weeks or months. As a result a situation in which it is necessary for a person to spend a further day or even a week within the affected area to enable their move to be well planned would be unlikely to have a significant impact on the potential benefit from this relocation countermeasure.

The Recovery Phase

2.16.1 Following an emergency, which had led to members of the public being either evacuated (acute / response phase) or relocated (longer term phase), those managing the response would need to consider their return. This would involve an assessment of whether areas needed to be decontaminated before this could take place. Relaxation of health protection countermeasures is one of a number of factors that may indicate that the transition to recovery has started. Plans need to provide for this transition to “recovery” since experience with nuclear emergencies in other countries shows that the way recovery is managed will have an important bearing on the subsequent wellbeing of all those affected. Part 3 – Recovery provides further information on the recovery phase.

3. Emergency Planning

Summary

3.1.1 REPPIR[14] sets out the requirement for developing emergency plans for radiation emergencies. Both operators and local authorities are required by REPPIR to develop an emergency plan where it is reasonably foreseeable that a radiation emergency might arise.

3.1.2 The local authority off-site plan should be prepared for the area, defined by the ONR, around each site to provide an effective response primarily for the protection of the public from any radiation emergency.

3.1.3 The local authority with a licensed nuclear site covered by REPPIR acts as the co-ordinator for all the relevant organisations[15] involved to ensure there is a multi-agency local offsite plan as required by REPPIR.

3.1.4 It is good practice for local authorities, together with their resilience partners, to assess the extent to which it is reasonably practicable and worthwhile to extend the introduction of emergency measures beyond those planned in detail within the offsite plan for a beyond reasonably foreseeable radiation emergency. The chapter also describes the principles and approach for best practice extendibility.

3.1.5 This chapter does not set guidance for developing operators' or national level plans. However, the information within this chapter will be relevant to them to inform the development of an integrated planning framework.

Introduction to Emergency Response Planning

3.2.1 Emergency planning is a cycle of activities involving risk evaluation, planning, testing and review. It is a systematic and on-going process, preparing organisations for the response to and recovery from emergencies. It should evolve as lessons are identified and addressed, and as circumstances change.

3.2.2 Off-site plans should be embedded within the management culture of the local authority and relevant local resilience organisations required in the emergency response. This is vital to ensuring an effective response should an emergency happen. It is equally vital to maintain the plans[16] as circumstances change, and to ensure that awareness of the plans is renewed as they are revised.

3.2.3 Operators, carriers and local authorities have a responsibility to prepare multi agency plans under REPPIR. Though other local resilience organisations are not regulated under REPPIR they may have emergency planning regulatory requirements under the CCA. Operators, carriers and local authorities are required to consult with other organisations in the preparation of their plans. Local authorities often do this via meetings of the Local Resilience Forum,

[14] http://www.legislation.gov.uk/uksi/2001/2975/contents/made

[15] This may include relevant members of the Local Resilience Forum (England and Wales) or Resilience Partnership (Scotland) and any other organisations that are relevant to radiation emergency planning in the local area.

[16] As required under Regulation 10 REPPIR.

Resilience Partnership (in Scotland) or a local Emergency Planning Consultative Committee (EPCC).

Emergency Response Planning: REPPIR Requirements

3.3.1 REPPIR and the Health and Safety Executive's (HSE) Guidance on the Regulations[17] aim to establish a framework for the protection of the public through emergency preparedness from premises and specified transport operations with the potential to affect members of the public; and ensure the provision of information to the public.

3.3.2 A summary of the regulations within REPPIR that lead to the requirement for an off-site plan are given in Annex A.

Emergency Response Planning: Objectives

3.4.1 The over-riding principle for an off-site emergency plan is to ensure protection of the public, by reducing (so far as is reasonably practicable) exposure to ionising radiations and securing the health and safety of those affected by a radiation emergency.

3.4.2 The off-site plan should be written having regard to the principles described in **REPPIR Schedule 8, part I:**

- The intervention should only be undertaken if the reduction in harm from radiation is sufficient to justify the harm and costs, including social costs, caused by the intervention; and
- The intervention should ensure that exposures to radiation are kept as low as is reasonably practicable, but that the health impacts of any intervention do not outweigh radiological risk.[18]

3.4.3 In addition, **REPPIR Schedule 8, Part II** describes the purposes of intervention for the off-site plan (which should inform decisions on protection measures). These are as follows:

- Reducing or stopping at source direct radiation and the emission of radionuclides;
- Reducing the transfer of radioactive substances to individuals from the environment (including food sources); and
- Reducing the exposure and organising the treatment of persons who have been exposed to radiation.

3.4.4 Finally, an off-site plan must address each reasonably foreseeable radiation emergency, as identified by the operator. **REPPIR Schedule 7, Part III** sets out the statutory minimum requirements for the off-site emergency plan.

[17] http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717622405

[18] The effectiveness of nuclear emergency plans is not determined by their ability to eliminate totally any additional radiation exposure but is instead measured by their ability to reduce by quite small amounts any additional lifetime risk of cancer. The plans must achieve this without causing other detriments to those affected people that could outweigh these relatively modest reductions in lifetime risk. Minimising the effects of stress therefore needs serious attention within plans, alongside the measures taken to address radiation risks.

3.4.5 In addition it is good practice for the emergency plan to provide the basis for dealing with beyond reasonably foreseeable radiation emergencies, through the concept of extendibility. Detail on extendibility is set out in paragraph 3.6.

3.4.6 The off-site emergency plan should focus on the first few hours and days of a radiation emergency. It is also good practice for the plan to address the response required during all phases of the emergency, including longer-term recovery. See Part 3 Recovery for more details on recovery planning.

Emergency Response Planning: Features and Content

3.5.1 Each off-site emergency plan will be specific to the site, its hazards and risk assessments. However, **REPPIR Schedule 7, Part III** describes the minimum information required in an off-site emergency plan.

3.5.2 The information required within the plan should enable the local authority along with their resilience partners to:

- **Quickly alert and call out emergency responders** (following the operator's initial alert), including the details of those persons (or positions) who are authorised to take charge or and co-ordinate the off-site emergency response;
- **Co-ordinate resources necessary to implement the plan**, including carefully pre-planned co-operation of local resilience partners to deliver protection measures where multi-agency co-operation is vital to success (e.g. evacuation);
- **Assist the operator in bringing the emergency under control** and returning the site to a safe condition;
- **Undertake off-site mitigation actions to protect the public**, which are likely to include the provision of countermeasures where appropriate;
- **Provide the public with specific information** relating to the emergency and the behaviours that should be adopted (particularly with regards to any countermeasures) (see Part 2 Response for information on warning and informing);
- Ensure that those emergency responders who are involved in dealing with the emergency are not put at unnecessary risk and, in particular, to ensure that they are not exposed to unnecessary radiation doses. This should include dose levels deemed appropriate for putting the plan into action.

3.5.3 Information within the plan that will help meet the requirements of **REPPIR Schedule 7 Part III** and the actions listed in 3.5.2 above include:

- **General Information**. A short, overall description of the plan and its purpose. Some reference to the risk assessment on which the plan is based (with more detail as necessary in an annex).
- **Management, Control and Co-ordination Command and Control arrangements**. The main elements of the plan in a hierarchy of importance. The main resilience partners, their roles and responsibilities and procedures for governing them. The key concepts, doctrine and terminology. The main facilities, locations and communications.
- **Activation, including alert and standby**. The procedures for alerting, placing on standby and then activating the key teams named in the control

and co-ordination section. This includes the procedure for determining when an emergency has occurred.

- **Action**. Specific actions to be undertaken, as their contribution to the overall response, by the key organisations, divisions, departments and officers in the hierarchy. Key officer checklists can be abstracted from here.
- **Annexes**. Call-out lists (related to the key teams). Resource lists. Further information, including: more on the risk assessment, as necessary; and a policy statement on carrying out training and exercises.

3.5.4 Local authorities may wish to draw on existing plans for other civil emergencies developed under the CCA. This might include, for instance, generic plans that describe the procedures for setting up joint strategic or tactical co-ordination centres or generic communication plans.

Extendibility Assessment: Introduction

3.6.1 Extendibility assessment is a good practice approach, which considers how countermeasures/arrangements set out within detailed plans required under REPPIR could be extended in the event of a more severe beyond reasonably foreseeable radiation emergency. The HSE's guide to REPPIR, states that:

"*It is good practice for the emergency plan also to provide the basis for dealing with radiation emergencies that are not reasonably foreseeable through the concept of extendibility. The emergency plan should be extendible to provide rapid and effective mitigation for radiation emergencies which could occur, but the likelihood of which is so remote that detailed emergency planning against their consequences is not justified*."

3.6.2 This section provides good practice guidance on extendibility assessments. The default assumption should be that whenever off-site planning is required under REPPIR then the local authority should act as a co-ordinator of the Local Resilience Forum or Regional Resilience Partnership to make an assessment of if and how countermeasures/protection arrangements could be extended in the case of a more severe beyond reasonably foreseeable radiation emergency.

3.6.3 The main objective of the extendibility assessment is to provide an effective, meaningful, practical and proportionate assessment of the practicability of extending countermeasures and arrangements for public protection (beyond those set out in the REPPIR, Reg 9 detailed planning area) in the very unlikely event of a more severe beyond reasonably foreseeable radiation emergency. This assessment can be achieved without further analysis beyond the detailed analysis and assessments already undertaken in respect of the REPPIR Hazard Identification and Risk Evaluation (HIRE). The extendibility assessment should consider the site-specific risk, practicality, worth and cost benefit of extending countermeasures/arrangements for public protection beyond those in the REPPIR, Reg 9 area.

3.6.4 The local authority, in consultation with local emergency planners and the site operator, should co-ordinate the extendibility assessment. The local authority led partnership should determine what reasonably practicable and worthwhile protection measures, including urgent health protection countermeasures, could be delivered beyond those covered in the detailed plan required under REPPIR.

3.6.5 The extent and nature of extendibility planning around a nuclear site should be determined through a local assessment of what countermeasures/health protection measures may need to be and can reasonably be extended in the event of a more severe nuclear emergency. The extendibility assessment should, where appropriate, identify where local planning may need to call on additional practical resources (including regional and national capabilities such as additional stable iodine stocks) and confirm how this will be achieved. The approach to carrying out this assessment is described in Annex D.

3.6.6 The local authority should satisfy themselves on two important points. Firstly, that they have considered the worth of extending arrangements. This should be considered in consultation with the nuclear site operator. For example, does the site-specific safety case warrant consideration of extending countermeasures and if so, how far? Secondly, the local authority should consider the practicability of extending arrangements in the event of a more severe radiation emergency.

3.6.7 Off-site emergency plans should link with other multi-agency plans prepared under the CCA. These plans provide a framework to potentially scale a response to a radiation emergency, should requires countermeasures be required beyond those set out in the detailed plan.

3.6.8 However, it is disproportionate for planning for more severe beyond reasonably foreseeable emergencies to be carried out to the same level as that of the detailed plans required under REPPIR. Instead the extendibility assessment should provide a summary of the worth and practicability of extending emergency planning protection measures e.g. shelter, evacuation, transport restrictions. The assessment should show:

- Which protection measures are reasonably practicable;
- How the emergency protection measures would be extended / implemented, linking to existing arrangements either within the REPPIR, Reg 9 detailed planning area or generic arrangements under the CCA; and
- The time frame required for implementing the emergency protection measures.

3.6.9 The worth and practicability of implementing countermeasures/public protection measures beyond the REPPIR, Reg 9 area should include advice from the operator on the worth of extending countermeasures (based on the detailed assessment in the HIRE), PHE CRCE ERL data/guidance, the justification principles (ensuring protection measures deliver more good than harm), local capability (existing local arrangements under CCA) and the HSE guidance on “reasonably practicable”.

3.6.10 Nuclear operators have agreed to allow local authorities to recover reasonable costs incurred in undertaking extendibility assessments. Should a local authority consider it necessary it may include the agreed costs of other emergency planners, needed to inform extendibility planning assessments, including where appropriate, attendance at local assessment meetings. Such costs will be met from the overall capped funding limit.

3.6.11 There is no regulatory requirement to publish or test extendibility plans or to provide prior information on extendibility. However, local authorities may decide to periodically test any extendibility arrangements and may choose to provide a

summary of, or reference to, their extendibility assessment within the detailed plan required by REPPIR.

3.6.12 There is also no regulatory requirement to review extendibility arrangements under REPPIR. A local authority may choose to conduct a light-touch review of extendibility plans at the same time the detailed REPPIR plan is reviewed (every 3 years, or as needed if local factors significantly change) as good practice.

3.6.13 The local authority partnership undertaking the extendibility assessment may identify arrangements which they feel would be reasonably practicable and worthwhile for an extendibility plan but cannot implement them unilaterally through the Local Resilience Forum / Regional Resilience Partnership. The local area should initially consider whether these identified arrangements are beneficial to wider civil contingencies and whether they can be put in place via the LRF/RRP. Where they are deemed to be nuclear specific the local area should consider with the relevant operator whether there are solutions that can be developed locally. There may be cases where arrangements identified would benefit from consideration at the national level. Such issues should be raised with other local areas through an appropriate forum for consideration. Where it is then considered that national support would provide additional benefits to local extendibility planning this should be raised with the relevant government department. At all stages both local and national level will need to be mindful that proposals are appropriate to the level of risk.

4. Testing of Off-Site Plans

Summary

4.1.1 This chapter outlines approaches for testing off-site plans for nuclear sites. It covers the programming, planning, scope, conducting, assessing, debriefing and reporting of off-site emergency exercises.

> Exercise Definition:
>
> *A simulation designed to validate organisations' capability to manage incidents and emergencies. Specifically exercises will seek to validate training undertaken and the procedures and systems within emergency or business continuity plans.*

Introduction

4.1.2 The legal requirements for the testing of off-site emergency plans are covered by the Regulation 10 of REPPIR, regulated by the ONR.

4.1.3 There is also a requirement under Licence Condition 11 of the Nuclear Installation Act, regulated by ONR, for exercises to be undertaken at nuclear sites. These exercises are known as Level 1 exercises and concentrate primarily on the operator's actions on site. The frequency of these exercises are determined by ONR on a case by case basis but are usually carried out annually.

4.1.4 *Local authorities are required by REPPIR regulation 10 to test the off-site emergency plan at three yearly intervals (known as a Level 2 exercise).* In particular, these exercises test the functioning of the Strategic Co-ordination Centre (SCC), responsibilities of individual local agencies within the SCC and the support provided to the SCC from other organisations such as the operator, national agencies, and ONR. From the annual programme of local off-site exercises one civil site and one defence site is chosen as the national exercise to rehearse not only the functioning of the SCC but also the wider involvement of central government. This is known as a Level 3 exercise. These exercises include the exercising of the various government departments and agencies, including the LGD's Operation Centre (Department for Energy and Climate Change (DECC) Emergency Operation Centre, Ministry of Defence Headquarters Defence Nuclear Emergency Organisation (HQ DNEO) or the Scottish Government Resilience Room. in Scotland. The decision on which exercise should be selected as the national exercise is made jointly between the licensees, the lead government departments (DECC, MOD or Scottish Government), the relevant local authority, and in consultation with ONR.

4.1.5 The National Exercise Programme (tier 1 and tier 2 exercises) co-ordinated by the Cabinet Office is the vehicle for testing national arrangements.

4.1.6 The remainder of this chapter lays down the process that can be followed in planning off-site exercises (Level 2 and Level 3) in full or modular format.

Programming – Level 2 and Level 3 Exercises

4.2.1 Regulation 10 of REPPIR requires the off-site plan to be tested within three years of the date of the last test. This should test all constituent parts of the plan. This can be achieved either by:

- Full exercise where all the aspects of the emergency arrangements are demonstrated in a single event, normally over one day; or
- Modular exercise when elements of a full exercise are demonstrated over a period of up to three years taking account of other exercises.

Full or Modular Exercise?

The following should be considered in deciding whether a full or modular exercise should be undertaken:

- Legal requirements for full exercise or modular;
- Last use of SCC was it for a full or modular exercise;
- Requirements of local and national organisations; and
- Review of other exercises, or live activation of arrangements that have been tested which that would directly support the Offsite Plan e.g. Rest Centre Plan.

4.2.2 To aid emergency planners Annex E includes constituent elements to be tested as agreed at a local level through the exercise planning process. Periodically the test should include the implementation of extendibility emergency arrangements beyond the off-site emergency planning area. Detail on extendibility is set out in para 3.6.1.

4.2.3 Under the modular approach to exercising, credit could be taken for elements tested via conventional incidents under CCA e.g. coordination of evacuation and setting up of reception centres.

4.2.4 Exercise dates are agreed between local authorities, nuclear site operators and ONR taking account of:

- Dates of previous exercises;
- Availability of the SCC;
- Availability of organisations that contribute to testing the issued plan; and
- Potential clashes with other local or national exercises.

The exercise programme is compiled and published on ONR's website[19]

Planning

4.3.1 REPPIR requires both the local authority and the operator to test their plans. In practice the testing of off-site plans is needed to ensure that both the nuclear operator and the Local Authority can meet their separate legal obligations. Hence the nuclear operator and the Local Authority need to work together to ensure that off-site testing is carried out effectively.

[19] See www.onr.org.uk

4.3.2 The Local Authority normally leads the planning of off-site exercises. Arrangements made under REPPIR cover this. Exercise planning should make provision for meetings with representatives of organisations who contribute to the plan and wish to participate in the exercise (the planning group) and, if necessary, for meetings of specialist sub-groups to assist in the development of relevant details of the exercises, for example the technical scenario and media briefing inputs should be considered. Annex F identifies a process that can be used to plan full and modular exercises. An Exercise Director should be appointed to manage the formulation, implementation and execution of the arrangements and to provide a focus for consultation with other interested parties. The secretariat for the planning meetings should record and report the issues discussed.

4.3.3 The Exercise Director should chair all planning group meetings. The initial meeting should be convened at least 6 - 12 months before the date of the exercise or in the case of a modular format 6 months prior to the next 3 year period, to identify, amongst other things, the extent of participation and to agree the overall planning arrangements, objectives, scope and format (modular or full) of the exercise. It is anticipated that 3 or 4 planning meetings will be required, although this will be decided by the Planning Group at the first meeting. Each participating organisation should be present to speak authoritatively on behalf of the organisation they represent and to put forward their organisation's intended contribution, objectives, and view on the format of the exercise. The Exercise Director should consider and, where possible, accommodate the requests of all participants. A key activity for the Exercise Planning Group, and related sub group, will be to develop the exercise scenario and Master Events List (MEL) which will set out the list of events that will take place both through live play and injects. In developing the scenario for a reasonably foreseeable emergency, it is important to ensure that it provides sufficient challenge for the players whilst staying within the constraints of a reasonably foreseeable radiation emergency, as set out in the HIRE.

4.3.4 For a full exercise a final planning meeting should be held about 4 weeks before the exercise, at which representatives' final agreement is obtained to the MEL and management of the exercise. Details of the exercise operational order, including information provided by participating organisations, should be issued to all members of the planning group at least 2 weeks prior to the exercise date.

4.3.5 For a modular exercise a meeting should be held with the relevant organisations to identify the dates when each element will be demonstrated.

Scope and Duration of the Exercise

4.4.1 The objective of the programme should be to ensure that all relevant parts of the emergency arrangements are tested. However, it is recognised that this cannot be achieved in one exercise. To assist exercise planners on the extent of testing Annex E contains a list of elements that should be tested in order to demonstrate the off-site plan. The matrix provides an overall framework for emergency responders to use when planning exercises and should not be considered as exhaustive. Additional requirements may arise due to operational changes, experience from exercises, real events or regulatory issues.

4.4.2 Emergency response organisations may wish to use the exercise matrix in Annex E to provide an auditable and transparent process to confirm the relevant elements of their plan have been tested. The matrix has a 'last tested' column

which the local authority may want to complete prior to the first planning meeting and use the matrix to inform a discussion on the elements of the plan that should be tested in the exercise.

4.4.3 Both modular and full exercises should attempt to demonstrate the following key activities:

- Notification;
- Setting up of facilities;
- Supply of information;
- Interpretation of information;
- Interfaces and exchanges/team-working;
- Decision making;
- Communications & public information;
- Facilities and equipment; and
- Competence of participants.

4.4.4 For a live exercise the duration of the exercise should sensibly reflect the scope of the event. The planning group should be aware that experience to date suggests that local off-site exercises can be demonstrated adequately over a timescale in the range of 4 to 8 hours and for national off-site exercises possibly longer in order to test fully the national dimension.

4.4.5 For a modular exercise no predefined duration can be given, except that all modules should be completed within the three-year period.

4.4.6 An emergency exercise aimed at testing extendibility would need to follow the usual principles of good exercise planning, especially in respect of properly addressing the objectives of the participating organisations.

4.4.7 The elements, which might need to be tested in an extended scenario, would not be different from those for a scenario based on the reasonably foreseeable radiation emergency in most respects. However, some elements, such as public protection measures are particularly relevant. Decisions would need to be taken by the planners on what elements or aspects should be tested and how this should be done. In these circumstances, it is recommended that at the start of the planning process for any extendibility exercise, the key elements for testing are identified taking account of the requirements of planning, and that these help determine the scenario for the exercise.

Exercise Conduct

4.5.1 The Exercise Director has overall responsibility for control throughout the exercise or the particular module being tested, including decisions on termination and on changing its course if the objectives are not being met. Any decision made by the Exercise Director should only be made after prior consultation with key parties.

4.5.2 There should also be an Exercise Control (Excon) established at the SCC made up of subject matter experts who will be responsible for inputting injects to replicate activities that would be part of a response to a real emergency.

4.5.3 Umpires drive the exercise by providing input to the responders by painting a picture of what can be seen or by providing information directly into the exercise

to maintain the response. Some organisations combine the role of the Assessor and Umpire.

Exercise Assessment

4.6.1 ONR observe the exercise to ensure that sufficient aspects of the off-site emergency plan have been tested, and that the requirements of regulation 10 of REPPIR have been complied with. ONR will provide key observations to the post exercise 'hot debrief', and a more detailed and formal response ahead of the 'cold debrief' for inclusion in to the exercise report issued by the local authority (see sections 4.8 & 4.9). Key areas which ONR will consider are:

- Completeness, consistency and accuracy of the emergency plan and other documentation used by organisations responding to an emergency;
- Adequacy of the equipment and facilities and their operability, especially under emergency conditions; and
- Competence of staff to carry out the duties identified for them in the emergency plan, and their use of the equipment and facilities.

4.6.2 However, other responders also have a role in evaluating the lessons learned to determine whether modifications are required to the plan and to promote good practice. With many organisations being involved, there will not be one single method for evaluating the effectiveness of the plan test, and each organisation may want to establish its own self-evaluation criteria relevant to its own response. However, there should be consistency of approach for evaluating the effectiveness of the interfaces between responding organisations. For example, organisations may want to set quantitative measures for timeliness of response, or qualitative measures for effective performance. Guidance on developing both a quantitative and qualitative assessment is provided at Annex I, together with an example of an assessment proforma at Annex J.

Debriefing following the Exercise

4.7.1 For a full exercise a 'Hot Debrief' meeting should be held immediately after the exercise has finished allowing participants attending the SCC to give their initial assessment of the exercise and to identify any immediate issues that might have arisen. A single representative of each SCC participating organisation should be present to give their reactions to the exercise. For civil exercises the meeting should be chaired by ONR. Consideration should be given to a hot debrief for other command facilities that may be established during the exercise and how this is fed into the main hot debrief.

4.7.2 A "Cold Debrief" should be held approximately four weeks after a full exercise to review the comments received, the actions, areas for improvement and a draft report of the exercise. The meeting should, where possible, identify each issue as falling in to one or other of the following categories:

- Issues for which local resolution is appropriate; and
- Issues of a generic nature for which resolution at a national level is appropriate.

4.7.3 These issues, as modified by written comments, should be translated into agreed actions for resolution. These actions once accepted by the appropriate responsible organisation should be cleared as soon as possible.

4.7.4 For modular exercises a final debriefing meeting should be undertaken when all the modules that are going to be exercised have been undertaken and all the supporting information has been collected (i.e. this may be when other full exercises have been undertaken at the SCC).

The Exercise Report

4.8.1 The final report prepared by the Local Authority should be available to participants within six weeks of the exercise or completion of the modules. This should ensure that lessons can quickly be learned and actions addressed promptly. As a minimum, the report should contain an overview of the exercise, highlight the strengths and weaknesses of the off-site emergency arrangements as shown by the exercise and contain a clear and concise agreed action plan. The report should reflect the important points raised by participants in their initial views expressed at the hot debrief and subsequently confirmed in writing. A brief outline of the background to each action should also be given.

4.8.2 If the exercise was undertaken in modular format then a table should be included in the final report stating when and how each module was covered.

4.8.3 Participating organisations should all have the opportunity to comment on the report prior to it being finally agreed. They should be informed that the final report would be in the public domain.

Monitoring the Actions

4.9.1 Actions relating to local issues should be brought by the operator and the Local Authority to the attention of the established local forum on emergency planning. The Local Authority should bring issues of a national nature to the attention of the relevant government department through the relevant local authority representative, as appropriate, and should, where necessary, regularly report on progress to the licensee's local emergency planning forum e.g. Emergency Planning Consultative Committee (EPCC).

4.9.2 ONR produce the Annual National Lessons Learned Report. This report is submitted to the DECC chaired Lessons Learned Board to consider, allocate and track the actions and recommendations from the report with the aims of:

- Identifying the key areas for development in forthcoming exercises;
- Improving off site plans;
- Improving infrastructure; and
- Sharing good practice.

Cost Recovery

4.10 REPPIR sets out conditions for the recovery of costs for testing emergency plans. The local authority and operator should agree the recovery of costs process as part of the exercise planning. It should be noted that currently REPPIR does not allow for cost recovery against separate extendibility or recovery exercises.

5. Testing of Recovery Plans

Introduction

5.1.1 The development and testing of recovery plans is not a statutory requirement under REPPIR. However, the guidance[20] supporting REPPIR states:

- *'The emergency plan should address the response required during all phases of the emergency, both the immediate need and longer term recovery, but focusing on the first few hours after the accident occurs'*. (Para 139); and
- *'Testing will usually examine the response during the emergency phase, and may examine aspects of the recovery phase where appropriate'*. (Para 258).

5.1.2 This means that the statutory requirement for testing nuclear emergency plans must take priority. However, the testing of nuclear recovery arrangements may be considered best practice - an approach which has been adopted by a number of local authorities and their multi-agency partners over recent years.

5.1.3 The purpose of this section is to provide pointers to effective testing of recovery plans in the context of nuclear emergencies. An indicative time line for planning for a nuclear recovery exercise is set out in Annex B2. The emphasis will be on the particular challenge presented by the need to generate a realistic technical scenario, as well as the pace and feel of events which are rare in UK, and on which there are few examples to draw on worldwide.

5.1.4 Recovery plans undergoing test may differ in origin. Some will be based fully or in part on the UK Nuclear Recovery Plan Template. Other local authorities have adopted a generic approach – developing a recovery plan to cover an all hazards approach for a range of incidents. However, it is likely that the majority of plans used for nuclear recovery will include the structures, set out in Section 1 and responders will apply a process approximating to that described in Section 2 to support community recovery.

5.1.5 The principles for effective testing of emergency plans apply equally to recovery plans and are documented extensively. See Annex C3 for a list of useful guidance.

5.1.6 To assist local authorities and their partners in testing nuclear recovery arrangements, the table in Annex D4 provides:

- A selection of example objectives;
- Makes recommendations on the exercise format to deliver an effective test;
- Sets out the organisations and stakeholders who need to be involved; and
- Notes the facilities needed to support the event.

[20] A guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001, HSE 2002

Setting exercise objectives

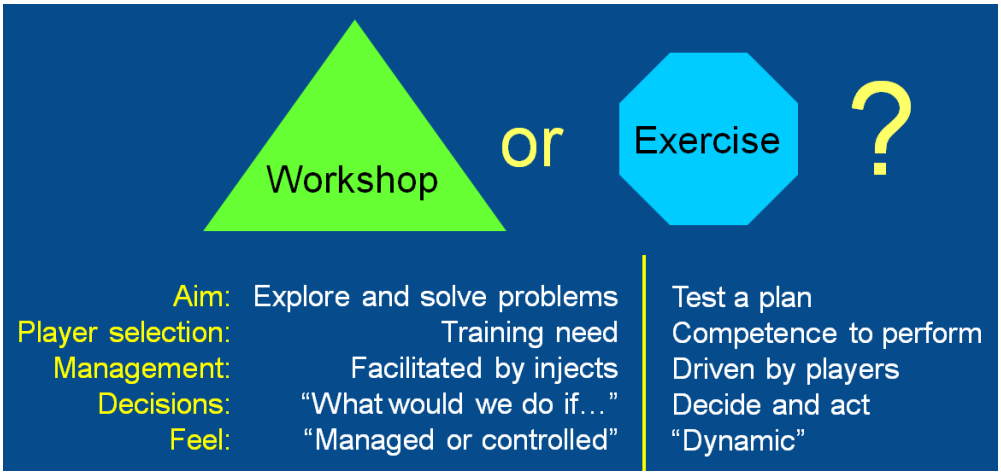
5.2.1 Setting clear objectives for a nuclear recovery exercise is key to achieving a successful outcome. The elements of nuclear recovery that organisations may wish to test fall into two main areas:

- How we manage nuclear recovery. This would involve testing:
  - The frameworks for organising people and resources (RCG and recovery subgroups) and the interfaces between them;
  - The effectiveness of strategic decision-making and inter-agency working;
  - Transition from response to recovery;
  - Managing health, safety and wellbeing;
  - Co-ordinating remediation activities;
  - Integration and interoperability with the nuclear operator;
  - Use of templates and pre-prepared guidance, positions and advice.
- How we address the recovery issues and challenges following a nuclear emergency.
  - This is about testing the ability of the multi-agency group to develop and implement a recovery strategy or important elements of a nuclear recovery strategy, as described in Part 3 - Recovery. It gets to the crux of what supporting nuclear recovery is all about – understanding the impacts on people and environment, prioritising communities that need support, identifying what needs to be done, managing resources and taking action. It tests technical and problem-solving capabilities of responding organisations and the evidence, tools, systems and process which support this activity. Testing in these areas is also a powerful tool for identifying gaps in our national capability for recovering from nuclear emergencies.
- Typical examples of areas to test include:
  - Transition from response to recovery;
  - Development and implementation of an environmental monitoring strategy;
  - Priorities and approaches to decontamination;
  - Dealing with milk contaminated with radioactivity;
  - Dealing with livestock and crops which have been contaminated with radioactivity;
  - Development and implementation of a waste management strategy;
  - Development of an overall Communications Strategy, ensuring consistency of messaging;
  - Recovery actions to enable re-opening of a school;
  - Recovery actions to enable people to return to their homes; and
  - Recovery actions to enable businesses to return to their premises.
- Cross-border issues. For example, involving England, Wales, Scotland, Northern Ireland and Republic of Ireland.

Exercise Format

5.3.1 What you decide to test will determine the exercise format. Formats range from desktop or facilitated workshops, modular events focusing on specific issues, to full exercises running in 'real time'. There are likely to be many combinations and variations on these. Each will make varying demands on resources, facilitators and players. For example, facilitators will generally have more control over the topics for discussion and the timetable of a workshop compared with a real time recovery exercise. Here the activities and decisions of players will determine priorities and outcomes. Effective umpiring will be needed to ensure that exercise play delivers intended objectives. Exercise planners should also consider whether or not to link a recovery event with a nuclear emergency exercise – either immediately or at some later date. The pros and cons of this approach are discussed further in Section 5.1.

Figure 2. Comparison of workshop and exercise formats for exploration and testing of nuclear recovery arrangements.



5.3.2 The scope and complexity of a recovery exercise can be tailored to address issues most relevant to emergency planners. If the intention is to explore multi-agency capability to solve specific nuclear recovery problems, a 'modular' approach focusing on a single or limited number of issues is recommended. For example, topics might include developing strategies to manage contaminated milk or implementation of a waste management strategy.

Developing the nuclear recovery scenario

Scoping the scenario to deliver the off-site consequences you need

5.4.1 Having agreed exercise objectives, the next step is to consider features of the scenario that will deliver:

- An effective test of the management arrangements; and
- The off-site recovery challenges that you intend to explore

The following features of the nuclear scenario should be considered:

- The magnitude and scale of off-site radiological consequences for people and environment;
- The recovery frameworks and structures that need to be in place. For example, RCG, subgroups and participating organisations;
- The people and organisations that need to be involved including appropriate roles, skills, expertise and stakeholder involvement;

- Resources; and
- Information such radiological monitoring results, assessment results, geographical and demographic data and land use information.

5.4.2 During recovery from a real nuclear emergency all information on what has happened from the start of the emergency will be readily available to aid those responsible for recovery in their decision making. In an exercise, this may not necessarily be the case.

5.4.3 To run an effective nuclear recovery exercise, planners need to have an accurate sequence of events and will need to generate information and data reflecting that which would be generated between the start of the nuclear emergency and the point at which the recovery exercise begins. The best way to achieve this is to record and use the sequence of events and supporting information from a past emergency or exercise to provide the background for the recovery exercise. An alternative option is for planners to generate their own sequence of events and supporting information. Annex B2 provides a template for developing the sequence of events or 'story board' leading up to the start of 'live recovery play'.

Using data from a past emergency or exercise

5.4.4 A good approach to running a nuclear recovery exercise is to allow an exercise of the emergency phase to run seamlessly into the recovery phase using the same players. However, there is need to ensure emergency phase exercise objectives are uncompromised and closed out and the time impact of extending the exercise is managed. If the timeframe of the exercise presents the need for organisations to arrange a change of staff, adopt normal shift change and handover processes. This means a separate briefing for players for the recovery part of the exercise is not needed.

5.4.5 There may be a number of reasons why this approach is not suitable for a particular recovery exercise. For example, the exercise may require a second shift and the need for hand over; unable to allocate the necessary resources. If this approach cannot be used, exercise planners will need to provide players with a briefing on the sequence of events and supporting information up to the start of the recovery exercise.

Generating a new sequence of events

5.4.6 Although the time between the beginning of the emergency and the beginning of the recovery exercise may be a relatively short period of time (a few hours), the decision-making and information generation during this time has been undertaken by a large number of people. As a result it may take several months for a planning team to develop all the relevant decisions and information required to manage a recovery exercise effectively. It is also important that those developing the scenario have an understanding of nuclear emergency response and recovery in order to be able to understand what decisions will have been made and what information will have been generated. This emphasises the importance of off-site recovery plans aligning with those of the operator and that planning is integrated.

Time shifts

5.4.7 The process of defining decisions made and information produced will also have to be undertaken to account for any time shifts incorporated into the scenario. Introducing time jumps into a scenario will result in significant increases in the level of preparation. The table in Annex B2 provides a framework for developing the sequence of events, decisions and actions which have taken place up to the point that exercising begins and may be adapted to account for the different times that are being explored. For example, recovery issues at the end of one week, one month and one year.

Limiting the scope of the scenario

5.4.8 The process of defining decisions made and presenting any information produced can be reduced by limiting the scope of a recovery exercise. If the recovery exercise is only focussed on some aspects of the recovery, some decision making and information requirements can be ignored.

Developing the materials to manage the nuclear recovery event

5.5.1 The materials you need to develop will be dependent on the format of the event. For example, a facilitated workshop, a facilitated exercise, a real-time exercise, or a 'walk-through, talk-through' of the actions and decisions recovery organisations will take. The following sections are intended to assist the development of materials for all formats.

How will you set the scene?

5.5.2 Options include:

- Running your emergency recovery exercise/workshop as part of the same event – so briefing about what has happened is not necessary;
- Providing a briefing at the start of the event and whenever there is a time shift;
- Holding a pre-exercise familiarisation event (in person/virtual) which provides refresh on recovery arrangements as well as the sequence of events which lead up to the start of the exercise; and
- Providing a daily news bulletin based on the 'story board' developed using Annex B2 during the week leading up to the recovery exercise. This will highlight what has happened, key elements of the response, decisions, actions and concerns of the public. It should clarify what issues have been closed down and which ones remain to be addressed by players when the nuclear recovery exercise starts. The news bulletin may be delivered as a daily brief to all players by e-mail and/or virtual face to face meeting. Alternatively, the briefings could be brought together in a single, pre-exercise players pack.

What technical data, information and assessments will you need?

5.5.3 This will depend on the exercise objectives and the issues you want to explore. However you will need:

- A scenario that delivers the right mix of off-site challenges;
- Off-site environmental monitoring data which is consistent with the scenario and made available at realistic time scales; and

- Processed monitoring data, including assessment of radiation exposures to people in the affected areas over a given time periods – week, month, year.

How will you present this information?

5.5.4 The time available to collate, analyse and assess data and information for decision-making will be constrained in the context of an exercise. This means that technical information and assessments need to be processed and presented in a way that decisions can be made without delay. This is a good opportunity to consider what decision-makers in the Recovery Co-ordinating Group will need and the formats that will support assimilation and understanding as part of the preparation for nuclear recovery. For example, information formats may include radiation dose maps and tables summarising the costs and benefits of feasible remediation options.

Developing a driving script

5.6.1 The driving script for a nuclear recovery exercise will be underpinned by the aims and objectives of the event. The script will ensure that success criteria are achieved; players focus on areas intended for exploration and the event is realistic in terms of pace and demand. When developing a script consider:

- Areas players are likely to address without prompt, through simply carrying out their responsibilities;
- Areas where players will need specific prompts to steer their thinking and decision-making; and
- What could divert attention from intended areas of focus and strategies for keeping the event on track.

Validating your driving script

5.6.2 Consider who could usefully peer review your exercise/workshop materials. They may be from your own organisation, from the NEP Recovery Board or from other organisations with experience of running similar events. A fresh pair of eyes will be able to assess whether outcomes are achievable and identify any inconsistencies or potential pitfalls.

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