Title:	Hazardous Materials
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Synopsis:	The guidance covers the generic hazards and controls when dealing with hazardous material incidents and features guidance on initial operational response and dry decontamination. Specific classes of hazardous materials will be covered in more detailed guidance to be published in 2016/17.
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National Operational Guidance – Hazardous materials first edition version one (ARCHIVED on 20-09-2017)

Introduction

This section of guidance examines the hazards encountered by fire and rescue service personnel, other responders and members of the public at all hazardous materials incidents. It contains hazard and control measure knowledge relevant to generic hazardous materials incidents, rather than specific types of these incidents, such as a spillage of a corrosive acid.

The fire and rescue service responds to a wide range of incidents involving hazardous materials that have the potential to cause harm to firefighters, the surrounding community and the environment. They may be called specifically to deal with emergency spillages or releases, or they may encounter hazardous materials at fires and other emergency incidents.

This guidance primarily deals with accidental hazardous materials incidents. The operational principles are essentially the same for deliberate, malicious or terrorist events. However, terrorist or CBRN(E) events require a more specific response because of:

- Increased security measures
- Increased risks to fire and rescue service personnel
- Complexity of multi-agency working
- Potential for multiple events caused by secondary devices
- Potential for perpetrators to use virulent agents that may be both persistent and difficult to identify
- Potential to change, remove or conceal safety signage and material information
- Potential to select locations that exploit the characteristics of the agent
- Need to exchange information with off site intelligence and scientific advisers
- Potential for increased public exposure

For these reasons you will find additional guidance in National Operational Guidance: Initial operational response to a Chemical, Biological, Radiological, Nuclear or Explosive incident (IOR) and Special operational response (SOR) (to follow).

The generic key roles of the fire and rescue service at hazardous materials or CBRN(E) incidents are to:

- Save life
- Protect the public and other responders
- Fight and prevent fires
- Manage hazardous materials
- Protect the environment
- Mitigate damage from fires or firefighting and rescue
- Ensure the health and safety of fire service responders
- Ensure safety management inside the inner cordon, other than during the initial stages of terrorist incidents
- Provide health and safety management at incidents that involve other emergency responders

- Urban search and rescue

This guidance does not give information on the specific hazards and control measures relating to environmental protection. Although these are integral to any hazardous materials response, they are covered separately in National Operational Guidance: Environmental protection.

Relevant knowledge

The term 'Hazardous materials' (also referred to as Hazmats or dangerous/hazardous substances or goods) means solids, liquids, or gases that can harm people, other living organisms, property, or the environment. They include materials that are:

- Toxic
- Radioactive
- Flammable
- Explosive
- Corrosive
- Oxidisers
- Asphyxiates
- Biohazards

It also includes materials with physical conditions or other characteristics that render them hazardous in specific circumstances, such as compressed gases and liquids or hot or cold materials. Non-fire and rescue service organisations and agencies may use more technical and specific definitions because of their own requirements, but the above definition is the most appropriate for fire and rescue services to base their risk assessments and planning assumptions on.

Another clear distinction relating to hazardous material operations that needs to be understood before using this guidance is the difference between *'contamination'* and *'exposure':*

- **Contamination** occurs when a substance adheres to or is deposited on people, equipment or the environment, creating a risk of exposure and possible injury or harm. Contamination does not automatically lead to exposure but may do so.
- **Exposure** occurs when a harmful substance enters the body through a route, for example, inhalation, ingestion, absorption or injection, or when the body is irradiated

Due to the technical nature of hazardous materials operations, fire and rescue services must ensure their responders have appropriate specific skills, knowledge and understanding to maintain safety. 'FF5 - Protect the environment from the effects of hazardous materials' is the only hazardous materials specific National Occupational Standard (NOS) and is found in the Firefighters' Role Map. Incident commanders require a higher level of knowledge and understanding; this is not specified in the National Occupational Standard (NOS).

Specific hazardous materials roles may also be required in fire and rescue services to support and manage their hazardous materials response. These may include hazardous materials adviser (HMA), decontamination director, mass decontamination subject matter adviser or tactical adviser (Tac Ad) etc.

The number, type and specification of these roles will vary according to the fire and rescue service's risk profile, risk management plan and equipment/appliances provided.

It should be noted that the term hazardous materials adviser (HMA) is a generic description for any person, with enhanced knowledge of emergency hazardous materials operations, used by a fire and rescue service to provide independent specialist advice to the incident commander. It includes such roles as the hazardous materials officer, hazardous materials and environmental protection officer/adviser (HMEPO, HMEPA), scientific adviser etc. Their primary functions are to:

- Gather, filter and interpret technical information on hazardous materials for the incident commander
- Assess the risks posed by emergency hazardous materials incidents
- Advise the incident commander on the development of a tactical response plan.

Foundation material to enable fire and rescue service personnel to develop competence in hazardous materials operations includes:

'Fire and rescue service operational guidance - incidents involving hazardous materials', 2012, DCLG, TSO.

'Fire service manual – volume 1, fire service technology equipment and media – Physics and chemistry for firefighters', 2001, Home Office, TSO.

'The environmental protection handbook for the fire and rescue service', 2013, EA

'Initial Operational Response to a CBRN(E) Incident', 2015, Joint Emergency Services Interoperability Programme (JESIP), Home Office.

'The dangerous goods emergency action code list 2015', 2015, NCEC, TSO.

'The emergency response guidebook 2012 (ERG)', 2012, US Department of Transportation

Legislation

A hazardous materials response can be complicated by numerous pieces of legislation and regulation. In the main, these are the responsibility of those who produce, transport, use or store the substances. However, some do relate directly to the fire and rescue service:

The Fire and Rescue Services Act (as amended)

The Fire and Rescue Services (Emergencies) (England) Order

The Civil Contingencies Act

The Environmental Permitting (England and Wales) Regulations

The Environmental Damage (Prevention and Remediation) Regulations

Health and Safety at Work Act

Management of Health and Safety at Work Regulations

Personal Protective Equipment at Work Regulations

Personal Protective Equipment Regulations

Confined space regulations

Provision and Use of Work Equipment Regulations (PUWER)

Control of Substances Hazardous to Health Regulations (COSHH)

The Control of Asbestos Regulations

The Control of Lead at Work Regulations

The Ionising Radiation Regulations (IRR)

Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR)

The Control of Major Accident Hazards Regulations (COMAH)

Notification and marking of sites regulations (NAMOS)

The following legislation and regulation place duties and responsibilities on the hazardous materials industry:

ADR (European agreement concerning the International Carriage of Dangerous Goods by Road)

RID (European agreement concerning the International Carriage of Dangerous Goods by Rail)

ADN (European agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)

Dangerous Goods Regulations - International Air Transport Association (IATA)

International Maritime Dangerous Goods (IMDG) Code

Registration, Evaluation, Authorisation & restriction of Chemicals Regulations (REACH)

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

The Water Industry Act

The Groundwater Regulations

Environmental Protection Act

Water Resources Act

The Hazardous Waste Regulations

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDG)

The Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP)

The Air Navigation Order

The Air Navigation (Dangerous Goods) (Amended) Regulations

Radioactive Material (Road Transport) (Great Britain) Regulations (RAM Road)

Packaging Labelling and Carriage of Radioactive Materials by Rail Regulations

Manufacture and Storage of Explosives Regulations (MSER)

NOTE. It is important for fire and rescue services to have personnel with specialist knowledge about hazardous materials to ensure that legal provisions designed to keep the community and responders safe are recognised, understood and maintained.

Risk management plan

Each fire and rescue authority must develop their strategic direction through their risk management plan. To determine the extent of their hazardous materials capability, strategic managers will consider their statutory duties and the foreseeable risk of hazardous materials emergencies occurring in their area.

Work to identify specific hazardous materials risks and prepare operational plans should be carried out with regard to all stakeholders, including local emergency planning groups and the fire and rescue service's risk management plan.

Personnel who may be exposed to hazardous materials must be provided with suitable and sufficient information, instruction and training on:

- Possible risks to their health
- Precautions that must be taken
- Proper use of control measures

Hazard and control statement

Hazard	Control measures
Injury or loss due to insufficient pre-planning for hazardous materials risks	Comply with hazardous materials legislation Gather and have available risk critical information on hazardous material risks or sites Prepare, test and exercise hazardous materials emergency plans Access specialist hazardous material advice Provide an effective means of transferring hazardous material information to the incident ground Provide access to appropriate specialist equipment Provide suitable and sufficient personal protective equipment (PPE)
Failure to mobilise an appropriate response to hazardous material incidents	Assess the level, scale and type of incident from the call Mobilise the appropriate resources to the incident, identifying rendezvous points (RVPs) and marshalling areas Notify relevant agencies

Hazard	**Control measures**
Unsafe approach to hazardous material incidents	Approach the incident safely and estimate potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Liaise with people on and off site Work with other responders to develop a joint understanding of risk Identify the problem and the likely impact of the hazardous materials incident Access specialist hazardous material advice Estimate the resource requirements (hazardous material incident specific)
Undetected or unidentified hazardous materials at incidents	Recognise signs, labels and other marking systems Recognise signs and symptoms of exposure to hazardous materials Gather information on hazardous materials Access specialist hazardous material advice Participate in multi-agency Joint Dynamic Hazard Assessment Recognise the need for detection, identification and monitoring (DIM) equipment Carry out risk assessment based on the information available
Defective hazardous materials containment system	Recognise common hazardous materials containers Identify what is causing or threatening to cause the containment to fail Identify or estimate the quantity involved or potentially involved in the release Access specialist hazardous material advice
Unpredicted impact of hazardous material incidents	Understand the effect of weather and topography on the incident Model the potential or actual release zone Use appropriate equipment to monitor the release Understand the effects of the incident on the environment and local community Access specialist hazardous material advice
Exposure of the general public to hazardous materials	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons

Hazard	**Control measures**
	Consider the immediate life risk Implement life-saving activities Gather information on the hazardous materials Access specialist hazardous materials advice Carry out public evacuation or shelter-in-place Consider downwind protection zones Reduce the chemical hazard
Contaminated members of the public	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Consider the immediate life risk Gather information on the hazardous materials Access specialist hazardous material advice Establish and operate public decontamination Decontaminate people Communicate effectively with public and community Ensure effective inter-agency liaison Work with other responders to develop a joint understanding of risk
Exposure of responders to hazardous materials	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Gather information on the hazardous materials Access specialist hazardous material advice Assess the tasks and associated hazards Select the most appropriate personal protective equipment (PPE) Select the most appropriate personnel Brief personnel effectively before committing them to the hazard zone Use effective communications systems Designate clean areas with washing, hydration and welfare facilities Emergency exposure procedures
Contaminated responders	Approach the incident safely and estimate the potential hazard zone

Hazard	Control measures
	Recognise hazards and risks from a safe location and implement effective cordons Gather information on the hazardous materials Access specialist hazardous material advice Establish firefighter decontamination Decontaminate firefighters and equipment Provide emergency decontamination Provision of decontamination additive Operate agreed protocols for decontamination of inter-agency partners
Uncontrolled release and/or spill of a hazardous material	Approach the incident safely and estimate potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Consider the immediate life risk Gather information on the hazardous materials Access specialist hazardous material advice Identify the problem and likely impact of the hazardous materials incident Identify the objectives and develop a risk assessed response plan with specialist advisers and other agencies Control and/or contain the release Implement effective environmental protection Work with people and agencies that may provide additional advice and assistance
Unsafe and/or ineffective closure of incident	Provide a health monitoring system for all personnel Recording personnel exposure Use an appropriate method for dealing with waste from hazardous materials incidents Implement incident handover procedure Have an effective plan for return to operational readiness

Injury or loss due to insufficient pre-planning for hazardous materials risks

Hazard	Control measures
Injury or loss due to insufficient pre-planning for hazardous materials risks	Comply with hazardous materials legislation Gather and have available risk critical information on hazardous material risks/sites

	Prepare, test and exercise hazardous materials emergency plans Access specialist hazardous material advice Provide an effective means of transferring hazardous material information to the incident ground Provide access to appropriate specialist equipment Provide suitable and sufficient personal protective equipment (PPE)

Hazard knowledge

See National Operational Guidance: Operations – Information gathering

Fire and rescue authorities must have effective arrangements for gathering risk information and making it readily available to operational crews. This is especially important at incidents involving hazardous materials because of their effect on response tactics, such as cordons, personal protective equipment (PPE), environmental protection, protection of the local community, evacuation, shelter-in-place, and so on.

Each fire and rescue service should assess the hazards and risks in its area that relate to hazardous materials. Site-specific plans should be developed where the risks are significant.

The value of multi-agency pre-planning within the remit of the Civil Contingencies Act should not be underestimated. The importance of local emergency planning groups in the planning stage adds further dimensions to existing fire and rescue service work. It enables the risks to be viewed holistically and should add value to any plan, benefitting the responders and their communities.

Control measure – Comply with hazardous materials legislation

Control measure knowledge

See National Operational Guidance: Operations – Information gathering

This control measure deals with the legislative guidance applicable to hazardous materials operations and the duties placed on fire and rescue authorities by health and safety legislation (see **Legislation**).

Strategic actions

Fire and rescue services must:

- Ensure they are involved in preparing, testing and exercising major accident emergency plans within the areas in which they are expected to respond (Metropolitan fire authorities have additional requirements in the preparation of off-site emergency plans where the Control of Major Accident Hazards regulations apply, see COMAH.)

Control measure – Gather and have available risk critical information on hazardous material risks or sites

Control measure knowledge

See National Operational Guidance: Operations – Information gathering

Fire and rescue services should assess the hazards and risks in their area relating to hazardous materials. This may be site-specific, for example, a factory using acid baths, or it may be generic, for example the local road network carrying hazardous materials.

In addition to general site-specific information, the following should be considered:

- Dangerous Substances and Explosive Atmospheres Regulations (DESEAR)
- Manufacture and Storage of Explosives Regulations (MSER), enforcement notices, prohibition notices etc.)
- Notification and Marking of Sites (NAMOS) inspections and information
- British Agrochemicals Safety Inspection Scheme (BASIS) inspections and pre-plans
- The asbestos register
- Significant Control of Substances Hazardous to Health (COSHH) assessments
- Control of Major Accident Hazards (COMAH) plans and information
- CBRN(E) site-specific plans

Strategic actions

Fire and rescue services should:

- Collate and maintain risk information regarding hazardous materials sites within their area or neighbouring fire and rescue service areas where it is foreseeable that their personnel may be required to respond to hazardous materials incidents

Tactical actions

Incident commanders should:

- Identify and declare safe access routes, considering the nature of hazardous material, the terrain and weather conditions
- Identify the hazards associated with substances involved and develop an incident plan containing suitable controls
- Be aware of the associated hazards that evolve from a hazardous materials incident and plan accordingly

Control measure – Prepare, test and exercise hazardous materials emergency plans

Control measure knowledge

See National Operational Guidance: Operations – Information gathering

The development of emergency response plans with specialist advisers, other agencies and operational personnel will focus the content of the plans to identify key specific objectives, identify options, provide tactics and ensure multi-agency agreement.

All plans should be tested and exercised in accordance with the enforcing authority's requirements, which should, in any case, be proportionate to the risks posed.

Strategic actions

Fire and rescue services should:

- Ensure they are involved in preparing, testing and exercising emergency plans in relation to any legislative requirements, such as the Control of Major Accident Hazards (COMAH) regulations
- Ensure a training and exercising strategy includes significant hazardous materials sites
- Be involved with preparing, testing and exercising emergency plans for hazardous material sites and ensure these plans do not conflict
- Ensure plans are reviewed and updated periodically and following learning events
- Ensure an effective system is in place for sharing key information with partner agencies, in compliance with government official marking protocols.

Control measure – Access specialist hazardous materials advice

Control measure knowledge

To ensure a hazardous materials incident is managed safely, the fire and rescue service will need to ensure that specialist advice is available to support the incident commander and operational crews. The amount, quantity and quality of information will be directed by the nature of the incident and it is crucial that the on-scene commander or mobilising control can access the most current information possible.

Specialist hazardous materials advice may be required to:

- Identify the release or spill
- Identify the hazards posed by the release
- Identify or predict physical or chemical reactions
- Assist with the selection of the most appropriate personal protective equipment (PPE)
- Assist with decontamination of people and equipment
- Mitigate further damage to the environment
- Ensure response plans and tactics are appropriate and safe
- Deal with people who have been exposed to hazardous materials
- Assess wider public safety concerns
- Assist with investigations and debriefings

Specialist hazardous materials advice may come from:

- Fire and rescue service personnel with an enhanced level of skills, knowledge and understanding, such as a hazardous material adviser (see HMA)
- Non-fire and rescue service personnel with specific knowledge of hazardous materials or individual products/processes, such as scientific advisers or company chemists

- The National Chemical Emergency Centre (NCEC) that provides 24-hour assistance through the CHEMSAFE scheme
- Printed information sources, for example:
    - The dangerous goods emergency action code list (See emergency action code list)
    - The Emergency Response Guidebook (See ERG)
    - Safety Data Sheets (SDS) also referred to as Material Safety Data Sheets (MSDS), Chemical Safety Data Sheets (CSDS)
    - Transportation instructions in writing (IIW), etc.
    - Electronic information sources, such as Chemdata, wireless information system for emergency responders (WISER), the Emergency Response Guidebook (ERG) app, etc.
- Government agencies, for example:
    - The Met Office
    - Atomic Weapons Establishment (AWE)
    - Defence Science and Technology Laboratory (DSTL)
    - Government Decontamination Service (GDS)
- Environment agencies
- Public health agencies
- Industry response schemes such as Radsafe or Chlor-Aid

Strategic actions

Fire and rescue services should:

- Have access to current and predicted weather forecasting systems such as FireMet
- Have arrangements in place to access risk critical information from remote specialists quickly during incidents, for example, Chemdata via vehicle mounted mobile data terminals (MDT)
- Ensure specialist personnel with enhanced skills, knowledge and understanding in hazardous materials operations are available to perform the key role of hazardous materials adviser (HMA)
- Ensure personnel understand the purpose of the hazardous materials adviser (HMA) role
- Ensure personnel understand basic hazardous materials terminology
- Be able to access site-specific and multi-agency response plans
- Ensure that key dangerous substance information sources are immediately available, reliable and resilient
- Provide access to specialist hazardous materials advice that can evaluate:
    - The effectiveness of personal protective equipment (PPE) against hazardous properties of spills and releases
    - Primary decontamination
    - Secondary decontamination and the potential reuse of equipment

- Risks to the environment and appropriate strategies/pollution control equipment needed to prevent or mitigate damage

Tactical actions

Incident commanders should:

- Access specialist hazardous materials information sources
- Access and use weather information, for example, FireMet, to approach the incident safely and anticipate its impact on the incident
- Consider contacting hazardous material advisers (HMA) en-route as they can provide advice and, if necessary, access information sources before mobilising
- Use the hazardous material adviser (HMA) to carry out a hazardous materials risk assessment and interpret scientific information and/or advice
- Access scientific advisers, site or product specialists and other advisers when necessary

Control measure – Provide an effective means of transferring hazardous material information to the incident ground

Control measure knowledge

Transferring critical hazardous material information is vital to scene safety and underpins all risk assessments, actions and decisions made by the incident commander.

Strategic actions

Fire and rescue services should:

- Have a quick, secure, efficient and effective means for transferring, accessing and recording key hazardous material information that is used to support a hazardous materials incident
- Ensure that the information is contained in an appropriate format and is easily read and can be understood at the incident ground
- Ensure that all information transferred is recorded, time-stamped and dealt with securely
- Ensure incident commanders are able to access and use any system that provides key information to support initial and on-going operations

Tactical actions

Incident commanders should:

- Access available hazardous materials information

Control measure – Provide access to appropriate specialist equipment

Control measure knowledge

Accessing appropriate and specific equipment to deal with a hazardous material incident can assist in mitigating the effects of the incident. Such equipment can be expensive and difficult to maintain. For these reasons, a number of organisations may provide the equipment to the fire and rescue service for use in an emergency. This equipment may be supplied before incidents as part of mutual support, or be available on request at an incident. For example:

- Site owners/operators
- Environment agencies
- Highways agencies
- Private fire and rescue services
- Private contractors

The amount and type of equipment will be determined by the risk posed at the hazardous material site. Use of non-fire and rescue equipment should be subject to normal risk assessment procedures.

Strategic actions

Fire and rescue services should:

- Ensure additional hazardous material specific equipment is available and functions correctly
- Ensure personnel understand the availability of additional specialist equipment and its potential use in a hazardous material incident
- Ensure crews are familiar with specialist equipment provided by external suppliers and its safe use, including an understanding of the testing and maintenance regime associated with additional specialist equipment
- Record the existence of and access to specialist equipment in formal emergency plans and agreements
- Consider the need for intrinsically safe equipment

For further information on pollution equipment supplied by the Environment Agency, see National Operational Guidance: Environmental protection.

Tactical actions

Incident commanders should:

- Access available specialist equipment if appropriate to do so
- Ensure equipment is only operated by competent people in accordance with pre-planned arrangements

Control measure – Provide suitable and sufficient personal protective equipment (PPE)

Control measure knowledge

This control measure aims to ensure that the personal protective equipment (PPE) chosen by fire services when they are equipping their personnel, meets the varied legislative and functional requirements of emergency hazardous materials incidents. It does not cover the selection of PPE at on the incident ground,

which is contained in Hazard – Exposure of responders to hazardous materials, Control measure – Select the most appropriate personal protective equipment (PPE).

For generic guidance on PPE see National Operational Guidance: Operations – Health, Safety and Welfare.

Fire and rescue services should recognise that in line with the concept of the 'hierarchy of controls' in risk management, personal protective equipment (PPE) forms the last line of defence for an individual working in a hazardous environment. Legislative requirements require fire and rescue services to prevent or control the exposure of personnel and others to hazardous substances whilst at work – for example, the Control of Asbestos Act. However, at hazardous materials incidents that fire and rescue services are called to, there will be few alternatives to using PPE, particularly when saving life or preventing damage to the environment. It is therefore vitally important that fire and rescue services understand the advantages and limitations of the available PPE ensembles. This can only be achieved by understanding the performance standards and level of protection afforded by PPE ensembles.

Guidance is provided by the Health and Safety Executive: http://www.hse.gov.uk/toolbox/ppe.htm

In general, when pre-planning for hazardous materials incidents, personal protective equipment (PPE) should be considered in three distinct areas:

- Respiratory protective equipment (RPE) – to prevent exposure to harmful substances through inhalation and ingestion
- Chemical protective clothing (CPC) – to prevent exposure through skin contact and penetration
- Protection against other foreseeable hazards, for example, fire, extreme heat or cold or projectiles

A number of personal protective equipment (PPE) ensembles are available to fire and rescue services, each with different levels of protection in these three areas. Very rarely does one ensemble protect the wearer against all foreseeable hazards. Therefore, selecting hazardous materials PPE must be the result of a risk assessment carried out at the scene of operations (See Control measure – Select the most appropriate personal protective equipment (PPE)).

Structural firefighting kit should be the common default position for fire and rescue personnel whilst en-route and during the initial attendance. Subsequent actions determined by the incident commander, and subject to a risk assessment, may require crews to wear additional protective equipment.

However, the level of protection afforded by structural firefighting kit should not be underestimated and has been subject to rigorous testing as part of the ORCHIDS research programme for CBRN(E) incidents, and in particular Initial operational response. (ORCHIDS at http://www.orchidsproject.eu)

Strategic actions

Fire and rescue services must:

- Ensure any personal protective equipment (PPE) provided is fit for purpose and complies with current legislation (See personal protective equipment

Fire and rescue services should:

- Make provision for personal protective equipment (PPE) in line with the needs of known hazardous material risks, both at known sites and foreseeable transportation risks

- Ensure personnel are properly trained in the use and limitations of any personal protective equipment (PPE) that is provided
- Ensure procedures are in place for maintaining, cleaning, re-using and/or disposing of personal protective equipment (PPE)

Failure to mobilise an appropriate response to hazardous material incidents

Hazard	Control measures
Failure to mobilise an appropriate response to hazardous material incidents	Assess the level, scale and type of incident from the call Mobilise appropriate resources to the incident, identifying rendezvous points (RVPs) and marshalling areas Notify relevant agencies

Hazard knowledge

Without pre-planned and pre-determined information on known hazardous materials sites, fire and rescue services may increase the level of potential exposure of their personnel to a hazardous material. Failure to identify triggers that hazardous materials are involved at the initial time of call, and a lack of understanding of the incident site's inventory will also increase the level of risk to all responders, and could result in emergency responders being exposed to a hazardous material. Mobilising is defined as the activation and continuous process of deploying and managing personnel and resources, including emergency call handling, turning-out and travelling to the emergency. This hazard deals only with the specific mobilising procedures required for hazardous materials incidents.

See Hazard 'Failure to handle emergency calls and mobilise resources in a timely manner' from National Operational Guidance: Operations for further guidance on generic mobilising.

Control measure – Assess the level, scale and type of incident from the call

Control measure knowledge

Mobilising control should follow a set format for gathering key, critical information at the time of the initial call and be able to determine the appropriate resources to mobilise. Pre-planned information regarding known hazardous materials sites should assist each fire and rescue service to identify and pre-determine the appropriate resources to deal with a hazardous material incident.

To support the implementation of multi-agency and major incident plans, mobilising additional specialist personnel to tactical/strategic co-ordination groups, remote from the initial incident, would also be a key consideration, along with sharing information with other relevant agencies

Strategic actions

Fire and rescue services should:

- Ensure call handlers have a basic knowledge of hazardous materials operations

- Ensure mobilising controls have accurate information on all known significant hazardous materials sites
- Ensure mobilising control personnel and systems can quickly and accurately match the information given by callers to site-specific pre-determined attendances (PDA), hazardous materials specific operational plans and hazardous materials related multi-agency plans
- Ensure the scale of attendance reflects the foreseeable risks posed by the type, size and location of the incident
- Consider using the national incident types when categorising hazardous materials incidents
- Ensure sites known to contain significant hazardous materials risks have specific pre-determined attendances (PDAs) based on, for example:
    - The risk to human life
    - Quantity and type of hazardous materials
    - Processes carried out
    - Site management and the risk of escalation
    - Location in relation to inhabited areas, critical infrastructure, sensitive environments, etc.

Tactical actions

Mobilising controls should:

- Gather information from the caller:
    - Where is the incident? Is it at a known risk or target/sensitive site/occupancy?
    - Is there a site-specific plan for the location?
    - Are hazardous materials actually involved or just present at the location?
    - What quantity is involved?
    - Are there reports of any unusual odours, explosions or other unusual reactions?
    - Are there any injuries or casualties? Are the causes or reasons known? (See 'STEP 1-2-3 Plus' (Safety Triggers for Emergency Personnel))
    - Are other emergency services in attendance or involved?
- Match incident details to site-specific pre-determined attendances (PDAs), operational plans, multi-agency plans, etc.
- Implement 'major incident' plans if the information provided by the caller meets agreed triggers (Consider the METHANE acronym)

Control measure - Mobilise appropriate resources to the incident, identifying rendezvous points (RVPs) and marshalling areas

Control measure knowledge

The mobilisation of resources should be in line with a pre-planned and pre-determined response. The resources mobilised should enable arriving fire and rescue personnel to put in place safe systems of work.

Due to the very nature of the hazardous material incidents, rendezvous points (RVPs) and marshalling areas large enough to hold emergency responder resources off-site should be identified and agreed in the planning stage, and should take into account the varying requirements presented by the weather conditions of the day.

Access to Site-Specific Risk Information (SSRI), pre-determined attendances, specialist advice and operational and multi-agency plans would enable a mobilising fire and rescue service to control and advise en-route resources on:

- Safe approach routes
- Prevailing weather conditions, for example, wind speed and direction information from FireMet
- Pre-planned rendezvous points (RVP), for example Control of Major Accident Hazards (COMAH) plans, airports
- Marshalling areas

Strategic actions

Fire and rescue services should:

- Consider using pre-planned marshalling sites or rendezvous points (RVPs) for significant known hazardous material risks
- Use FireMet and supply information to responders
- Consider mobilising to upwind rendezvous points (RVPs) for significant incidents
- Mobilise resources according to incident type, scale and location
- Mobilise enhanced resources for 'major incidents'
- Mobilise enhanced resources to known CBRN(E) events
- Identify and be able to mobilise key personnel, equipment and vehicles for a hazardous materials incident, for example, hazardous materials advisers (HMAs), decontamination units
- Ensure the size and location of rendezvous points (RVPs) and marshalling areas are:
    - Far enough away
    - Large enough to contain fire and rescue resources as well as other responding agencies
    - Upwind and uphill from incident site if possible
- Ensure critical information can be shared between mobilising control rooms, responders and other relevant agencies

Tactical actions

Incident commanders should:

- Monitor actual weather conditions on approach to the incident, as these may differ from theoretical FireMet predictions due to local circumstances
- Request information on, and begin to consider, the likely hazards and control measures when mobilised to known hazardous material sites

- Access Site-Specific Risk Information (SSRI)
- Establish a safe system of work for moving vehicles into and out of an identified rendezvous point (RVP) or marshalling area
- Consider a 'make-up' for enhanced resources and/or declaration of a 'major incident'

Control measure – Notify relevant agencies

Control measure knowledge

Other responding agencies will also have a critical role in managing a hazardous materials incident. Information sharing from the initial call benefits the response and enables any pre-planned requirements to be implemented quickly.

This co-ordinated response ensures a consistent approach with pre-defined goals for all responding agencies. This combined effect results in improving the safety of initial responders, increases public safety and should lead to earlier resolution of the incident and a quicker return to normality.

A well co-ordinated multi-agency response may also provide a level of assurance to the public and give a professional image of those attending the incident. In a hazardous materials incident, good public relations cannot be underestimated and will be critical in gaining public confidence in the emergency services, especially if large cordons or evacuations are considered necessary.

Strategic actions

Fire and rescue services should:

- Have systems for disseminating or collating information to/from other relevant agencies in place in mobilising control
- Be able to request information from other agencies over the phone and, if necessary, attend the incident or command centre to assist in the management of the hazardous material incident using the METHANE format as best practice
- Ensure mutual aid schemes and specialist responders are available to assist in managing a hazardous materials incident

Tactical actions

Incident commanders should:

- Consider how other agencies can help resolve the incident
- Request required agencies to attend
- Ensure hazard information is shared between agencies (See joint understanding of risk (JUR))
- Adopt a multi-agency co-ordinated response if appropriate

Unsafe approach to hazardous material incidents

Hazard	Control measures

Unsafe approach to hazardous material incidents	Approach the incident safely and estimate potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Liaise with people on and off site Work with other responders to develop a joint understanding of risk Identify the problem and the likely impact of the hazardous materials incident Access specialist hazardous material advice Estimate the resource requirements (hazardous material incident specific)

Hazard knowledge

To understand this hazard fully it is important that responders know the following definitions:

Initial cordon

The initial cordon is temporarily established by the first emergency responders, before any detailed scene assessment has been conducted. It provides an initial means of controlling, safeguarding and co-ordinating the immediate response and adds an element of control to the incident. It must be flexible so that it can be expanded or reduced if necessary.

The initial cordon is an immediate precautionary measure and must be formed in a position of safety. Unprotected responders must never be deliberately deployed to a position where 'contamination' is suspected. However, it should be considered as enclosing a 'potential hazard' zone rather than an 'exclusion' zone. Only responders who have been briefed and equipped to deal with the hazards should be allowed to operate inside it.

Where the hazardous materials involved are toxic by inhalation, it may be necessary to extend the initial cordon in the downwind direction to protect people from vapours, gases or dusts. The initial cordon should enclose the area in which people may become incapacitated and unable to take protective action and/or may incur serious or irreversible acute health effects.

Areas where non-acute or possibly longer-term health risks may be present should be designated and dealt with by the public health agencies. The initial cordon must be communicated to all first responders, especially oncoming response vehicles.

Inner cordon

The inner cordon surrounds the area where potentially hazardous activity may be conducted, and encompasses both the 'hot' and 'warm' zones. It is used to control access to the immediate scene of operations. Access to the area controlled by an inner cordon, which by definition is the hazard zone, should be restricted to the minimum numbers required for work to be undertaken safely and effectively.

Outer cordon

The outer cordon designates the controlled area into which unauthorised access is not permitted. It encompasses the inner cordon and the 'hot', 'warm' and 'cold' zones. It should be established and maintained by the police

Hazard zone

This is an area containing hazards for which a risk assessment should be applied to determine a suitable inner cordon. A hazard zone is not necessarily an 'exclusion zone' and would encompass both the hot and warm zones if they exist. The hazard zone is sometimes called the 'evacuation zone' by other agencies. It generally means the area where they would try to encourage members of the public to leave or possibly shelter-in-place.

Exclusion zone

An exclusion zone is an area containing hazards that have been risk assessed as so dangerous to health that nobody, including fire and rescue service personnel, should be allowed to enter (for example, the blast area around explosives involved in fire).

The mobilisation and response phase of a hazardous materials incident is critical in achieving and enhancing the safety of responding resources. Failure to take into account predicted and actual local weather conditions, specialist advice and information from any pre-planning that has been conducted, either on a multi-agency or single-agency basis, can have a detrimental effect on the usefulness of the resources deployed, and in some cases may result in responders being exposed to a hazardous material.

All responders should be vigilant on approach to a hazardous material incident. They should use their senses to ensure any incident information supplied correlates with what they are observing on the incident ground. For instance, that FireMet wind direction matches visually observed wind-blown foliage indicating wind direction.

Cordon control

Cordons are used as an effective method of controlling resources and maintaining safety on the incident ground. They must be continuously monitored and adapted to reflect changes in hazards, weather etc.

Cordons may be defined by a series of markers (for example, cones, traffic tape, police, members of personnel, etc.) or a notional boundary (for example, an agreed line on a map, existing boundary lines or fences etc.). Where the boundary is not obvious, it must be communicated to all responders.

Incident commanders must consider the safety of fire and rescue service personnel, the public, members of other emergency services and voluntary agencies attending incidents. But overall responsibility for the health and safety of personnel working inside cordons remains with the individual agencies. Agencies should ensure that personnel arriving at the site have effective personal protective equipment (PPE) and are adequately trained and briefed for the work they are to undertake inside the cordon. When this is not the case, the matter must be referred to command level.

At hazardous materials incidents strict cordon control is essential to manage the release and associated contamination issues. After the initial cordon has been established to secure and stabilise the site, the incident should be divided into two types of cordon – inner and outer.

Hot zone

This is the contaminated area(s) to where the initial release occurs or disperses. It will be the area likely to pose an immediate threat to the health and safety of everybody in it and is the area of greatest risk. It is located inside the inner cordon and is part of the hazard zone

Effective personal protective equipment (PPE) is required when working in the hot zone. Every emergency service has differing specifications for PPE and will decide on the appropriateness of their own equipment. The effectiveness of each type of PPE for the hot zone depends on the type and concentration of the contaminant. Any decisions made should be based on a hazard assessment.

There may be more than one area of release, or material may be spread or channelled, leading to more than one hot zone. Where possible all hot zones should be inside a single inner cordon. Where this is not possible for reasons of scale, location, topography etc., establishing two or more inner cordons should be considered. This may necessitate treating the cordoned areas as separate incidents with distinct command structures. This is potentially more likely at CBRN(E) events rather than hazardous materials incidents.

Warm zone

This is the area uncontaminated by the initial release of a substance. It may become contaminated by the movement of people or vehicles. It is surrounded by the inner cordon and is part of the hazard zone, but usually contains lower risks than the hot zone.

In the initial stages of an incident, the movement of contamination from the hot zone to the warm zone will be uncontrolled. As soon as practicable, the warm zone will be managed and controlled by emergency responders wearing appropriate personal protective equipment (PPE). The warm zone will later be extended to include the managed area encompassing decontamination. This extended section of the warm zone is called the decontamination area.

At small scale, low risk, low complexity hazardous materials incidents, warm zones may not exist. Responders should not designate them if there is no benefit from doing so.

Cold zone

This is the uncontaminated area between the inner and outer cordon. Key operational command positions and other essential activities will be set up in this area. The police service, in liaison with the fire and rescue service and the ambulance service, should decide whether members of the public need to be evacuated from the cold zone.

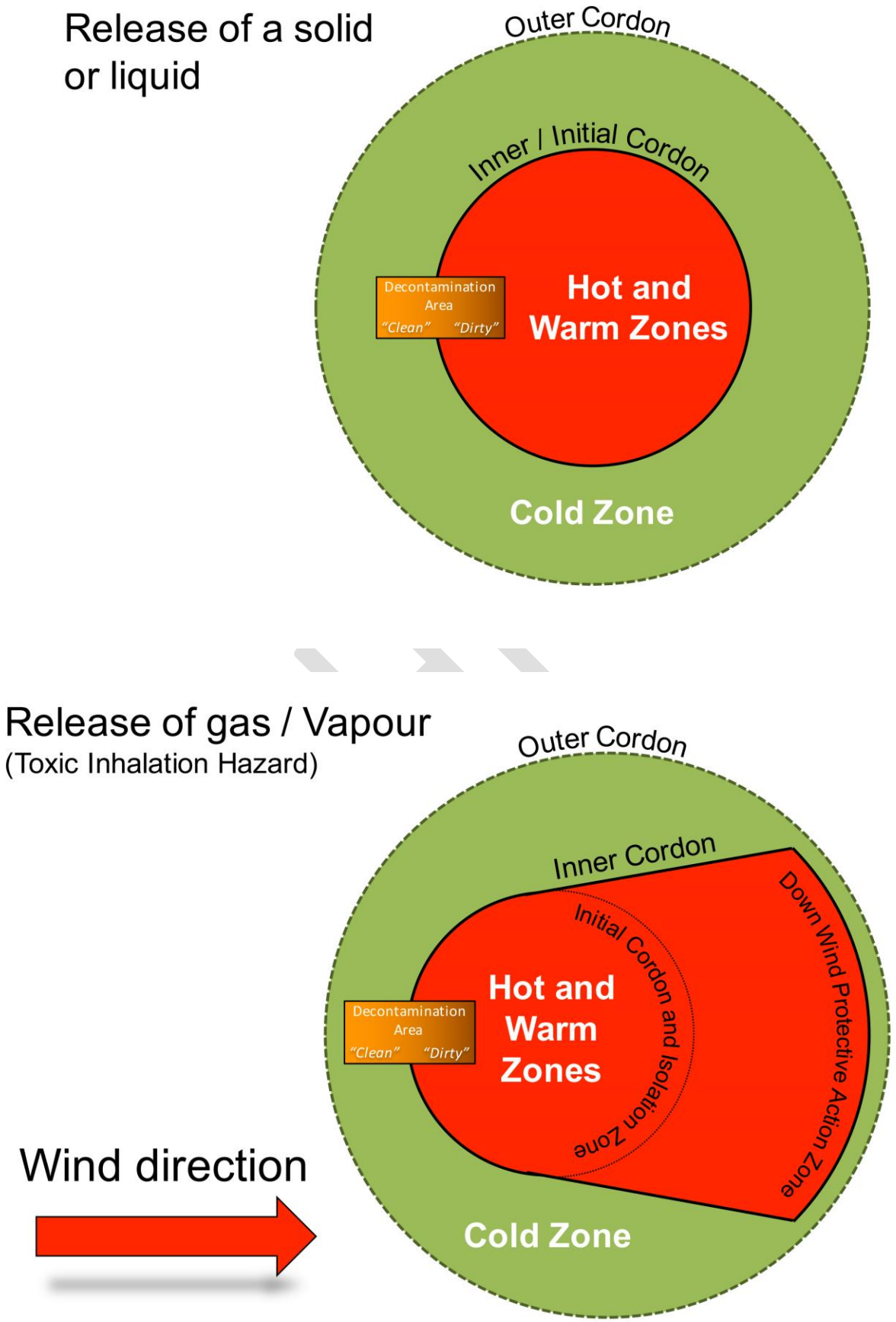

Figure 1: Zones for release of a solid or liquid and gas/vapour

Control measure – Approach the incident safely and estimate potential hazard zone

Control measure knowledge

Initial responders should be able to anticipate the type, size and potential scope of the hazardous material incident from the initial mobilising instructions. Approaching responders should be aware of potential contamination issues whilst approaching a hazardous materials incident. The proactive use of information systems, specialist advice, pre-planning arrangements and 'incident indicators' will add value to the response and ensure a safe approach can be determined. Examples of incident-indicators include:

- Smoke, gas and vapour clouds or plumes
- Visible smoke and other signs of fire
- Liquid spills, wet areas, patches, puddles, pools and streams/flowing liquids, which may indicate the affected area
- Unexplained noise (for example explosions, venting cylinders, site-specific audible warnings etc.), which may indicate a more cautious approach and larger hazard zone
- Distinct odours (for example bleach, garlic, rotten cabbage, bad eggs etc.). Being able to smell an unusual or unexplained odour usually indicates being in, or close to, the hot zone
- Damaged containers and packages
- Biological indicators, such as dead birds, animals, fish, insects, trees and vegetation
- Casualties and other 'involved people' may physically mark the hazard zone or they may be able to describe it based on their experience.

The effect of wind and gradient on a hazardous materials release should be taken into account when arriving at the incident and initially positioning vehicles. Ideally, all responding resources should approach cautiously and at slow speed from an upwind, uphill location. This will:

- Enable visual assessment of scene (such as plumes, liquid spills etc.)
- Reduce the probability of driving into a hazardous area
- Avoid collisions with casualties, people escaping the release and other members of the public who may be attracted to the incident

Once responders are in attendance they should deploy improvised wind monitoring devices, examples are shown in the photos.

Figure 2: Example of wind monitoring device
Source: Dorset Fire and Rescue Service

Hazard zones will vary in size depending on the:

- Hazardous materials involved
- Form of the hazardous material (i.e. gas, liquid, solid)
- Concentration
- Whether leak is continuous or not
- Potential for fire or explosion
- Reaction between release and surroundings
- Pathways, for example, drains/vapour cloud may enter drains

When approaching a hazardous material incident in an urban area, the acronym 'DDOOR' highlights the key factors to consider with regard to the potential dispersion plume.

DDOOR – stands for 'downwind, dilution, obstacle, oscillation and retention'. It serves to highlight key factors to remember when dealing with a hazardous release in an urban environment, in particular, the effect that the built environment and the wind can have on a dispersion plume.

- **D**ownwind – the largest part of the plume moves downwind, and becomes wider and higher
- **D**ilution – the gas/vapour dilutes as it mixes with the air around it; the concentrations decrease downwind and at the sides and top of the plume
- **O**bstacles – the plume's movement is strongly influenced by obstacles such as buildings and other structures. Some parts of the plume go up and over the building, while others zigzag along the streets in the downwind direction. The plume may quickly fill street 'canyons'. N.B. some parts of the plume spread upwind.
- **O**scillation – the plume will oscillate; its position and course will not remain constant, but vary over time. It will follow different routes downwind, often in response to minor changes in environmental factors.
- **R**etention – some parts of the plume can be retained, and gradually released later, even after the source has been dealt with

STEP 1-2-3 Plus – Safety triggers for emergency personnel

- **STEP 1** One person incapacitated with no obvious reason **–** Approach using standard protocols
- **STEP 2** Two people incapacitated with no obvious reason **–** Approach with caution using standard protocols
- **STEP 3** Three or more people in close proximity, incapacitated with no obvious reason **–** Use caution and follow STEP 'Plus'
- **Plus** – Follow the CBRN(e) first responder flow chart to consider what actions can be undertaken to save life, using the following principles:
    - **Evacuate** – get people away from the scene of contamination

- **Communicate and advise** – immediate medical advice and reassurance that help is on its way
- **Disrobe** – remove clothing
- **Decontaminate** – improvised decontamination – dry decontamination when a non-caustic agent is suspected and wet decontamination when a caustic agent is suspected

Responders can share situational awareness using the mnemonic METHANE:

- M – Major Incident declared/ standby
- E – Exact location
- T – Type of incident
- H – Hazards
- A – Access and egress
- N – Number of casualties
- E – Emergency services required

Strategic actions

Fire and rescue services should:

- Ensure an effective means of communicating key information to mobilised resources from all agencies
- Ensure responders have access to compass aided mapping systems
- Ensure incident commanders receive specific information and instruction on approaching hazardous materials incidents

Tactical actions

Incident commanders should:

- Use weather information, for example, FireMet, and visual indicators of wind strength and direction (wind blown tree foliage, etc.) to plan the approach to the incident from the upwind direction, so that crews are not exposed to hazardous vapours or gases. Always bear in mind that wind strength and direction can change, so ensure personnel and vehicles have clear, immediately available means of egress.
- Use local knowledge of topography and mapping systems to choose the safest approach road
- Remember that vapour/gas releases in built up urban environments may have a number of cloud/plume dispersion characteristics (see downwind, dilution, obstacle, oscillation and retention ‘DDOOR)
- Deploy improvised wind monitoring devices
- Be aware that the production of vapours is temperature dependant, elevated temperatures will increase the production of vapours whereas colder temperatures will see a reduction or prevention of any vapour production

Remember that hazardous materials may not be visible and may not have an odour. If possible and safe to do so without additional personal protection equipment (PPE), approach the incident from higher ground, especially if hazardous liquids are known to be present.

- Ensure response vehicles approach the vicinity of the incident cautiously and at slow speed
- When approaching the vicinity of the incident use senses to assess 'incident-indicators' to assist in estimating the extent of the hazard zone

Apply the primary response protocol STEP 1-2-3 Plus (Safety Triggers for Emergency Personnel) when the cause of harm to the casualties is unknown

- Estimate the potential hazard zone and position personnel and vehicles outside it
- Establish an initial command/contact point in a safe location
- Understand the potential for contamination from the incident source to move
- Consider declaring a 'major incident' using the acronym METHANE

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

Control measure knowledge

When first responders arrive at a hazardous materials incident, they are often required to carry out a risk assessment with limited information. To begin with, incident commanders will need to screen the information that is available to implement an initial cordon. This provides an initial means of controlling, safeguarding and co-ordinating the immediate response, and adds an element of control to the incident.

The initial assessment of the hazards must be carried out from a place of safety to avoid responders becoming contaminated and becoming part of the emergency.

See The foundation for incident command, 'Organisation at an incident – Cordons'.

Where the hazardous materials involved are toxic by inhalation, it may be necessary to extend the Initial cordon in the downwind direction to protect people from vapours, gases or dusts (N.B. solids/liquids that produce toxic gases on contact with water). The initial cordon should enclose the area in which people may become incapacitated and unable to take protective action and/or may incur serious or irreversible acute health effects. Areas where non-acute or possibly long-term health risks may be present should be designated and dealt with by the public health agencies.

The initial cordon must be communicated to all responders, especially on-coming response vehicle drivers.

Incident commanders should consider the following generic initial cordon distances as a basis for further risk assessment based on the operational circumstances:

Generic initial cordon distance guidance **Note: continuous risk assessment should be carried out to ensure that the cordon remains appropriate and proportionate to the risks identified by the incident commander**	
Incident type	**Initial cordon distance (metres radius)**

Explosives - manufacture, storage, transport (NB pre-planning for known sites should include rendezvous points (RVPs) at safe distances)	100m for transport incident HD 1.4 200m for transport incident HD 1.3 600m for transport incident HD 1.1, HD 1.2 and HD 1.5 (or when HD is not known) 100m for registered premises (fireworks only) 200m for incidents at other registered premises 600m for incidents involving licensed storage (under 2000kg) 1000m for incidents involving licensed storage (more than 2000kg)
Explosives –CBRN(E), terrorist (*Consider no fire and rescue service attendance or treat as 'exclusion' distances for fire and rescue service personnel, take guidance from police and explosive ordnance disposal (EOD))	100m for an activated device <u>Unexploded devices</u>:* 100m for a suitcase-sized device 200m for a car-sized device 400m for a lorry (or when size of device is not known)
Cylinders involved in fire (N.B. shielding may reduce distances)	Fireball up to 25m Cylinder may be thrown up to 150m Flying fragments up to 200m
Chemicals being transported	25m for solids 50m for liquids 100m for gases, vapours, particulates
Radiation	<u>Outside buildings:</u> 50m – unshielded or damaged potentially dangerous source 100m – major spill from a potentially dangerous source 300m – fire, explosion or fumes involving a potentially dangerous source 400m or more to protect against an explosion – suspected bomb (exploded or unexploded) <u>Inside buildings:</u> Affected and adjacent areas (including the floor above and below) – damage, loss of shielding or spill of a potentially dangerous source Entire building and outside distances detailed above – fire or other event that can spread a potentially dangerous source materials throughout the building (for example through the ventilation system)

The dangerous goods emergency action code (EAC) list gives the following information on public safety hazards. An ‘E’ following the first two characters of an EAC indicates that there may be a public safety hazard outside the immediate area of the incident, and that the following actions should be considered:

- People should be told to stay indoors, with all doors and windows closed, preferably in upstairs rooms facing away from the incident. They should eliminate all ignition sources and stop any ventilation.
- Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250m away from the incident.
- Police and fire and rescue service incident commanders should consult with each other and with a product expert or a source of product expertise
- The possible need for subsequent public evacuation should be considered, but it should be remembered that in most cases it will be safer to shelter-in-place than to evacuate

Further information and guidance on setting cordons for specific substances and types of hazardous materials can be found in the Emergency Response Guidebook (ERG) (see Emergency Response Guidebook (ERG)) and Chemdata. The setting of cordon distances is not a specific science. Incident commanders should consult a hazardous materials adviser (HMA), who will have a better understanding of the application of the guidance as soon as reasonably practicable.

Strategic actions

Fire and rescue services should:

- Ensure personnel have the skills, knowledge and understanding to implement an appropriate initial cordon

Tactical actions

Incident commanders should:

- Ensure a cautious, safe response enabling full situational awareness.
- Assess the scene, consider using equipment such as:
  - Thermal imaging equipment
  - Binoculars
  - Monitoring devices
- Consider that the dangers from hazardous materials come from either:
  - Energy, for example, an explosion, ionising radiation, etc. (as a priority)
  - Matter, for example, toxicity, corrosive action, etc.
- Consider possible entry routes into the body, for example:
  - Inhalation
  - Ingestion
  - Direct contact with the skin
  - Absorption/injection through the skin or eyes
- Consider the risk to property and the environment. Consider using:
  - Generic initial cordon distances

- Chemdata
- Emergency Response Guidebook (ERG)
- Emergency action code (EAC)

Control measure – Liaise with people on and off site

Control measure knowledge

Interaction with on-site personnel and witnesses will create a fuller understanding of the incident for all responders. Key questioning will ascertain:

- Whether there is an immediate risk to life
- The extent of the incident
- Actions already taken
- Whether or not on-site emergency plans have been activated

Responders may need to liaise with:

- Hazardous materials adviser (HMA)
- Detection identification and monitoring (DIM) advisers
- CBRN(E) subject matter advisers (SMA) or tactical adviser (Tac-Ad)
- Independent scientific advisers
- National Chemical Emergency Centre (NCEC)
- Chemical industry emergency responders and mutual aid schemes (for example Chemsafe, Radsafe, Chlor-Aid, Bromaid etc.)
- Environmental agencies
- Water and sewage company representatives
- Public health agencies
- Port or harbour authorities
- Other emergency services and specialist military assets
- Site and company experts/technical advisers
- Local authority emergency planning or public health departments, environmental health departments and local emergency planning groups

From the information gained, responders can start to create and prioritise key objectives for the response plan.

Strategic actions

Fire and rescue services should:

- Ensure response plans incorporate contact details of key on site personnel, who can provide specialist/expert assistance

- Consider the use of multi-agency pre-written media statements for warning and informing the public

Tactical actions

Incident commanders should:

- Gather information about the emergency or accident from eye witnesses
- Gather information from people responsible for the product causing the release – if possible, for example, site personnel or driver
- Document or record information gained
- Liaise with other people or agencies to gain specific knowledge about the event, substance, site, process, treatment of casualties or containment system
- Gather information on any relevant history of problems, failures, releases, similar events, etc.

Control measure – Work with other responders to develop a joint understanding of risk

Control measure knowledge

At significant emergency hazardous materials or CBRN(E) incidents, there will be multi-agency initial attendance. The first responders should work together quickly and efficiently to save lives, including the development of a joint understanding of risk (JUR) to inform multi-agency decision making. This will achieve a safe multi-agency response and deliver an effective resolution to the incident for the public and emergency responders alike.

The joint understanding of risk is a key component in achieving a safe multi-agency response to deliver a safe resolution to the incident. It is part of the Joint Decision Model (JDM), which is shown in the diagram below.

Figure 3: Joint Decision Model (JDM)
Source: Joint Emergency Services Interoperability Programme (JESIP)

Further information is contained in National Operational Guidance: Initial Operational Response to a Chemical, Biological, Radiological, Nuclear and Explosive (CBRN(E)), and Joint Emergency Services Interoperability Principles (JESIP) 'Initial Operational Response to a CBRN Incident' and 'CBRN Initial Operational Response Aide Memoire'.

Strategic actions

Fire and rescue services should:

- Ensure that call handlers and responders have received suitable and sufficient information and instruction to enable them to apply the joint decision model (JDM) to develop a multi-agency joint understanding of risk

Tactical actions

Incident commanders should work with other responders to:

- Identify the hazards, taking the following into account:
  - Indicators of a release of hazardous material (chemical, biological, radiological)
  - Casualty numbers (walking and non-walking)
  - Severity and type of signs and symptoms
  - Weather conditions – in particular wind direction
  - Hazards present or suspected

  - The location of the incident – is it likely to be terrorism or a hazardous material incident?
  - Environment – building, open space, underground
  - Presence of perpetrators
- Share and agree risk assessments
- Identify the hazard area (hot and warm zones)
- Identify safe working areas (cold zone)
- Develop an operational plan
- Establish a rendezvous point (RVP) and forward command point (FCP) and ensure they are staffed

Control measure – Identify the problem and the likely impact of the hazardous materials incident

Control measure knowledge

It is necessary to find out what has caused, or is causing the emergency or event, then to estimate what foreseeably will happen, and who and what will be adversely affected. To assist with this, responders should consider retrieving hazard and incident information from:

- Emergency Response Guidebook (ERG)
- Placarding and signage, for example, UN hazard warning labels, ADR (Accord européen relatif au transport international des marchandises Dangereuses par Route) placards, Notification and Marking of Sites (NAMOS) signs, Classification, Labelling and Packaging (CLP) labels, etc.
- Dangerous goods emergency action guide (EAC)
- Technical reference databases, for example, Chemdata
- Scientific support and technical information specialists, for example, scientific advisers, Defence Science and Technology Laboratory (DSTL), county chemists, Bureau Veritas
- Specific emergency response agencies, for example, Radsafe, Chlor-Aid, Bromaid
- Fire and rescue service detection, identification and monitoring (DIM) teams
- Safety data sheets (SDS)
- EH40 workplace exposure limits
- Transportation documents, for example instructions in writing (IIW)

They should also assess the condition of the containment system, paying attention to:

- Construction and operation of road, rail and other transport containers
- Construction and use of fixed storage tanks
- Construction and operation of intermediate bulk containers (IBC)
- Pressurised containers are inherently higher risk than non-pressurised
- Type of stressors involved (for example, direct flame impingement, heat, cold, chemical, mechanical, shock, friction)

- Ability of the container to tolerate the stresses on it

When trying to predict the behaviour of the hazardous material involved consider:

- The more complex the incident, the higher the level of knowledge required to perform this task
- Consulting product and process specialists
- Physical and chemical properties
- Quantity, concentration, release rate and surface area
- Weather and ambient conditions
- Fire and/or explosion risk
- Topography and site layout (for example slopes, spacing of tanks)
- Method of containment
- Will the containment system cope? For example, is it sufficient in volume and able to store containment material safely?
- Mixtures of substances
- Combinations of additional hazards

To estimate the size of the endangered area consider:

- Consulting product and process specialists
- Predicting dispersal pattern by using:
    - Downwind, detection, obstacle, oscillation and retention guidance in urban areas (see 'DDOOR)
    - CHEMET plume predictions
    - Fixed or transportable monitoring equipment that may be found at high-risk sites
    - Mobile air monitoring response services that environmental agencies can provide
- The quantity, concentration, release rate and surface area of the release or spill
- Weather, particularly the likelihood of change, for example, rain on water-reactive substances
- Fire or explosion risk
- Emergency Response Guidebook (ERG) and Chemdata guidance

Responders will need to determine:

- Who will be affected and what will happen to them?
- What property will be damaged or lost and how will this affect production, services and transportation?
- How will the land and air be affected?
- How will the water resources be affected? (N.B. consider both drinking water/other abstractions, and impact on aquatic and fauna and flora, fisheries and amenity use of water such as bathing)
- How long will the emergency last?

- Contamination – that is, of casualties, responders, property and the environment, secondary contamination
- Acute and chronic effects of substances
- Environmental toxicity/persistence/organic loading

Strategic actions

Fire and rescue services should:

- Provide personnel that deal with hazardous material incidents with specialist information, instruction and training on the process of identifying hazardous materials

Tactical actions

Incident commanders should:

- Carry out a full survey of the incident ground, with the responsible person if possible
- Access, or carry out, a full hazardous materials inventory of the incident ground (i.e. find out what's there and what's actually involved or likely to be involved)
- Locate where the release is coming from
- Identify site containment information, for example, drainage, sewerage, bunding separators and drain closure valves
- Draw up/acquire a site layout plan and annotate with all relevant information
- Identify whether deliberate reconnaissance inside the initial cordon is necessary
- Retrieve and interpret hazard and incident information
- Assess the condition of damaged containment systems
- Predict the likely behaviour of the hazardous material involved
- Estimate the size of the endangered area
- Identify the hazard zone
- Estimate the potential harm or impact
- Review the position of the initial cordon with regard to the information gathered and the predicted hazard zone
- Consider the elimination of ignition sources
- Identify the potential impact on the environment, considering:
    - Source
    - Pathways
    - Receptors
- Consider requesting attendance of environment agencies

Control measure – Access specialist hazardous material advice

See Hazard - Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure - Access specialist hazardous materials advice

Control measure – Estimate the resource requirements (hazardous material incident specific)

Control measure knowledge

Understanding the risk-critical information of hazardous materials sites is beneficial in anticipating the correct level of resources required. Ensuring sufficient numbers of personnel and specialist/non-specialist equipment are available allows initial emergency responders to put safe systems of work in place and start to gain control of the incident.

Strategic actions

Fire and rescue services should:

- Ensure specialist personnel and equipment are available, to support a potential hazardous materials incident
- Have pre-determined the response in accordance with the site's risk profile, and predict enhanced attendances where known site-specific hazardous material risks exist
- Ensure mutual aid schemes and specialist responders are available, to assist in managing a hazardous materials incident
- Have systems in place to request assistance from non-fire and rescue organisations

Tactical actions

Incident commanders may:

- Request fire and rescue service assistance based on the information gathered and the actions already known to be required. Consider:
    - Numbers of casualties/rescues
    - Offensive or defensive actions
    - Future need for deliberate reconnaissance
    - Number of firefighters required
    - Number and level of command roles required
    - Number and level of hazardous materials specialists
    - Additional personal protective equipment (PPE) requirements
    - Type and amount of decontamination equipment and competent personnel
    - Safety officers
    - Cordoning and possible evacuation
    - Need for specialist hazardous materials advice
    - Need for specialist detection, identification and monitoring (DIM) team

  - Type and amount of neutralising agent, absorbent, over-size containers, drain seals and other pollution control equipment, foam etc.

- Request assistance from non-fire and rescue service organisations
- Declare a 'major incident' (subject to local emergency planning groups agreements)

Undetected or unidentified hazardous materials at incidents

Hazard	Control measures
Undetected or unidentified hazardous materials at incidents	Recognise signs, labels and other marking systems Recognise signs and symptoms of exposure to hazardous materials Gather information on hazardous materials Access specialist hazardous material advice Participate in multi agency Joint Dynamic Hazard Assessment Recognise the need for detection, identification and monitoring (DIM) equipment Carry out risk assessment based on the information available

Hazard knowledge

Hazardous materials have a number of properties and behaviours that can make an incident more dangerous. Therefore, it is vital to recognise their presence as soon as possible to prevent harm occurring. Responders may meet this hazard at:

- Incidents where hazardous materials are known or suspected to be involved before arrival
- Incidents where hazardous materials are encountered during operations

Control measure – Recognise signs, labels and other marking systems

Control measure knowledge

It is important for responders to recognise signs, labels and other marking systems so that they can gain information regarding the hazards associated with substance safety. These will generally be found on modes of transport or fixed sites. The requirements are governed by detailed legislation, regulation and codes of practice. People who produce, transport, store or use hazardous substance must comply with these regulations.

Transport

The legal framework for the international transport of hazardous materials is set out in the United Nations (UN) model regulations ('Recommendations on the transport of dangerous goods', commonly known as the 'orange book'). These rules are revised every two years and form the basis of the internationally and nationally recognised legislation.

These recommendations are adopted in Europe, and consequently in the UK, as ADR (Accord européen relatif au transport international des marchandises Dangereuses par Route) for road transport and RID (Reglement International concernant le transport de marchandises Dangereuses par chemin de fer) for rail transport. Additionally, the UK maintains some deviations from ADR, for example, Hazchem placards. As both marking systems are permitted in the UK, it is important for responders to be familiar with both.

The regulations establish a basic system for the safe transportation of dangerous goods and are designed to reduce the risk of incidents occurring.

The regulations require dangerous goods to be:

- Classified (identified) according to their hazard(s)
- Packaged to the required standards
- Marked
- Labelled
- Documented

Applicable materials are assigned into one of nine classes based on their primary hazard. Materials are then allocated an identification number (UN number). The UN recommends that UN numbers appear on all transport documents and are displayed on packages, containers, vehicles, along with a description of the substance called the proper shipping name. The nine UN hazard classes are numbered 1 to 9 and each is assigned hazard warning diamonds.

Above certain volumes, vehicles transporting hazardous materials must display orange panels on the front and rear of the vehicle. Where hazardous materials are transported in bulk or in tanks, additional information must be displayed. In Europe this is the hazard identification number (HIN) and in the UK, other than when involved on international journeys, the emergency action code (EAC). For bulk liquids, this is incorporated into the Hazchem plate.

Further information on the placarding and marking of road vehicles and rail wagons can be found on the Health and Safety Executive website. (see http://www.hse.gov.uk/cdg/manual/consignment.htm#placarding)

The International Maritime Dangerous Goods (IMDG) code contains internationally agreed guidance on the safe transport of dangerous goods by sea, and most commonly relates to the carriage of dangerous goods in freight containers and tank containers. Primarily it is used by shipping operators but it is also relevant to those transporting dangerous goods on journeys involving a sea crossing. In the UK, many operators do not undertake complete international journeys but only visit a port to deliver or collect trailers, freight containers or tank containers that have a placard with IMDG labels for sea journeys. Where there is full compliance with the IMDG Code, vehicles are exempted from the placarding requirements of ADR (Accord européen relatif au transport international des marchandises Dangereuses par Route).

Further information on the placarding and marking of maritime vessels and cargo can be found on the Health and Safety Executive website. (see http://www.hse.gov.uk/cdg/manual/commonproblems/adr-imdg.htm)

Fixed sites

For static sites, warning signage is governed by the dangerous substances Notification and Marking of Sites) (NAMOS) regulations 1990. The aim of these regulations is to ensure that firefighters arriving at an incident are warned of the presence of hazardous materials. It is a legal requirement to notify the fire and rescue service about any site with a total quantity of 25 tonnes or more (150 tonnes for ammonium nitrate fertilisers). There is a requirement to place warnings signs at access points. (see Health and Safety Executive website for further details. http://www.hse.gov.uk/pubns/indg467.htm)

Labelling of hazardous materials for general use is governed by the Classification, Labelling and Packaging regulations (CLP). These regulations adopt the UN Globally Harmonised System (GHS) on the classification and labelling of chemicals across all European Union countries, including the UK.

Under the control of asbestos at work regulations, there are specific labelling requirements for asbestos in non-domestic buildings. Responders should recognise this label.

Strategic actions

Fire and rescue services must:

- Ensure personnel can recognise materials that may contain asbestos

Fire and rescue services should ensure that:

- Information on the recognition of hazardous materials is immediately available to personnel
- Responders can recognise signs, labels and other markings on hazardous materials packages
- Responders can recognise hazardous materials signs, labels and other markings on vehicles
- Responders can recognise signs, labels and other markings on sites containing hazardous materials
- Responders can recognise signs, labels and other markings on pipelines containing hazardous materials
- There is a system for recording hazardous materials information in the hot zone, for example, a hazardous materials information retrieval board

Tactical actions

Incident commanders should:

- Where possible retrieve information from a safe location and or distance
- Identify orange placards when present on vehicles
- Identify rail wagon placards and use the Total Operations Processing System (TOPS) if necessary
- Identify the primary hazards associated with the UN hazard class and division of the hazardous materials present
- Obtain the emergency action code (EAC) where available
- Identify and use transportation documents and safety data sheets (SDS)
- Recognise typical hazardous materials packages by type
- Recognise package labelling

- Recognise sites with hazardous materials
- Recognise pipelines carrying hazardous materials. See National Operational Guidance: Environmental protection
- Consider the use of a hazardous materials information retrieval board

Control measure – Recognise signs and symptoms of exposure to hazardous materials

Control measure knowledge

Symptoms of exposure to hazardous materials can provide important information to responders regarding the type and level of hazard. Symptoms will also provide responders with key information to determine the priorities in dealing with those who have potentially been exposed. Exposure to chemical hazardous materials will usually lead to the onset of symptoms much quicker than from exposure to biological or radiological materials. At an unknown event, this can often be used as an indicator of the type of hazardous material involved.

Important information can be gained from the type of symptoms that are displayed, the number of people exposed and the time from exposure to symptoms becoming apparent.

Four routes of exposure can lead to symptoms developing:

- Ingestion
- Contact with skin or eyes
- Inhalation
- Injection or through cuts

The route through which exposure occurs can also be a significant factor on the speed and type of symptoms displayed. For example, exposure through a cut may mean that some hazardous substances get absorbed into the blood stream more quickly, enabling symptoms to develop rapidly.

Symptoms from hazardous materials will be either acute or chronic:

- **Acute**: Substances whose effects develop quickly (usually within minutes to days) and worsen with increasing levels of exposure. These hazardous materials also have a level or 'threshold' below which no harm is caused, although for example, in cases of highly toxic substance, this level can be very low.
- **Chronic**: Substances whose effects develop after significant periods of time and usually following repeated exposure, for example, substances that can cause cancer.

Strategic actions

Fire and rescue services should:

- Ensure their policies and procedures include the need to save life, even at CBRN(E) incidents
- Have robust occupational health/post incident screening for personnel. See Hazard – Unsafe closure of the incident Control measure – Provide a health monitoring system for all personnel'

Tactical actions

Incident commanders should:

- Observe individuals for signs of exposure to hazardous materials, for example skin reddening, itching and burning of eyes or skin may indicate exposure to a corrosive substance
- Liaise with paramedics and other health professionals
- Initiate screening procedure for personnel following a potential exposure
- Consider vulnerable groups where the effects of exposure may be more immediate, severe or prolonged
- Ensure symptoms are consistent with hazard identification

Control measure – Gather information on hazardous materials

Control measure knowledge

The information provided through legislation on hazardous materials containers is a key factor in identifying hazards to responders and the public. Other sources of information should also be considered and their value not overlooked in determining a complete picture of the incident. There are also times when marking, placarding and signs are not present, or are incorrect, damaged or obscured, such as during a fire or where hazardous materials are badly controlled or even used illicitly.

In such cases, other information sources will increase in their level of importance. Information and direct observations from site personnel, eyewitnesses (members of the public) and/or information from other responders can be very valuable in determining the objectives, hazards and controls.

In addition to marking and signage, other legislative requirements for the use of substances require sites to keep records of substances held, their hazards and control measures. These legal requirements mean that sites should have access to safety data sheets (SDS) or Control of Substances Hazardous to Health (COSHH) sheets. This information can provide information about the hazards, health effects, behaviours and control measures. Similar information can be obtained from written and/or electronic data sources such as Chemdata or the Emergency Response Guidebook (see ERG).

Other sources of information that can assist may be obtained from scientific advisers such as the National Chemical Emergency Centre (NCEC) or other company or product specialists and industry mutual aid schemes, for example Bromaid. This may be by providing information on a substance, process or premises, or may be in the form of assistance in interpreting information gained.

A useful mnemonic to help in the gathering of hazardous materials information is **SEDITION**:

- **S**tressor – What is causing or threatening to cause the containment to fail?
- **E**scapes – Where are the breaches in the containment system?
- **D**ispersal – Where is the substance going, or potentially going to go?
- **I**mpingement – What is the substance going to come into contact with?
- **T**roubles – What are the potential negative effects?
- react**ION** - What reactions could take place?

Specific knowledge about the event, substance, site, process, treatment of casualties and containment system may be gained from:

- Written information sources such as the Emergency Response Guidebook (ERG), safety data sheets (SDS) etc.
- Electronic information systems such as Chemdata, wireless information system for emergency responders (WISER) or other internet based systems
- Fire and rescue service hazardous materials adviser (HMA)
- Detection, identification and monitoring (DIM) advisers
- Fire and rescue service CBRN(E) subject matter advisers or tactical adviser (Tac-Ad)
- Independent scientific advisers
- Site or product experts or technical advisers
- National Chemical Emergency Centre (NCEC) – Chemsafe 24/7 helpline
- Chemical industry emergency responders and mutual aid schemes (for example Radsafe, Chlor-Aid, Bromaid etc.)
- Environmental agencies
- Water company representatives
- Public health agencies
- Port or harbour authorities
- Other emergency services and specialist military assets, for example, explosive ordnance disposal (EOD)
- Local authority emergency planning departments and local emergency planning groups

Strategic actions

Fire and rescue services should:

- Consider developing mechanisms to ensure that information related specifically to hazardous materials is gathered in a safe, systematic and timely manner
- Consider developing systems for information on hazardous materials to gather pre-planning information on local risks and incident specific information
- Provide hazardous materials information retrieval systems
- Provide access to specialists such as Chemsafe (see http://the-ncec.com/chemsafe/) or other scientific advisers
- Provide access to appropriate detection, identification and monitoring (DIM) equipment (see National Resilience framework)

Tactical actions

Incident commanders should:

- Gather information from:
    - Systems containing hazardous materials Site-Specific Risk Information (SSRI), such as from site inspection visits
    - People or agencies on and off site, such as site personnel, driver, eye witnesses (members of public) and/or other responders
- Gain specific knowledge about the event, substance, site, process, treatment of casualties and containment system
- Consider using the SEDITION mnemonic
- Gather information on any relevant history of problems, failures, releases, similar events, etc.
- Ensure a number of sources are used and that the information or advice is consistent

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice

Control measure – Participate in multi-agency Joint Dynamic Hazard Assessment

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Work with other responders to develop a joint understanding of risk

Control measure – Recognise the need for detection, identification and monitoring (DIM) equipment

Control measure knowledge

The identification of hazards is fundamental to any safe system of work at hazardous materials incidents. Typically, this is achieved either by direct observation of behaviours or by accessing information sources and specialists to get hazard information after obtaining a chemical name, UN number or Chemical Abstracts Service (CAS) number.

Where specific risks relating to substances or activities at local sites are known, fire and rescue services may provide equipment that will help responders to identify and monitor releases. Such equipment can, in some cases, determine the nature or name of the hazardous material involved. Once this is known, responders can access the usual data source and specialists to establish hazards and control measures.

In some cases, such as gas monitoring, it may be possible to monitor the spread of hazardous materials. This will help maintain safe cordon distances and determine whether intervention techniques are being effective.

In addition to monitoring equipment obtained by fire and rescue services, the government has provided a number of suites of detection identification and monitoring (DIM) equipment nationally as part of the National Resilience framework.

- Detection – recognising the presence of a hazardous or CBRN(E) material.
- Identification – determining the hazardous or CBRN(E) material that is present.

- Monitoring – quantitatively determining the presence or absence of hazardous or CBRN(E) material in a continuous or periodic process

At an incident where National Resilience detection identification and monitoring (DIM) teams are deployed the hazardous materials adviser (HMA) will act as the link between the detection identification and monitoring (DIM) team and the incident commander. At a CBRN(E) event, a CBRN(E) subject matter adviser or tactical adviser (Tac Ad), when mobilised, will be responsible for advising the incident commander on developing the tactical response plan.

An alternative or supplementary approach is to use techniques to determine the hazard directly through observation, as opposed to determining the identity and then looking up the hazards. This is given the term 'hazard categorisation' but is also often referred to as 'wet chemistry' or 'field chemistry' techniques.

The process is straightforward. A very small amount of the hazardous material is safely obtained as a sample. This is then subjected to a number of tests where behaviour is observed. For example, adding a small amount of water can provide a lot of information, such as whether the substance is water reactive, soluble, immiscible and floats or sinks in water. With this information, responders can predict the behaviour of the material that will help determine tactics for control.

Strategic actions

Fire and rescue services should:

- Consider local risks and obtain detection, identification and monitoring (DIM) equipment appropriate for the risk
- Develop and maintain systems to ensure mutual aid agreements are developed on a local, regional and national basis to ensure the access and availability of National Resilience detection, identification and monitoring (DIM) assets and personnel
- Ensure personnel are trained in the deployment, use and interpretation of their detection, identification and monitoring (DIM) equipment, such as gas monitoring equipment or dosimeters

Tactical actions

Incident commanders should:

- Request available detection, identification and monitoring equipment, for example:
    - Thermal imaging equipment
    - Gas or vapour detection and monitoring equipment, such as a lower explosive limit (LEL) meter
    - Radiation detection and monitoring equipment
- Consider the suitability of National Resilience detection, identification and monitoring (DIM) assets to deal with the incident and request their attendance if appropriate
- Deploy competent responders with detection, identification and monitoring (DIM) equipment
- Provide a clear brief to responders including:
    - Locations of detection, identification and monitoring (DIM)
    - Sampling technique

- Scene preservation
- Appropriate personal protective equipment (PPE), decontamination and other safety controls

Control measure – Carry out risk assessment based on the information available

Control measure knowledge

Hazardous materials incidents should follow the same dynamic or incident risk assessment as any other emergency. See Pillar 3 of the 'Health, safety and welfare framework for the operational environment', June 2013. However, at hazardous materials incidents a specific risk assessment of the substances and their hazards will need to be carried out.

Incident risk assessment takes into account information from:

- Site-specific premises risk information
- Standard operational procedures, including those for hazard specific incidents, for example radiation suspected, asbestos, acetylene cylinders involved in fire etc.
- Observation of incident circumstances
- Eye witnesses at the time of the incident

At an operational incident, the overriding priority of the incident commander is the safety of everyone that may be affected by operations. A safe working environment should be established as soon as is practicable by selecting the most appropriate control measures, given the demands of the incident and taking into account an assessment of the risks and benefits to be gained, and any time constraints. The selected safe systems of work (SSoW) should be implemented, developed, maintained and reviewed, throughout the life of any incident. There are a number of risk assessment methods that can be used in the initial and subsequent incident phases.

The process of risk assessment at hazardous materials incidents falls into three distinct phases:

- Initial attendance and risk assessment of time critical actions
- Secondary actions to stabilise the incident
- Hazardous materials risk assessment. See appendix B, 'Fire and rescue service operational guidance - incidents involving hazardous materials', 2012, DCLG

The hazardous materials risk assessment process requires staff who have received specific training on hazardous materials. Responders should be skilled in interpreting the information collected and how it can be applied to create a risk assessed tactical plan. This should always be based on a risk benefit analysis. Where the benefit outweighs the risk, procedures should be enabling and assertive, and provide for proportionate and effective tactics.

At larger or more complex incidents the volume and detail of applicable hazardous materials information is likely to be greater. The capacity of personnel to assimilate information will vary in proportion to the nature and size of the incident, and the stage the operational response has reached. The ability to scale up the crucial process of hazardous materials risk assessment may require additional support to ensure the required tasks are completed in a precise and detailed yet timely manner.

Strategic actions

Fire and rescue services should:

- Ensure personnel who respond to hazardous materials incidents receive specific information, instruction and training on the conducting a hazardous materials risk assessment
- Consider using consistent systems and formats to record information from all hazardous materials incidents, for example see Appendix B, page 589 'Hazardous materials incident information record and Fire and Rescue Service Risk assessment template', 'Fire and rescue service operational guidance - incidents involving hazardous materials', 2012, DCLG, TSO
- Ensure the information gathered is treated as confidential, unless disclosure is required for legal reasons
- Provide mechanisms to enable the rapid assessment and interpretation of information retrieved from the scene
- Ensure personnel can interpret hazard data systems at scene to enable a suitable and sufficient risk assessment to be completed

Tactical actions

Incident commanders should:

- Ensure that all information gathered is only risk assessed by a competent person
- Consider emergency action codes (EAC) and additional personal protection (APP) codes where available (see emergency action code list)
- Consider using the Emergency Response Guidebook (ERG)
- Access dangerous substance data systems, retrieve and interpret information
- Ensure that, when appropriate, a written record of the hazardous materials risk assessment is made and incorporated into any analytical risk assessment for the incident
- Access additional support through pre-agreed channels from hazardous materials specialist such as:
    - Hazardous materials advisers (HMA)
    - Scientific advisers
    - The National Chemical Emergency Centre (NCEC)
    - Mutual aid schemes

Defective hazardous materials containment system

Hazard	Control measures
Defective hazardous materials containment system	Recognise common hazardous materials containers Identify what is causing or threatening to cause the containment to fail Identify or estimate the quantity involved or potentially involved in the release Access specialist hazardous material advice

Hazard knowledge

Hazardous materials containers are controlled by legislation to ensure that their construction is appropriate and the materials that they are made from are compatible with their contents. Similar controls exist for materials held in process and static storage as well as items that contain hazardous materials, for example, batteries. The presence of these containers is a key mechanism to recognise that hazardous materials may be involved at incidents.

More importantly, the way in which hazardous materials, their containers and any secondary containment interact at an incident can significantly increase the scale and level of harm. It is important that responders understand these interactions so events can be accurately predicted and control measures implemented.

Control measure - Recognise common hazardous materials containers

Control measure knowledge

Hazardous materials containers range in size from small vials and jars used in laboratories, through larger packages and transport containers holding many tonnes, to site storage tanks and vessels that can hold many thousands of tonnes.

All hazardous materials containers have a number of design features. The cause of most hazardous materials incidents is a failure of one or more of the requirements; for example, a container in fire is unable to withstand additional external temperature and internal pressure, leading to a breach.

Design features:

- Compatibility – must not react with its contents
- Suitability for the physical form (solid, liquid, gas) of the hazardous material for the temperatures and pressures the container may be subjected to
- Ability to withstand reasonably expected external stressors such as knocks or being dropped during transport
- Have access to add and/or remove the hazardous materials
- Meet certain legal requirements
- Meet regular testing, inspection and maintenance or replacement requirements

It is important that during incidents responders can:

- Recognise typical container shapes/types that would indicate the presence of hazardous materials whether in storage, in use or in transit
- Identify the basic design and construction features, including closures for storage, packaging and transportation systems

Strategic actions

Fire and rescue services should:

- Ensure attending personnel have the necessary instruction and training in the identification of hazardous materials containers

- Ensure an appropriate method for hazardous materials information gathering, including container recognition, is available to the incident commander in a timely manner

Tactical actions

Incident commanders should:

- Identify if containers indicating the presence of general or specific hazardous materials are involved
- Assess the likelihood of containers rupturing if heated or subjected to an internal reaction

Control measure - Identify what is causing or threatening to cause the containment to fail

Control measure knowledge

If the correct container has been used and it is intact, the substance is in a 'controlled' state and no risk is posed to people, infrastructure or the environment. Incidents involving hazardous materials are fundamentally driven by containment failure and the way in which failure occurs. This leads to the hazardous materials becoming 'uncontrolled' and introduces risk.

Containment failure can only occur following a 'stressor' being applied to the container. There are a limited number of stressors that can affect containment:

- Thermal
- Chemical/biochemical/photochemical
- Mechanical
- Human or animal

Once containment failure has become inevitable, the manner in which containment fails can also have significant effect on the outcome and scale of the incident. Again, a container can breach in a limited number of ways; these will lead to a specific type of release that will affect the scale and hazards:

Type of Breach		**Potential Release**
Disintegration	→	Detonation
Runaway cracking	→	Violent rupture
Attachments opening up	→	Rapid release
Punctures	→	Leak
Splits or tears	→	Spill

Strategic actions

Fire and rescue services should:

- Ensure personnel who respond to hazardous materials incidents receive specific information, instruction and training on the causes, mechanisms and impact of containment failure

Tactical actions

Incident commanders should assess:

- The condition of damaged hazardous materials containment systems
- Construction and operation of road, rail and other transport containers
- Construction and use of fixed storage tanks
- Construction and operation of intermediate bulk containers (IBCs)
- The presence of pressurised containers, as these are inherently higher risk than non-pressurised
- Type of stressors involved (for example, direct flame, heat, cold, chemical, mechanical, shock, friction)
- The ability of the container to tolerate the stresses on it
- Whether deliberate reconnaissance inside the inner cordon is necessary
- The likely breach that may occur or has occurred, and its impact on the scale of incident
- The presence and effectiveness of secondary and tertiary containment. For example, oil and chemical tanks are often bunded.

Control measure – Identify or estimate the quantity involved or potentially involved in the release

Control measure knowledge

Hazardous materials can only exist in one of two states, controlled or uncontrolled. When stored or handled correctly, risk of harm is low and the hazardous materials are controlled. It is only in the uncontrolled state that harm to people, infrastructure or the environment can occur.

At any hazardous materials incident, the level of hazard, scale and impact will be directly determined by the amount of material that is in an 'uncontrolled' state.

The actions and tactics adopted should be selected based on the scale and likely impact of the incident, which will be determined by the quantity. It is important that responders can rapidly, and accurately, estimate or determine the quantity of hazardous materials involved.

The size of container(s) involved is a key piece of information in determining the quantity, but responders should also assess the quantity that is 'uncontrolled', such as the size of spill rather than just the size of container. Material remaining in the container will pose less of a risk in most cases.

Strategic actions

Fire and rescue services should:

- Ensure the initial response to hazardous materials incidents includes an estimation of any potential hazard zone
- Ensure attending personnel have the necessary skills to quickly and safely estimate the quantity involved

Tactical actions

The incident commander should:

- Use 'incident-indicators' to make a rough estimate of the quantity of hazardous materials involved such as:
  - Gas and vapour clouds or plumes
  - Visible smoke and other signs of fire
  - Liquid spills, wet areas, patches, puddles, pools and streams or flowing liquids
  - Unexplained noise (for example explosions, venting cylinders, site specific audible warnings), which may indicate a more cautious approach and larger hazard zone
  - Distinct odours (for example bleach, garlic, rotten cabbage, bad eggs)
  - Damaged containers and packages
  - Biological indicators such as dead birds, animals, fish, insects, trees and vegetation
  - Cryogenic effect of escaping product (for example frosting around defective pipes or a damaged area on a LPG container)
- Gain information from casualties and other 'involved people' who may physically mark the hazard zone or may be able to describe it based on their experience
- Be able to distinguish between the quantity involved (i.e. released or spilled) and the quantity in the container or the maximum contents of the container.

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Unpredicted impact of hazardous material incidents

Hazard	Control measures
Unpredicted impact of hazardous material incidents	Understand the effect of weather and topography on the incident Model the potential or actual release zone Use appropriate equipment to monitor the release Understand the effects of the incident on the environment and local community Access specialist hazardous material advice

Hazard knowledge

To ensure a safe and effective response to incidents involving hazardous materials, responders should be able to identify or predict the potential impact to provide the best outcomes for people, infrastructure and the environment.

Factors that affect the impact of the incident, in addition to the intrinsic properties of the substance and the effects from the container, are those relating to the location or context of the incident. For example, a significant vapour release in a rural location will have very different implications than the same release in a built up area.

A release of hazardous materials will only lead to harm if the material impinges on a receptor. The 'Source – Pathway – Receptor' concept is discussed widely when considering environmental protection (The environmental protection handbook for the fire and rescue service, 2013, EA). However, when considering a hazardous materials incident, the receptor could be responders, people in the local vicinity, the local community or infrastructure as well as the environment.

The impact of a release will also be affected by the size of the release and the direction and manner in which it spreads. It may also be affected by environmental factors, such as the pH of the receiving waterbody or soil. Many factors will affect this spread, and a good understanding of these is necessary to ensure responders identify the full effects of any incident.

Control measure - Understand the effect of weather and topography on the incident

Control measure knowledge

Two major weather and topography factors that affect the manner in which hazardous materials spread following a release are wind and slope of ground. The physical form (solid, liquid, vapour or gas) of the hazardous material will dictate the magnitude of the effect from wind and slope of ground. For example, vapours will be affected by wind and slope and will travel further and spread more quickly than liquids, which will spread further than solids. For solids, the particle size will affect the spread (fumes, powder, granules, solid pieces).

The combined effect of these two factors is the key reason that initial approach to hazardous materials incidents should be ‘upwind, uphill and safe distance’ (see Control measure – Approach the incident safely and estimate potential hazard zone).

Other weather-related factors that can affect hazardous materials incidents are temperature and rain. Temperature is important, particularly where the substance has a melting or boiling temperature that could be expected to be reached during the incident, as a phase change for the substance will have a significant impact on tactical options and the risk assessment.

Rain can also have a significant effect as its interaction with some substances can affect their behaviour. For example, vapours that are water-soluble will dissolve in rain, reducing the concentrations of vapours in the air, thus reducing the distance over which they will be able to cause harm. However, if substances are dissolved in rainwater and then enter drains or a body of water, the pollutants could be dispersed or allowed to collect and flow to other locations. On the other hand, water reactive substances that are exposed to rain may react causing a change to the incident that may increase the level of hazard.

Effects of wind and gradient on a release

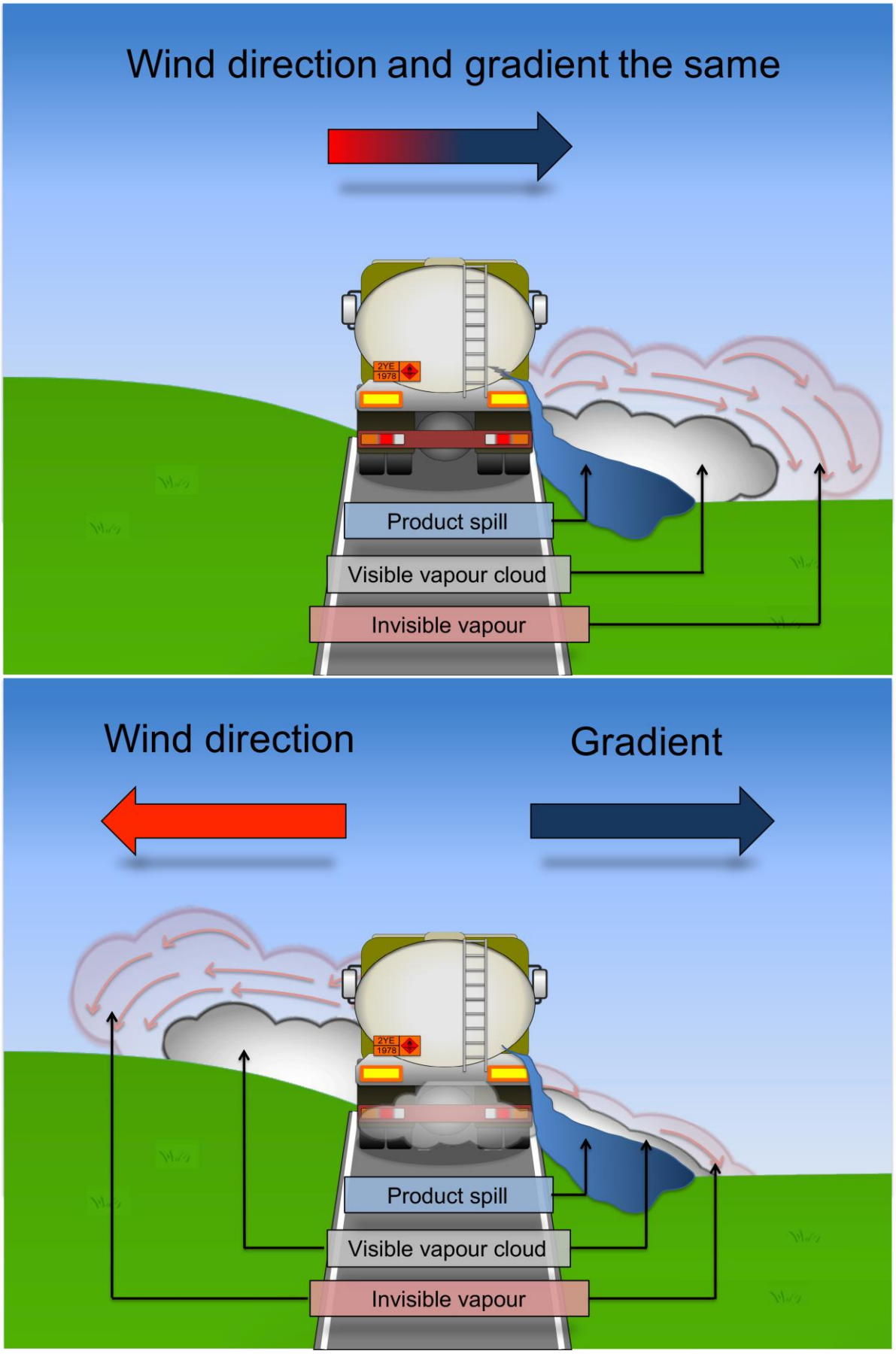

Figure 4: Effect of wind and gradient on a spill

Strategic actions

Fire and rescue services should:

- Ensure that personnel who respond to hazardous materials incidents are provided with the knowledge, skills and understanding they need to determine the effects of weather and topography on a hazardous release

Tactical actions

Incident commanders should:

- Approach the incident cautiously, usually from an upwind and uphill direction. The approach route should be chosen based on:
    - Weather information, for example, FireMet
    - Visual indicators of wind strength and direction (for example, windblown tree foliage)
    - The physical properties of the hazardous substance
    - Local knowledge of topography and mapping systems
- Establish a potential hazard zone inside an initial cordon
- Ensure personnel and vehicles have clear, immediately available means of egress, in case wind strength or direction changes
- Consider downwind, dilution, obstacle, oscillation and retention (DDOOR) (see 'DDOOR).
- Continually monitor conditions, for example deploy improvised wind monitoring devices

Control measure - Model the potential or actual release zone

Control measure knowledge

After thoroughly gathering all available information, it is important to model or measure the potential or actual release zone. This can be carried out in two ways:

- Direct measurement or observation
- Application of a model

A model is a predicting tool based on data collated before the incident, which will include a combination of the properties and quantity of the substance involved combined with environmental data such as wind speed and temperature. These models have been tested against experimental data to provide an estimation of hazard zones. There are a number of models available and they vary in their level of sophistication. The most appropriate model to use will depend on the level of information and time available to assess the hazard zone.

Simple models, such as the tables included in the Emergency Response Guidebook (ERG) or Chemdata, require minimal information from the scene and can be applied very quickly. However, the tables take into account 'worst case possible' scenarios and therefore could lead to unnecessary disruption. Techniques can be used in conjunction with this information to refine the modelled hazard zone to prevent excessive disruption.

The suggested initial cordon guidance distances are based on these models and provide a very simplified initial stand-off distance to keep responders and the public safe (see generic initial cordon distances guidance n Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons).

More complex models are available, such as the Aerial Locations of Hazardous Atmospheres (ALOHA) software, which can provide a more precise hazard zone. However, the level of information needed to use such modelling software is greater and may not always be available. See http://www2.epa.gov/cameo/aloha-software for further information on ALOHA.

To enable accurate modelling, weather effects are important and the Met Office also provides a number of tools that can be used in conjunction with modelling methods, available through 'hazard manager' on the Met Office website. They are:

- FireMet – FireMet is a weather information system provided by the Met Office. It provides fire and rescue service responders with the latest weather information to help them identify a safe approach when dealing with a major incident.
- CHEMET – In an incident involving hazardous chemicals, local fire and rescue services and police services can contact the Met Office Environment Monitoring and Response Centre. For small-scale events, the Environment Monitoring and Response Centre produces meteorological guidance and a plume prediction as a chemical meteorology report. For larger release events, such as the Buncefield oil depot fire, more-sophisticated plume modelling techniques are used.

'Hazard manager' is available to incident command units, mobilising controls and detection, identification and monitoring (DIM) units, as well as the National Co-ordination Centre.

The Met Office has highly advanced models to identify hazard zones. These are designed for more long-term spread. For example, the numerical atmospheric-dispersion modelling environment (NAME) is an atmospheric pollution dispersal model that is a much more sophisticated tool than Chemet for pollution forecasting. It can:

- Simulate the effect of fires
- Forecast air quality up to 36/48 hours ahead
- Take into account the chemical involved
- Show deposition, air concentration and height of the plume
- Predict long-standing air pollution problems such as acid rain
- Forecast international movement of pollutants.

To apply a model effectively, a number of factors need to be identified and considered:

- Physical and chemical properties
- Quantity, concentration, release rate and surface area
- Weather and ambient conditions
- Fire or explosion risk
- Topography and site layout (for example slopes, spacing of tanks)

- Method of containment
- Whether the containment system will cope
- That mixtures of hazardous materials are dangerous
- Combinations of additional hazards

Strategic actions

Fire and rescue services should:

- Develop systems to enable prediction of the likely behaviour of the hazardous materials involved, and to estimate the size of the endangered area and the potential harm/impact
- Ensure mechanisms are in place so that these systems are available to responders in a timely manner
- Ensure that personnel who respond to hazardous materials incidents are provided with knowledge, skills and understanding to use such models

Tactical actions

Incident commanders should:

- Predict the likely behaviour of the hazardous materials involved using observation and possibly modelling
- Identify the potential for chemical reactions (for example, fire, release of energy, heat, light, explosion) that may affect the model
- Consult product and process specialists before modelling
- Estimate the size of the endangered area and consider:
    - Prediction of the dispersal pattern, for example downwind, dilution, obstacle, oscillation and retention (DDOOR) guidance in urban areas, etc.
    - CHEMET plume predictions
    - That high-risk commercial premises/sites may have fixed or transportable monitoring equipment, such as large petrochemical sites
    - That environment agencies provide a mobile air monitoring response service to aid public health risk assessments
    - Quantity, concentration, release rate and surface area
    - The likelihood of a change in weather (see FireMet)
    - Fire or explosion risk
    - The Emergency Response Guidebook (ERG) and Chemdata guidance on isolation distances for significant releases

Control measure - Use appropriate equipment to monitor the release

Control measure knowledge

A number of techniques and pieces of equipment are available to responders to monitor the presence and/or quantity of a number of hazardous materials that may be encountered at incidents. Such equipment can be used to identify hazardous areas for both a responder and from a public safety perspective. Where such equipment is deployed, it is important that the user has a thorough understanding of the capabilities and limitations of the equipment as well as how to operate the equipment in a hazardous environment and how to interpret the information provided.

These techniques, if applied correctly, will enable very precise determination of any potential hazard zone. This has the advantage over modelling as any good model will include a suitable safety margin to take account of any unknown variables. This means that a model will always have a greater potential for some unnecessary disruption to the public.

Strategic actions

Fire and rescue services should:

- Ensure adequate monitoring equipment is available for likely risks in its area
- Ensure mobilising arrangements are suitable and timely
- Make sure equipment is deployed, used and interpreted effectively through effective training and skill maintenance
- Consider providing monitoring equipment to first attending responders

Tactical actions

Incident commanders should:

- Use/request detection, identification and monitoring (DIM) equipment owned by the fire and rescue service
- Provide a detailed brief on exact deployment activity
- Ensure only competent people operate and interpret results obtained from such equipment
- Consider mobilising National Resilience detection, identification and monitoring (DIM) assets when appropriate. See National Resilience framework.

Control measure - Understand the effects of the incident on the environment and local community

Control measure knowledge

Once the spread and scale of incident has been determined, it is important to identify who and what is at risk in that area. Hazardous materials can have an adverse effect on:

- People (including emergency responders)
- Infrastructure
- Environment

Assessing the likelihood of harm to groups or locations in each of these three areas will develop a risk profile for the incident and enable tactical decisions to be taken based on priorities.

The risk of harm to people will be based on either the potential for release of energy or the intrinsic harmful properties of the substance if individuals are exposed (see Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Recognise signs and symptoms of exposure to hazardous materials). Responders will need to assess whether people can shelter-in-place as an alternative to evacuation. The assessment should consider:

- Health risks posed by the hazardous materials
- Size of the affected area
- Construction of buildings
- Time of day
- The number, condition and age of occupants
- Weather conditions
- Potential duration of release
- Availability of safe and suitable accommodation
- Availability of responders
- Numbers of personnel and other agencies required to carry out the evacuation
- Risk to responders carrying out the evacuation
- Communicating the evacuation (for example, fixed alarm system, responders with megaphones, door knocking, avoiding panic, radio and TV announcements)
- Safe holding area required for members of the public being evacuated.

The risk to the environment is covered extensively in National Operational Guidance:National Operational Guidance: Environmental protection and The environmental protection handbook for the fire and rescue service, 2013, EA

Risk to infrastructure is mainly concerned with the potential for hazardous materials to degrade, corrode, contaminate or damage the urban environment. For example, they may cause damage to roadways, buildings or other structures. Often the potential for these adverse effects to occur will be based on contact time of the substance and therefore, whilst a lower priority than saving life, early intervention can often prevent major disruption to the community.

Strategic actions

Fire and rescue services should:

- Ensure that personnel that respond to hazardous materials incidents are provided with knowledge, skills and understanding to determine the effects of the incident on the environment and local community

Tactical actions

Incident commanders should:

- Review the available pre-planning information, operational intelligence and 'incident indicator' information to identify other significant hazards
- Carry out a full survey of the incident ground in conjunction with the responsible person where possible
- Identify the hazards posed by the substance (for example, toxic, corrosive, explosive)
- Recognise the hazardous material's physical properties
- Identify the location of release in relation to populated areas and other risks
- Identify the potential for chemical reactions; for example, release of energy, heat, light, explosion
- Consider the realistic potential for the hazardous materials to spread whilst the response plan is being implemented
- Consider the impact of excessive or unnecessary cordons
- Assess the likelihood of catastrophic escalation, declare a 'major incident' if necessary
- Communicate with the Scientific and Technical Advice Cell (STAC) if one has been set-up for the incident
- Liaise with emergency planning at early stages of an incident where appropriate.
- Consider criminal or terrorist activity, including the risk of secondary devices
- Assess the impact on people, consider shelter-in-place as an alternative to evacuation and the numbers of people already exposed or potentially at risk
- Assess the potential impact on infrastructure and property
- Assess the impact on the environment. see National Operational Guidance: Environmental protection

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Exposure of the general public to hazardous materials

Hazard	Control measures
Exposure of the general public to hazardous materials	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Consider the immediate life risk Implement life-saving activities Gather information on the hazardous materials Access specialist hazardous materials advice Carry out public evacuation or shelter-in-place

	Consider downwind protection zones Reduce the chemical hazard

Hazard knowledge

To understand this hazard fully it is important that responders are clear about the difference between *'contamination'* and *'exposure':*

- **Contamination** occurs when a substance adheres to or is deposited on people, equipment or the environment, creating a risk of exposure and possible injury or harm. Contamination does not automatically lead to exposure but may do so.
- **Exposure** occurs when a harmful substance enters the body through a route, for example, inhalation, ingestion, absorption or injection, or when the body is irradiated

At a hazardous materials incident it is recognised that members of the public may be directly involved. The priority for all emergency responders at all incident types is to save life, therefore the primary focus for emergency responders involved in a hazardous material incident will be to conduct initial life-saving activity for casualties that are in need of assistance, direction or rescue.

The process of life saving will start with the mobilising control room on receipt of the initial call. Key information exchange and direction at this time can be very effective and not only can save lives but also can inform responders of the current situation they are responding to.

Information gathered by call handlers should be shared with other responding agencies, and will also form part of the joint understanding of risk and assist in shared situational awareness.

In a contamination incident, the speed of the response is critical to saving lives. The process of evacuation, disrobing and (improvised) decontamination, ideally within fifteen minutes, will result in the vast majority of skin contaminants being removed and further injury or death avoided.

First responders must also ensure their own safety by carrying out ongoing hazard assessments. These assessments should be shared with other responders, in line with Joint Emergency Services Interoperability Principles (JESIP). This can inform agency specific risk assessments to promote joint decision making and a safer operational approach.

(See Initial Operational Response to a CBRN(E) incident (published by the Joint Emergency Services Interoperability Programme (JESIP).)

Apart from 'immediate life rescues', hazardous materials incidents possess the ability to affect members of the public not initially involved in the original accident or release. The fact that hazardous materials can move from the scene of origin means there is a potential for members of the public to become exposed to harm some time after the start of the incident. Fire and rescue services have a responsibility to limit, or prevent further, involvement of the public and actions should be undertaken with this in mind.

Control measure – Approach the incident safely and estimate the potential hazard zone

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone.

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons.

Control measure – Consider the immediate life risk

Control measure knowledge

Understanding the current threat to life and the need for immediate action will take priority and have an effect on any pre-determined planned responses. The first objective of the three primary emergency blue light services is to save life, and all agencies are required to assist in achieving this key objective as a matter of urgency.

Immediate life-saving actions in a potentially contaminated environment can be prioritised and are underpinned by scientific research that was conducted for the initial operational response project. (ORCHIDS – www.orchidsproject.eu)

The initial operational response (IOR) was a programme of work that identified realistic expectations of front-line emergency responders in response to a CBRN(E) event. This principle could apply to a hazardous material incident where a risk to life exists in the early part of the response phase.

The key points to initial operational response (IOR) are:

- Evacuation – moving casualties away from the scene of contamination
- Disrobe - immediate disrobing of top clothing layers
- Decontamination – removing potential contaminants from exposed skin using an absorbent material, for example blue roll, kitchen or toilet roll. Where the contaminants are having a caustic effect on individuals consider using water to assist in the decontamination process.

To conduct life-saving actions in a hazardous material environment it is important to understand:

- The STEP 1-2-3 Plus (Safety Triggers for Emergency Personnel) process (see Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone)
- The advantages and limitations of responder personal protective equipment (PPE) and respiratory protective equipment (RPE)
- The need for multi-agency joint understanding of risk and a dynamic risk assessment (DRA)

If the incident commander is considering deploying crews to conduct life-saving activity, it is important to ensure an effective emergency decontamination strategy is available for both firefighters and casualties.

Strategic actions

Fire and rescue services should:

- Have recording systems and checklists in place in the mobilising controls to capture the need for rescues and be able to give instructions to those in need on the initial call

- Ensure personnel are aware of the principles of initial operational response (IOR)
- Understand standard protocols and rescue techniques that can be applied in a hazardous materials environment
- Have systems in place to capture the results of multi-agency risk assessments and also dynamic risk assessments (DRA)

Further information can be found in the Health, safety and welfare framework for the operational environment

Tactical actions

Incident commanders should:

- Assess the need for any immediate life-saving rescues considering:
  - Number, location and degree of entrapment of casualties
  - Whether conscious, unconscious or obviously dead
  - Likelihood or degree of contamination of casualties
  - Ability to survive if not rescued immediately
  - Options to improve survivability until rescued, for example protection of airways
  - Known or apparent hazards from the emergency/accident and the physical properties of the release/spill
  - Additional hazards for example, fire, explosion, mechanical processes, working at height
- Apply STEP 1-2-3 Plus if appropriate
- Consider effective control measures for rescue teams and casualties to prevent spread of contamination
- Consider limitations of personal protective equipment (PPE) and respiratory protective equipment (RPE) when applied to a hazardous materials incident (see Hazard – Exposure of responders to hazardous materials, Control measure – Select the most appropriate personal protective equipment (PPE))

Control measure – Implement life-saving activity

Control measure knowledge

It has always been recognised that during fire situations fire and rescue service personnel may need to make an immediate risk-assessed, immediate life-saving rescue, normally in the initial stages of the incident. This will also be the case for hazardous materials incidents. Members of the public in areas of either gross contamination and/or high concentrations of hazardous materials, and who therefore have no safe escape route, may require immediate life-saving actions.

Evacuation, disrobe and decontamination are key principles to follow when conducting life-saving activity in a contaminated environment. Maximum benefit will be realised if conducted within fifteen minutes of exposure.

These early operational activities should be considered an absolute priority. Casualties should be directed away from the scene, ideally upwind and uphill of contamination and point of release. Any casualties who are able to walk should be directed to this area with the minimum direct physical contact from emergency responders.

Communication to casualties on scene is important. Responders should clearly communicate what they know about the incident, what is being done to help affected people and how they can help themselves. This will help foster trust and confidence between casualties and responding organisations and help promote compliance with emergency interventions. First responders should consider communicating:

- What they know of the nature of the incident, even if it is just that more help is on its way
- What the emergency services are doing
- That medical assistance is coming
- That the advice and instructions from the emergency services should be followed
- That those who are capable should assist others who are injured or less able to carry out tasks if they can

Casualties that are identified as breathing and conscious, but unable to walk, should be regarded as a high priority to be rescued. They should be moved from the perceived area of greatest contamination and taken to an area of relative safety. At the earliest practicable opportunity, these casualties should be helped to disrobe and, if possible, undergo improvised or interim decontamination.

As first responders, only fire and rescue service personnel have suitable personal protective equipment (PPE) to carry out rescue at the incident scene and therefore should be the only people to enter this area. It is recognised that the time taken to don gas-tight suits (GTS) may compromise their ability to rescue non-walking, saveable life casualties in a timely manner. In these circumstances, the fire and rescue incident commander should consider the use of other acceptable personal protective equipment (PPE) ensembles. Fire and rescue service structural firefighting kit combined with self-contained breathing apparatus provides a lesser degree of protection than gas-tight suits (GTS). However, research has demonstrated that protection factors provided by this level of personal protective equipment (PPE) reduce the risk to fire and rescue service personnel to a level that may be considered acceptable in circumstances where saveable-life rescues could potentially be carried out.

Before carrying out any immediate life-saving rescue the following should be considered:

- Survey the area around the casualties, taking note of any hazards and information, for example emergency action codes (EACs), additional personal protection (APP) codes
- Structural firefighting kit, gloves, fire-hood and self-contained breathing apparatus as the minimum level of personal protective equipment (PPE)
- Use higher levels of chemical protective clothing (CPC) if the substance is obviously hazardous, the likelihood of contamination is high and the time taken to rig is proportionate to the casualty's condition
- Approach from upwind and, where possible, upslope
- Avoid or minimise contact with the release
- Minimise exposure time in the hazard zone

- Designate a safe access/egress route to minimise contamination of the rescuers
- Provide improvised decontamination and safe undressing procedures for the rescuers
- Disrobe casualties then undertake improvised, interim or clinical decontamination
- Use the minimum number of rescuers and if possible limit the number of rescuers coming into direct contact with the release and the casualties
- Give a specific safety brief to the rescuers, considering:
    - Likely hazards
    - Actions to be taken
    - Safe access and egress routes
    - Time limits
    - Team leader and lead rescuer
    - Location of inner cordon and casualty handover area
    - Decontamination/safe undressing procedure

It cannot be over-emphasised that this guidance is not an instruction to deploy responders into a potentially contaminated area in standard firefighting kit and self-contained breathing apparatus in every circumstance. The purpose is to provide incident commanders with guidance to allow them to make calculated risk based decisions, based on all available information, on whether or not to deploy staff in firefighting kit and self-contained breathing apparatus as part of a risk assessed plan to rescue saveable lives.

Strategic actions

Fire and rescue services should:

- Ensure incident commanders have the skills, knowledge and understanding required to undertake rapid risk assessment to perform immediate life-saving rescues at hazardous materials incidents
- Consider providing appropriate equipment to assist in removing casualties from the risk area, such as loud hailers, vehicle personal address systems, stretchers, etc.
- Ensure that the results of the research from the initial operational response (IOR) (see Joint Emergency Services Interoperability Principles (JESIP)) is incorporated into all policies and procedures that address hazardous materials incidents and CBRN(E) incidents
- Ensure that specialist advice from a hazardous materials adviser (HMA) is available to the incident commander as soon as possible to ensure that any risks to the rescuers, due to their level of personal protective equipment (PPE), are controlled
- Ensure personnel are aware of the limitations of the procedure and know not to attempt to extend these limitations

Tactical actions

Incident commanders should:

- Assess the need to conduct immediate life-saving rescues

- Give a specific safety brief to the rescuers
- Ensure an effective improvised decontamination strategy is available
- Assess the need for any immediate evacuation and/or identify places of relative safety
- Consider the realistic potential for the release to spread
- Assess 'sheltering-in-place' as an alternative to evacuation
- Assess the likelihood of catastrophic escalation occurring and declare a 'major incident' if necessary

Control measure – Gather information on the hazardous materials

See Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Gather information on hazardous materials

Control measure – Access specialist hazardous materials advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Control measure – Carry out public evacuation or shelter-in-place

Control measure knowledge

There are two recognised methods of reducing the impact of a hazardous material on members of the public not originally involved in the incident, but who could potentially become involved as the material moves from the incident. These are either 'shelter-in-place' or evacuation.

There are a number of considerations to be made by a hazardous materials adviser (HMA) when advising the incident commander on which course of action is correct for protecting the public. These are:

- The physical state of the material – solid, liquid or gas, and the impact this will have on the ability for a hazardous material to move from the incident
- The size of the inner cordon and the numbers of people already exposed or potentially at risk
- The realistic potential for the hazardous materials to spread whilst the response plan is being implemented
- The quantity and nature of the release, for example, a single release of a large amount of material over a very short period of time, or the steady flow of a material over a prolonged period of time
- That most materials will generally lessen as they disperse from an incident either due to the effects of downwind, dilution, oscillation, obstacles and retention (DDOOR) for gases or the general spreading out as solids or liquids move (see downwind, dilution, oscillation, obstacles and retention 'DDOOR, Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone)
- The effect that weather conditions such as wind speed and direction will have on a plume – and also considering using specialist services to assist in plotting a chemical plume
- The topography of the area, recognising that liquids and solids will generally travel in the direction of any slope

- The toxicity/harm a hazardous material can cause to human health – seek advice from toxicologists in public health agencies

When advising the public to shelter-in-place consider:

- How long the public are likely to need to shelter from any release – how long will the atmosphere outside the property likely to be considered hazardous?
- The age, type and construction of the properties in the affected area and how likely the property type is able to prevent the material from entering
- The location of the properties in relation to the incident and the likely reduction in the effect of the material the greater the distance from the release
- The demographics of the people involved and their resistance to the nature of the hazardous material, for example their age or health condition
- The location of any at risk groups, for example, at hospitals, homes for the elderly, schools etc.
- The air exchange for a building – what equipment is in place (air conditioning systems) and can they be switched off?
- The time of day and how this may affect the demographics of the community and the number of people in the affected area
- That vehicles are not generally accepted to be a suitable location in which to shelter
- How to communicate the message to shelter-in-place and to explain the process of shutting doors and windows and reducing any ventilation the properties may have – also, to advise how the 'all clear' message will be communicated and how often updates are likely to occur
- Liaising with the partner agencies to agree on how the shelter-in-place will be controlled and the public informed; this would be via the police or the public health agencies
- Weather conditions

When advising the public to evacuate consider the following:

- Liaise with the police services who will generally be responsible for carrying out the evacuation
- Recognise that fire and rescue service personnel may need to assist when police resources are limited and an evacuation is required immediately
- Be aware that when carrying out an evacuation, the area closest to the incident should be evacuated first and, as more resources arrive, the evacuation can be extended
- Be aware of the risk to responders carrying out the evacuation
- Liaise with the local authorities to establish a suitable location for an assembly point for displaced members of the public – ensuring that such an assembly point is out of the risk area and will remain so if weather conditions change (in particular if wind direction or speed changes)
- Evaluate the nature of the release and consider the environment through which the public will need to travel to be evacuated.
- Consider the demographics of the people being evacuated and the way a hazardous material may vary in its effect (for example, the elderly and young tend to be more vulnerable to hazardous materials)

- Consider the availability of safe accommodation
- Communicate the evacuation (for example, using a fixed alarm system, responders with megaphones, door knocking, avoiding panic, radio and TV announcements)
- Establish a safe holding area for members of the public being evacuated or consider a dispersal plan
- Establish the means of identifying empty properties

Strategic actions

Fire and rescue services should:

- Provide access to meteorological information (for example Met Office FireMet in 'hazard manager') to enable plume modelling and dispersal of chemical plumes to be predicted.
- Provide on-scene mapping facilities to enable risk areas to be identified and actions to be planned and documented
- Provide access to a hazardous materials adviser (HMA) who is able to interpret physical characteristics of chemicals as well as storage conditions, weather and topography impacts and other aspects that will affect the uncontrolled movement of hazardous materials
- Consider how messages can be communicated to large numbers of the public in a relatively short period of time (for example, radio and television reports or generic leaflet drop)
- Consider liaising with partner agencies who have air monitoring capabilities, public communication responsibilities and specialist knowledge on issues relating to human health
- Recognise the impact and resource requirements needed for an evacuation of a large number of the public
- Liaise with partner agencies – particularly the police service and public health agencies – to agree protocols around either advising members of the public to remain indoors or to initiate and complete an evacuation. For further information see National Operational Guidance: Operations.

Tactical actions

Incident commanders should:

- Gain advice from the hazardous materials adviser (HMA)
- Liaise with the police services regarding potential evacuation
- Ensure the area closest to the incident is prioritised
- Liaise with the local authorities to establish a suitable assembly point
- Consider necessary evacuation routes
- Consider the demographics of the people being evacuated and the way a hazardous material may vary in its effect
- Consider the availability of safe accommodation
- Communicate the evacuation, for example using:
    - A fixed alarm system

  - Responders with megaphones
  - Door knocking, avoiding panic
  - Radio and TV announcements, etc.
- Establish a safe holding area or consider a dispersal plan
- Establish the means of identifying known empty properties
- Consider whether advising the public to shelter-in-place is appropriate; if it is consider:
  - How to communicate the message to shelter-in-place, the process to be adopted, how the 'all clear' message and how updates will occur
  - Liaise with the partner agencies regarding how the shelter-in-place will be controlled and public informed

Control measure – Consider downwind protection zones

Control measure knowledge

There are different ways to determine the effect of a hazardous material over distance. The likelihood is that any solid or liquid will only affect the immediate area, unless it is able to access drainage systems or can act similarly in nature to a gas (for example, volatile liquids or powdered solids that can be carried on the wind). It is therefore recognised that the greatest risk is from gases, vapours, aerosols and particulates.

The Emergency Response Guidebook (ERG) gives general guidance on immediate hazard areas around materials (known as the initial isolation zone) based on the physical state (25m for solids, 50m for liquids and 100m for gases). However, these are initial distances. Once these are in place, further distances are quoted, known as downwind protection zones. As the name suggests, these are areas downwind of the incident (zones in the direction the wind is blowing) and are at greatest risk from the hazardous material.

Specialist advice from a hazardous materials adviser (HMA) is required to interpret downwind protection zones as these can be significantly affected by the weather conditions. For example, it is known that a strong wind will cause the hazardous material to travel further from the incident than a light breeze. However, a strong wind will generally cause the material to dilute or disperse much quicker than a light breeze. Plume modelling software, available from sources such as metrological centres, can be used to great effect in predicting the impact of hazardous materials in downwind protection zones.

Most software will produce a chart similar to this:

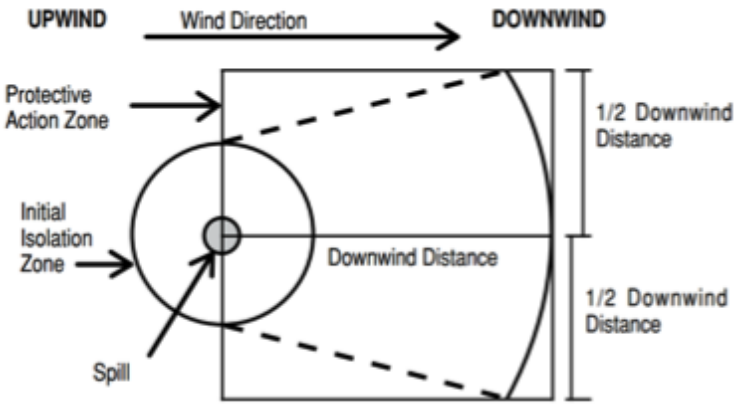

Figure 5: Example of protection zones modelling
Source: Emergency Response Guidebook (ERG)

The area of concern spreads out to form a cone. Members of the public inside this area should be considered to be potentially at risk – the degree of risk should be assessed by the hazardous materials adviser (HMA).

More sophisticated software can begin to assess the degree of risk, as well as the area of concern. This will require knowledge of the material being released, the quantity and nature of the release and the various weather conditions.

It should be remembered that the two zones – the initial isolation zone and the downwind protection zone – imply two different types of area. An initial isolation zone is more likely to require an evacuation. The downwind protection zone suggests that the public in this area need only to be protected from the release and this may often be considered for a shelter-in-place strategy.

Strategic actions

Fire and rescue services should:

- Form links with reputable sources of meteorological advice (for example, the Met Office)
- Assess and agree on any source of plume modelling or weather/wind direction software that they wish to adopt
- Provide specialist personnel and/or hazardous materials advisers (HMA) who are fully conversant with the software and able to interpret the information it provides
- Consider using the information provided in the Emergency Response Guidebook (ERG) – to be assessed and interpreted by a hazardous materials adviser (HMA)
- Provide a means of accessing the information on the incident ground

Tactical actions

Incident commanders should:

- Consider implementing the initial isolation zones depending on the size of the release
- Seek assistance from the police service to implement an initial isolation zone

- Obtain specialist advice from the hazardous materials adviser (HMA) regarding the size of any downwind protection zone and the suitability of a shelter-in-place strategy
- Consider the risks in the downwind protection zone, such as buildings with high-risk or high-dependency members of the public
- Consult with the appropriate public health agencies about a tactic of either evacuation or shelter-in-place

Control measure – Reduce the chemical hazard

Control measure knowledge

Neutralisation is the term used for counteracting an acid against an alkali (or visa versa) to bring its pH value to pH7 – however, it has generally become accepted that the term neutralise implies removing the hazard from a chemical. For example, bleach may neutralise the hazard from a biohazard, or water may neutralise the hazard from an exothermic material.

To neutralise the hazard posed by a material it is necessary to know what the initial hazard is, and what decontamination additive could be used to counteract its effect. A fire and rescue service may encounter a number of common materials where an additive will neutralise the effect. However, materials that are more complicated will need advice from a hazardous materials adviser (HMA) or scientific adviser.

Further information can be found in National Operational Guidance: Performing rescues, Hazard – Thermal or chemical injury.

Strategic actions

Fire and rescue services should:

- Seek advice from hazardous materials advisers (HMA) and scientific advisers regarding known decontamination additives, then select and purchase those that can be used against commonly encountered materials
- Determine the most appropriate manner in which the additives can be brought to an incident and who is most qualified to use them
- Incorporate additives into any decontamination strategy where they are deemed suitable and necessary
- Recognise that some additives may have hazards of their own and may only be suitable for use on chemical protection clothing (CPC) and not on the skin. Therefore, the use of an additive will vary depending on who or what is being decontaminated.

Tactical actions

Incident commanders should:

- Make every effort to identify the material involved; sometimes it will only be necessary to identify the hazards and characteristics of the substance to apply an effective and appropriate additive
- Incorporate the additive into the casualty's treatment or decontamination strategy

- Liaise with the hazardous materials adviser (HMA) to discuss the concentration of additive (where it can be altered) most suitable for the materials to be neutralised
- Recognise when water can and cannot be used to dilute or reduce the hazard
- Provide arrangements for medical aftercare for anyone exposed to hazardous materials (see Control measure – Provide a health monitoring system for all personnel)
- Approach the casualty with care, communicate with them and avoid cross-contamination
- Remember that patients with chemical burns may need irrigation with large amounts of water to clear the contaminant
- Request specialist advice, for example the National Chemical Emergency Centre (NCEC) 24/7 help line etc.
- Identify the chemical agent through a live database, for example Chemdata or on vehicle mobile data terminal (MDT) etc.

Contaminated members of the public

Hazard	Control measures
Contaminated members of the public	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Consider the immediate life risk Gather information on the hazardous materials Access specialist hazardous material advice Establish and operate public decontamination Decontaminate people Communicate effectively with public and community Ensure effective inter-agency liaison Work with other responders to develop a joint understanding of risk

Hazard knowledge

To understand this hazard fully it is important responders know the following definitions relating to public decontamination:

Decontamination: The physical and/or chemical process of reducing contamination to minimise the risk of further harm occurring and to minimise the risk of cross contamination to a level as low as reasonably practicable (it is not always possible to totally remove the contaminant or clean the equipment on site)

Mass decontamination: A planned and structured procedure using purpose designed decontamination equipment where there are large numbers of contaminated casualties that require 'wet decontamination'

Improvised Decontamination: Using an immediately available method of decontamination before the use of specialist resources

Interim Decontamination: Using standard equipment to provide a planned and structured 'wet decontamination' process

Clinical Decontamination: The process where contaminated casualties are treated individually, by trained healthcare professionals, using purpose-designed decontamination equipment. Triage should determine the priority for any casualties – refer to the Performing rescues – Casualty care guidance for further information. Priorities include:

- *Priority 1 (P1) Casualties:* Patients with a high priority for either immediate emergency medical care, or immediate emergency life-saving decontamination, or both
- *Priority 2 (P2) Casualties:* Less severely affected patients who need either emergency medical care or early decontamination to prevent further intoxication
- *Priority 3 (P3) Casualties:* Patients with slight to moderate intoxication and without contamination at a level that requires immediate action

At any incident involving hazardous materials there is a potential for members of the public to be contaminated. Fundamental first steps to decontaminate them have been developed as part of the initial operational response project (IOR) (see Joint Emergency Services Interoperability Programme (JESIP)).

The key elements of the initial operational response are:

Evacuate – get people away from the scene of contamination

Communicate and advise – immediate medical advice and reassurance that help is on its way

Disrobe – remove clothing

Decontaminate – improvised 'dry' decontamination when a non-caustic/corrosive agent is suspected and improvised 'wet' decontamination when a caustic/corrosive agent is suspected

The impact on members of the public will depend on the clothing they are wearing. Factors such as the total surface area of skin covered by clothing, the type of the clothing (waterproof, absorbent, fabric type, etc.), the number of layers, the speed and method with which it is removed will all vary the degree of contamination and harm to the person.

Due to these different considerations, it is imperative that a source of hazardous materials advice is available to offer advice on the level of decontamination required, any additives that may assist and how they should be used, the effectiveness of clothing against the contaminant and any other relevant consideration.

Control measure – Approach the incident safely and estimate the potential hazard zone

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone.

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons.

Control measure – Consider the immediate life risk

See Hazard – Exposure of the general public to hazardous materials, Control measure – Consider the immediate life risk.

Control measure – Gather information on the hazardous materials

See Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Gather information on hazardous materials

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Control measure – Establish and operate public decontamination

Control measure knowledge

Although the health service has primacy for public decontamination, the fire and rescue service is acknowledged as being the most capable emergency service with regard to its provision at an emergency incident. This is because of the equipment and personnel it can provide.

In establishing a decontamination process, the designation of an area to carry it out can greatly affect the effectiveness of the process and can reduce the impact of the process on the surrounding environment. If a 'wet' decontamination process is chosen the water run-off must be contained and prevented from entering drainage until discussed with the relevant agency and water companies. This is covered in the Protocol for the disposal of contaminated water and associated wastes at incidents, Section 9.2.2.

When positioning pumping appliances to be used in any interim decontamination, consideration should be given to preventing exhaust fumes being directed into the decontamination area and, where possible, pumping bays should remain in the cold zone.

Strategic actions

Fire and rescue services should:

- Secure access to appropriate specialist advice, both internal and external, on decontamination
- Recognise the level of containment required to prevent decontamination run-off from entering drainage and have controls in place to limit this by using the hierarchy of pollution control and appropriate containment equipment (see National Operational Guidance: Environmental protection)
- Provide systems for resilience in the event of breakdown or fault with any item of equipment; this may include replacement equipment or alternate methodology
- Ensure personnel that respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to establish and operate decontamination effectively

Figure 6: Examples of interim decontamination
Source: Dorset Fire and Rescue Service

Tactical actions

Incident commanders should:

- Assess any area to be used for decontamination for its suitability; consider:
  - Topography, any slopes or dips that will allow run-off to flow or collect
  - Drains – prioritise the blocking of surface drains
  - Drainage risk through porous ground
  - Operational circumstances and risk assessment
  - Level and method of decontamination
  - Weather conditions
  - Wind direction
  - Position of the inner cordon and hot zone
- Make preparations for dry decontamination of members of the public as they exit the hot zone, and have wet decontamination ready for people suffering from contamination with corrosive materials
- Designate a rendezvous point(s) (RVP) for attending equipment, to allow its deployment on scene to be controlled
- Use the natural layout of the surroundings to guide members of the public towards the decontamination area

- Ensure correct cordons and zones are set-up, identified and communicated to all partner agencies (see Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons)
- Set up the appropriate structure layout, depending on the type of casualty to be decontaminated
- Designate trained personnel to operate the decontamination procedure, provide guidance to members of the public, and operate and service decontamination equipment
- Contain any water run-off for a reasonable period and minimise any impact on the environment

Control measure – Decontaminate people

Control measure knowledge

It is accepted, following the work carried out for the initial operational response (IOR) (see Hazard – Exposure of the general public to hazardous materials, Control measure – Consider the immediate life risk and Implement life-saving activity), that most of a contaminant is removed by removing the outer layers of clothing. The amount will vary on the type of clothing and percentage of the body surface covered. However, the first principle is that decontamination should start as soon as possible and as soon as the person is away from the area of gross contamination. Removing the person from the hot zone significantly reduces the likelihood of any further contamination. Likewise, 'exposure' through the casualty's unprotected respiratory system will be reduced by an initial evacuation.

Once removed from the hot zone, decontamination should start immediately. Any primary decontamination procedure is a combination of two processes:

- Contamination reduction
- Safe undressing

Undressing and decontamination procedures will depend on the nature of the contaminant, so fire and rescue service personnel should be trained to recognise the signs and symptoms of various materials. Personnel should be familiar with the methodology used during this 'initial and interim decontamination' stage, which should be based around a multi-agency risk assessment.

It is generally now accepted that dry decontamination by using an absorbent material immediately after the outer layers of clothing have been removed is the most effective means of decontamination. Personnel should be mindful that the casualty's hair may still hold some contaminant and wet decontamination of the hair should be considered if there is good reason to believe it may be contaminated. Likewise, corrosive materials will also require wet decontamination which can be applied via an interim or improvised decontamination method.

Strategic actions

Fire and rescue services should:

- Ensure personnel who respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to decontaminate members of public effectively
- Adopt the protocols laid down in the initial operational response (IOR) (see Joint Emergency Services Interoperability Programme (JESIP))

- Provide procedures for improvised decontamination following initial operational response (IOR) guidance
- Provide procedures for interim decontamination
- Provide procedures and equipment for the mass decontamination of large numbers of the public, which are interoperable with other responders
- Work with partner agencies to ensure decontamination for all levels of casualties (i.e. P1, P2, P3)

Tactical actions

Incident commanders should:

- Move members of the public from the hot zone to a place of relative safety
- Inform the public that a system of disrobing is to be undertaken
- Identify whether dry or wet decontamination is appropriate
    - Casualties complaining of burning or itching would indicate a corrosive material and wet-contain decontamination should be used
- Support the ambulance service in performing clinical decontamination of P1 and P2 casualties when required
- Contain all water run-off from the decontamination procedure for a reasonable period of time

Liaise with the environmental agencies or hazardous materials adviser (HMA) regarding appropriate disposal. See National Operational Guidance: Environmental protection and The environmental protection handbook for the fire and rescue service, 2013, EA and Protocol for the disposal of contaminated water and associated wastes at incidents).

Control measure – Communicate effectively with public and community

Control measure knowledge

Decontamination is likely to be a stressful situation for members of the public. They will be requested to undertake actions (such as disrobing) that they may be reluctant to do. In addition, the public will be unfamiliar with the processes used for decontamination, although in some respects they are similar to normal washing.

Communication is an essential step in the decontamination of the public. Fire and rescue service personnel will need to be able to convey the importance of decontamination procedures in a way that respects the stressful nature of the incident, the importance of removing the contaminant, the dignity of the individual and also addresses any, gender, cultural, religious, disability and/or ethical issues that may arise. This may mean having interpreters and/or religious or cultural leaders either at the incident or involved in pre-planning.

Strategic actions

Fire and rescue services should:

- Establish protocols to assist their personnel in communicating with the public effectively

- Develop links with religious and cultural groups by actively engaging with relevant sections of the community
- Consider how the decontamination process may need to be segregated, such as on the basis of the gender of the people to be decontaminated
- Consider how the decontamination process may vary for people with disabilities, by engaging with health agencies and other support groups
- Consider access to translation services
- Consider pictorial guides to advise members of the public on decontamination procedures

Tactical actions

Incident commanders should:

- Communicate effectively with potentially large numbers of people
- Explain the decontamination process to the public
- Consider any gender, cultural or religious issues that may affect the decontamination process
- Attempt to identify individuals who could assist with translation
- Ensure communication with the public is consistent with that of other agencies
- Provide guidance on how any decontamination disrobe packs should be used, make reference to pictorial guides if available

Control measure – Ensure effective inter-agency liaison

Control measure knowledge

Responsibility for dealing with any member of the public who is reluctant or refuses to be decontaminated, and recording people passing through decontamination, rests with the police or security services. Therefore, it is clearly important that any fire and rescue service should forge links with all multi-agency partners.

Strategic actions

Fire and rescue services should:

- Identify the issues and priorities of their multi-agency partners
- Incorporate the priorities of their multi-agency partners into their own response to public decontamination
- Consider appointing a designated officer or representative to liaise with other agencies, for example a national inter-agency liaison officer (NILO)

Tactical actions

Incident commanders should:

- Liaise with multi-agency partners in the initial stages of the incident, and ensure this continues throughout the incident
- Consider appointing an inter-agency liaison officer (ILO), designated officer or representative responsible for liaison with multi-agency partners
- Agree a multi-agency risk assessment
- Agree priorities, limits of responsibility and initial actions
- Agree the layout of the decontamination zone to incorporate the needs of each agency

Control measure – Work with other responders to develop a joint understanding of risk

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Work with other responders to develop a joint understanding of risk

Exposure of responders to hazardous materials

Hazard	Control measures
Exposure of responders to hazardous materials	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Gather information on the hazardous materials Access specialist hazardous material advice Assess the tasks and associated hazards Select the most appropriate personal protective equipment (PPE) Select the most appropriate personnel Brief personnel effectively before committing them to the hazard zone Use effective communications systems Designate clean areas with washing, hydration and welfare facilities Emergency exposure procedures

Hazard knowledge

To understand this hazard fully it is important to recognise the difference between ‘exposure’ and ‘contamination’.

Contamination occurs when a substance adheres or is deposited on people, equipment or the environment, creating a risk of exposure and possible injury or harm. Contamination does not automatically lead to exposure but may do so.

Exposure occurs when a harmful substance enters the body, through a route such as inhalation, ingestion, absorption or injection, or when the body is irradiated.

Personal protective equipment (PPE) is used in emergency situations to prevent harmful substances from entering the bodies of responders. In normal workplaces, PPE should be considered as the last resort in terms of the health and safety hierarchy of control measures. But when called to emergencies involving hazardous materials, the fire and rescue service often has no alternative but to rely on PPE. It is therefore vitally important that responders understand the advantages and limitations of their PPE ensembles.

When choosing suitable protective garments, the standard of clothing worn beneath the specialist personal protective equipment (PPE) should also be taken into account. The selection of suitable sizes and gender specific requirements should also be considered. When selecting appropriate PPE, the need for rescuers to be visible against the operational background, including night working, and for the incident commander and personnel in other managerial and functional roles to be distinguishable, should also be considered. See National Operational Guidance: Operations – Physical hazards – Personal protective equipment (PPE).

Whilst attending incidents involving chemicals, personnel will inevitably be required to wear appropriate personal protective equipment (PPE). Personnel need appropriate familiarisation training on donning/doffing gas-tight suits, powered respirator protective suits (PRPS), liquid-tight protective clothing, etc., including being assisted or assisting others and carrying out simple tasks while wearing chemical protective clothing (CPC). This will help them appreciate the restrictions that this PPE can bring.

Control measure – Approach the incident safely and estimate the potential hazard zone

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone.

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons.

Control measure – Gather information on the hazardous materials

See Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Gather information on hazardous materials

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Control measure – Assess the tasks and associated hazards

Control measure knowledge

The personal protective equipment (PPE) chosen by responders should be suitable and sufficient for the tasks that need to be carried out. There should be a basic analysis of what needs to be done and the hazards that are likely to be encountered.

Strategic actions

See Control measure – Select the most appropriate personnel

Tactical actions

Incident commanders should assess the:

- Hazards posed by the substance
- Physical properties of the hazardous material, for example, vapour, liquid or solid
- Potential for the physical properties to change and affect the contamination of the responders, for example, condensation of vapours or water solubility of a vapour
- Concentration, temperature or potency of the hazardous materials
- Degree of contact with the hazardous materials
- Duration of contact with the hazardous materials
- Complexity of the tasks, for example the degree of manual dexterity needed
- Degree of strength or physical effort required
- Likelihood of heat stress
- Manual handling risks exacerbated by wearing personal protective equipment (PPE)
- Working at height risks exacerbated by wearing personal protective equipment (PPE)
- Working conditions, for example, hot or cold, light or dark, in the open or in a building, on firm or level ground versus slippery or uneven ground

Control measure – Select the most appropriate personal protective equipment (PPE)

Control measure knowledge

A number of personal protective equipment (PPE) ensembles are available to fire and rescue service responders. Rarely does one ensemble protect the wearer against all foreseeable hazards. Selecting hazardous materials PPE must be the result of a risk assessment carried out at the scene of operations.

The importance of effectively selecting and using appropriate personal protective equipment (PPE) at an incident cannot be overstated. It is vital to understand the performance standards and level of protection afforded by PPE ensembles. In general, PPE can be broken down into two distinct groups:

- Respiratory protection equipment (RPE)
- Protective clothing

To select the most appropriate personal protection equipment (PPE) the incident commander will have decided the tasks to be carried out and the hazards that may be encountered. They will then choose the ensemble that provides the greatest level of protection against the most dangerous foreseeable hazards. Seven basic factors will generally determine the level and type of protection required by responders:

- Fire – Is fire or a flammable atmosphere present? Most chemical protective clothing (CPC) should not be used in fire situations.
- Toxicity – Primarily via inhalation, but also consider ingestion or skin exposure

- Corrosiveness – From weak or strong concentrations of acids or alkalis
- Oxidation – Where there is a reaction with organic materials, producing heat and/or oxygen
- Temperature – Where the substance is at an extreme of temperature, whether hot or cold
- Biohazards – From pathogens and open cultures
- Radiation (ionising) – Whether involving an unsealed source or not

Structural firefighting kit and self-contained positive pressure breathing apparatus (BA) should be the minimum default level of personal protective equipment (PPE) for fire and rescue service personnel during the initial attendance. Subsequent actions determined by the incident commander, and subject to a risk assessment, may require crews to wear additional protective clothing due to the factors listed above.

The level of protection afforded by structural firefighting kit should not be underestimated. It has been subject to rigorous testing as part of the ORCHIDS research programme CBRN(E) incidents and in particular initial operational response (IOR) (see ORCHIDS at http://www.orchidsproject.eu)

Where human life is at risk, speed of rescue is often a critical factor. See Control measure – Consider the immediate life risk and Control measure – Implement life-saving activity for further information.

To determine the level of personal protective equipment (PPE) required at the initial response phase of an incident involving hazardous materials in a transport scenario, reference may be made to dangerous goods emergency action codes (EACs) (see emergency action code list), also known as Hazchem codes. Emergency action codes (EACs) give the emergency services an indication of the actions that may be necessary during the first few minutes of an incident involving dangerous goods, should the incident commander deem it necessary to take immediate actions.

Additional personal protection (APP) codes give emergency responders more information on appropriate levels of chemical protective clothing. These codes do not appear on vehicle placards or on emergency action code (EAC) cards but are available in the dangerous goods emergency action code (EAC) list, generally through mobilising controls or mobile data terminals.

Additional personal protection (APP) codes appear as either code ‘A’ or code ‘B’ on the list. For both codes, gas-tight chemical protective clothing conforming to BS EN 943; part 2 should be worn. The difference between them is that code A substances have additional hazards that require further protection. Structural firefighting kit should be worn, as an additional protective layer, in addition to gas-tight chemical protective clothing (CPC).

When directed to apply additional personal protection code (APP) code A, the most vulnerable areas of potential exposure will probably be the hands and feet. Appropriate hand protection for the particular hazard must be taken into consideration when conducting the risk assessment of any task to be undertaken. Structural firefighting kit is specified as tunic, over-trousers, fire hood and firefighting gloves, all conforming to the relevant British or European standard.

Most firefighting gloves cannot be worn with gas-tight suits. Even if crews are wearing gloves that meet the additional requirements of additional personal protection code (APP) code A, they will still not be fully protected against the extremely low temperatures encountered with cryogenic substances.

Strategic actions

Fire and rescue services should:

- Provide personnel who deal with hazardous material incidents with specialist information, instruction and training on selecting personal protective equipment (PPE)
- Provide a variety of generic ensembles of hazardous material personal protective equipment (PPE), and make them available to responders

Tactical actions

Incident commanders should:

- Consider information sources to assist the selection of appropriate personal protection equipment (PPE):
    - The dangerous goods emergency action code (EAC) list
    - Chemdata, via appliance mounted mobile data terminals (MDT)
    - The Emergency Response Guidebook (ERG)
    - CHEMSAFE via the National Chemical Emergency Centre 24-hour helpline
    - Hazardous materials advisers (HMA)
    - Scientific advisers
    - Industry or product specialists, etc.
- Consider the following when selecting the most appropriate personal protective equipment (PPE) ensemble:
    - Physical properties of the substance
    - Form (gas/vapour, liquid, solid)
    - Toxicity and/or infectivity
    - Concentration levels
    - Quantity of product involved or potentially involved
    - Likelihood of direct contact
    - Type of hazardous material incident (fire, potential fire, leak or spillage)
    - Limitations of personal protective equipment (PPE) on identified tasks
    - Nature and extent of proposed actions
    - Location within the environment (open air, enclosed compartment or structure)
    - Prevailing weather conditions
    - Potential decontamination strategy
- Consider the following when personnel are wearing chemical protective clothing in potentially flammable or explosive atmospheres:
    - A risk/benefit assessment should be carried out to establish if it is necessary to enter the risk area in chemical protective clothing
    - Always have firefighting media and covering sprays immediately available

- The build up of electrostatic charge on the fabric with the potential to ignite a flammable atmosphere or cause an explosion
- Sparks can also be caused by stones or grit embedded in the soles of boots and the use of metal tools
- In circumstances where the relative humidity is below 25%, the likelihood of sparks is increased
- Wetting the suit before entry to reduce electrostatic build up

Control measure – Select the most appropriate personnel

Control measure knowledge

Hazardous material incidents can place additional strains and pressures on any responders committed to the hazard zone. This can be due to the substance involved or the personal protective equipment (PPE) and tactics implemented.

Factors that affect the selection of the most appropriate personnel are:

- Competence in hazardous materials operations
- Experience in hazardous materials operations
- Size, for example, for entry into confined spaces
- Physical condition and suitability for the required operations and/or personal protective equipment (PPE)

Responders should also be aware that the potential for heat stress is increased if they:

- Have suffered a recent illness (especially vomiting or diarrhoea)
- Are suffering from sunburn
- Have taken medication that could affect their fluid balance
- Are suffering from the after-effects of alcohol consumption

Strategic actions

Fire and rescue services should:

- Provide personnel who deal with hazardous material incidents with specialist information, instruction and training on task and hazard analysis and on selecting personnel who operate in the hazard zones.

Tactical actions

Incident commanders should:

- Select the most appropriate and capable personnel to operate in hazardous materials hazard zones
- Carefully monitor the use of chemical protective clothing (CPC) as wearing it can create hazards; wearers may suffer from heat, physical and psychological stress

- Reduce the working duration for personnel wearing chemical protective clothing (CPC), to avoid excessive heat stress in high temperatures or for strenuous tasks
- Immediately withdraw a wearer who displays any symptoms of heat stress.

Control measure – Brief personnel effectively before committing them to the hazard zone

Control measure knowledge

Even competent and experienced personnel will need to be briefed effectively before being committed to hazardous materials incident hazard zones.

Strategic actions

Fire and rescue services should:

- Provide additional information, instruction and training to personnel who deal with hazardous material incidents on the briefing of personnel who operate in the hazard zones

Tactical actions

Incident commanders should give a specific safety brief to the wearers, including:

- Likely hazards and control measures to be adopted
- Actions to be taken whilst in the hazard zone
- Actions to be taken to avoid or limit contamination
- Safe access and egress routes; always try to approach from an upwind and upslope direction
- Time limits to reduce the potential damage caused by contamination or exposure
- Team leader and other roles, for example, detection equipment operator, safety or contamination observer
- Location of inner cordon and casualty handover area if appropriate
- Limitations and any additional hazards caused by wearing additional personal protective (APP) equipment
- Decontamination/safe undressing area and procedure to be used

Control measure – Use effective communications systems

Control measure knowledge

Effective communication is a pre-requisite for good incident ground command and control, but it is especially important at hazardous materials incidents. Specific actions and tactics need to be considered as an increased amount of information needs to be gathered and analysed, and unique communications issues are caused by wearing bulky personal protective equipment (PPE) ensembles.

Strategic actions

Fire and rescue services should ensure that personnel:

- Have access to communications systems that are suitable for use at hazardous materials incidents
- Receive specific information, instruction and training on hazardous material communication systems

Tactical actions

Incident commanders should consider:

- Using waterproof chemical/substance information retrieval boards
- Using intrinsically safe communications equipment when crews enter any potentially explosive atmosphere
- Having a hands-free radio communications system for use in chemical protective clothing (CPC)
- Having written and pictorial communication/information boards and megaphones for use in decontamination areas

Control measure – Designate clean areas with washing, hydration and welfare facilities

Control measure knowledge

Because of the much greater risk of personnel coming into contact with dangerous substances at hazardous materials incidents, normal welfare procedures should be enhanced. The primary objective is to prevent accidental ingestion of hazardous materials. Any designated area should:

- Have hygiene procedures that are monitored by supervisory personnel to ensure effective hand washing, etc.
- Be free from contamination and the risk of cross contamination
- Be provided with copious supplies of drinking water
- Have supervisory personnel to monitor the recovery of wearers who have carried out hard work in chemical protective clothing (CPC)

Strategic actions

Fire and rescue services should:

- Ensure personnel have access to clean rest areas with effective washing facilities where they can rehydrate free from the risk of cross contamination

Tactical actions

Incident commanders should:

- Consider providing a clean rest area with effective washing facilities where responders can recover and rehydrate themselves away from sources of contamination

Control measure – Emergency exposure procedures

Control measure knowledge

No matter how diligent responders are, it is always possible that personnel will inadvertently suffer an exposure to a hazardous material. This may be because of a malicious act or an event where there were simply no indications of a release. It could also be because personnel took a calculated risk for some non-life threatening exposure to save life or prevent the catastrophic escalation of an incident. For these reasons, all responders need to be trained in an emergency exposure procedure. This is a safe system of work that will quickly:

- Get them out of the hazard zone
- Get them out of their personal protective equipment (PPE)
- Remove the contaminant
- Get them medical assistance if required

Strategic actions

Fire and rescue services should:

- Provide an emergency exposure procedure for responders to hazardous materials incidents
- Ensure personnel that respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to operate emergency exposure procedures effectively

Tactical actions

Incident commanders should consider:

- Immediately withdrawing personnel who have been accidentally exposed to hazardous materials
- Starting emergency decontamination as soon as personnel are in a place of relative safety
- Reassuring potentially exposed crews that their structural firefighting kit and self-contained breathing apparatus provides a very high level of protection against short term accidental contamination
- Treating any skin exposure to an unknown substance by washing with copious amounts of water for at least 20 minutes (as recommended by most Control of Substances Hazardous to Health (COSHH) sheets)
- Immediately requesting medical assistance, if required
- Delayed health effects of exposure to some materials, possibly up to 48 hours in some cases

Contaminated responders

Hazard	**Control measures**
Contaminated responders	Approach the incident safely and estimate the potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Gather information on the hazardous materials

	Access specialist hazardous material advice Establish firefighter decontamination Decontaminate firefighters and equipment Provide emergency decontamination Provision of decontamination additive Operate agreed protocols for decontamination of inter-agency partners

Hazard knowledge

To understand this hazard fully it is important that responders are familiar with the following definitions:

Cross contamination: Cross contamination occurs when a person who is already contaminated makes contact with a person or object that is not contaminated

Decontamination: The physical and/or chemical process of reducing contamination to minimise the risk of further harm occurring and to minimise the risk of cross contamination to a level as low as reasonably practicable (it is not always possible to totally remove the contaminant or clean the equipment on site)

Primary or firefighter decontamination: Using equipment in a planned and structured manner on the incident ground to minimise the risk of further harm and reducing cross contamination to a level as low as reasonably practicable. This is primary decontamination to minimise risk, carried out on-site. Firefighter or primary decontamination is divided into three levels:

- *Initial decontamination:* The decontamination of firefighters using equipment that is immediately available on a pumping appliance. It should be used in all cases where there has been unforeseen contamination of firefighters, where there is an immediate life risk or where, at a minor incident, the hazards posed by the substance can be adequately controlled by the procedures.
- *Full decontamination:* The decontamination of firefighters using decontamination equipment, structured procedures and personnel who have been trained fully in its use
- *Emergency decontamination:* A quick method of removing a responder from their personal protective equipment (PPE). It is an additional control measure for exceptional circumstances such as a break down of PPE, for example ripped chemical protective clothing (CPC), breathing apparatus (BA) malfunction or an injured wearer. The decontamination procedures to be adopted in such circumstances should be adapted from the principles and procedures detailed in this section.

Secondary decontamination: Further off-site decontamination that may involve washing, scrubbing, thermal treatment and airing. This should take place as soon as possible after the incident and should be carried out by a competent person who has access to specialist advice.

Decontamination area: The area containing the decontamination personnel, equipment and structures of the fire and rescue service (and possibly other emergency services). It is a suitable area initially established outside the inner cordon, at first uncontaminated by the initial release, which becomes contaminated by the managed and controlled movement of people who require decontamination. Before decontamination, the inner cordon will be adjusted to encompass the decontamination area. The decontamination area should always be divided into 'clean' and 'dirty' areas to minimise cross contamination. Disrobing and re-robing areas may also be designated.

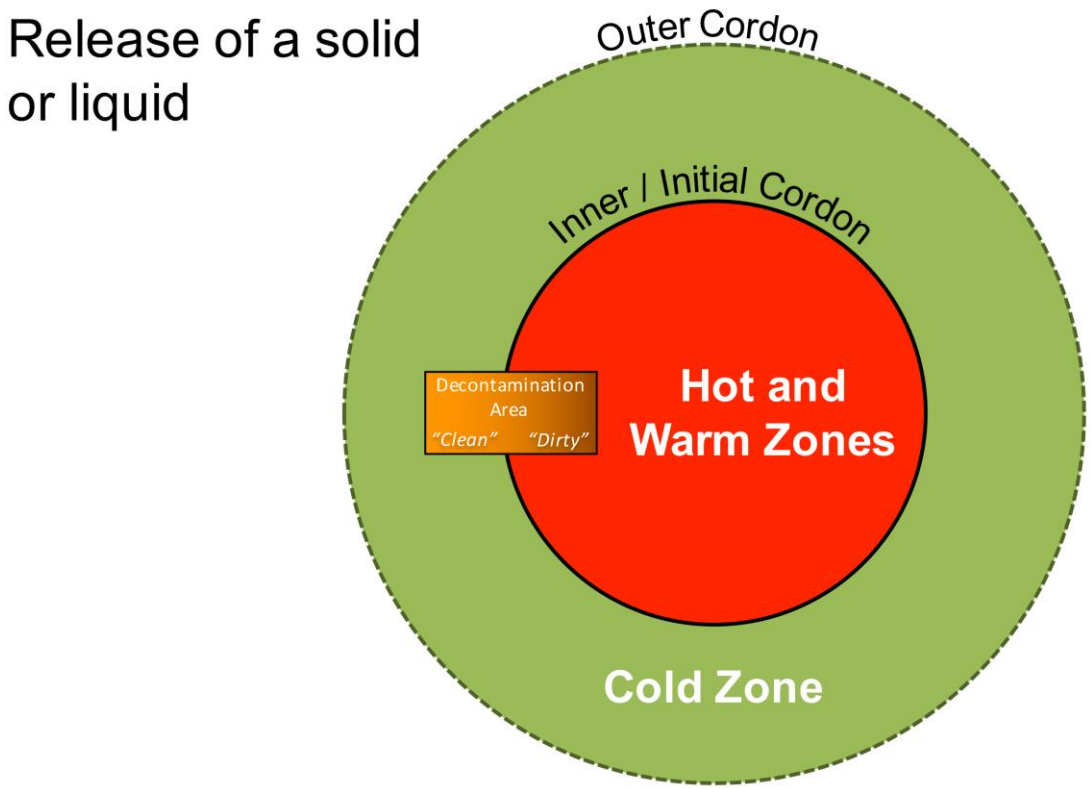

Figure 7: Zones for a release of a solid or liquid

The purpose of decontamination is to remove the wearer from their chemical protective clothing (CPC) while minimising the potential for any cross contamination. It should not be seen as a task to clean the chemical protective clothing (CPC).

No universal decontamination method will work for every hazardous materials incident. Different decontamination methods will be required for chemical, radioactive and biological contamination. Chemical decontamination may involve mass dilution, for instance, whereas minimal quantities of water should generally be used for biological and radioactive contamination. Although decontamination methods may vary, the general framework of procedures and the structure of firefighter decontamination should not. It is vital that operational personnel are completely familiar with their set-ups and standard operating procedures. These should be flexible enough to allow for variations in the methods and scale of decontamination.

Decontamination methods can be divided into two basic categories:

- **Physical methods** generally involve physically removing the contaminant from the contaminated person or object. Whilst these methods are often easier to perform and may dilute the concentration of the contamination (reducing its harmful effects) it generally remains chemically unchanged.
- **Chemical methods** generally involve removing the contaminant by some type of chemical process

Chemicals that adhere to the surface of the chemical protective clothing (CPC) (surface contamination) are fairly easy to remove. This means that until the chemical protective clothing (CPC) has been decontaminated, the surface contamination presents the most significant risk to unprotected personnel handling it or to the wearer during disrobing. This is the reason chemical protective clothing (CPC) is decontaminated at the site, to remove the surface contamination before undressing (primary decontamination). Primary decontamination may or may not remove any chemicals that have been absorbed or that have permeated into the chemical protective clothing (CPC) material (permeation or matrix contamination).

Accurate assessment of the degree of any remaining contamination of chemical protective clothing (CPC) can only be made by proper laboratory procedures that may involve a destructive test, thereby making re-use of a 'test suit' impossible. Chemicals that have been absorbed into the matrix of the chemical protective clothing material (CPC) may, in some cases, continue to diffuse through the material during storage, thereby presenting a possible risk of contamination to those who next wear or handle the chemical protective clothing.

Consideration of whether the equipment can be re-used should be based on this assessment of the hazardous material involved and the circumstances of the particular incident.

General degradation of chemical protective clothing may lessen the standard of chemical protection afforded. Degradation may be due to:

- Exposure to chemicals
- Mechanical damage
- Ageing

Control measure – Approach the incident safely and estimate the potential hazard zone

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone.

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons.

Control measure – Gather information on the hazardous materials

See Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Gather information on hazardous materials Gather information on hazardous materials

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Control measure – Establish firefighter decontamination

Control measure knowledge

The type of decontamination will be based on a number of factors:

- The level and type of personal protective equipment (PPE) (structural fire kit, liquid-tight or gas-tight chemical protection or re-usable or disposable protection)
- The type and quantity of contaminant
- The type and availability of decontamination additives
- The ability to monitor and/or detect contamination
- The availability of drainage and/or containment options
- The conditions of the weather (rain and wind)
- The topography of the area
- The availability of equipment to conduct the decontamination

The location of the decontamination area should take into account the following:

- The topography of the ground – it should be a flat area or sloped away from unprotected personnel in the cold zone
- Wind direction should be blowing away from unprotected personnel
- Any drainage in the area should be identified as either surface, foul or combined drainage and then blocked using a suitable drain blocker or mat
- It should be set up in the cold zone until ready to receive contaminated members of personnel, at which point it should become the warm zone
- It should be appropriately marked to prevent unprotected people from entering the decontamination zone
- Operational circumstances and the risk assessment
- The level and method of decontamination
- The weather conditions
- Location of breathing apparatus (BA) entry control
- Location of a pumping appliance if wet decontamination is being provided

Strategic actions

Fire and rescue services should:

- Put systems in place to assess contamination of personal protective equipment (PPE) and other kit
- Provide suitable equipment to conduct a decontamination process, or range of decontamination processes, based on the types of contamination likely or possible to be encountered during operational incidents in their area
- Ensure personnel that respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to operate decontamination effectively

- Provide hazardous materials advisers (HMA) to determine appropriate decontamination including the use of any additive to assist in removing the contaminant
- Provide a system to contain all run-off before seeking approval for disposal (see National Operational Guidance:National Operational Guidance: Environmental protection)
- Provide a system for contacting the environmental agencies and/or local water company before disposal of run-off
- Consider providing structured reference documents that detail the appropriate decontamination procedures
- Provide arrangements for dealing with contaminated equipment, including equipment used inside the hot zone and the decontamination equipment used for the decontamination process

Tactical actions

Incident commanders should:

- Ensure that decontamination should be available before any fire and rescue personnel are committed to the hot zone
- Use any reference documents or aide-memoire
- Contain all run-off from the decontamination process
- Contain all hazardous waste in suitable containers
- Provide a route in and route out of the decontamination zone
- Provide decontamination personnel in suitable personal protective equipment (PPE) to assist contaminated personnel
- Provide support personnel in structural fire kit to assist decontamination personnel
- Take advice from a hazardous materials adviser (HMA) on arrangements for contaminated equipment and other wastes

Control measure – Decontaminate firefighters and equipment

Control measure knowledge

The range of chemical, biological or radiological material that a firefighter could be contaminated with is extensive. The nature of the material may mean different procedures are required for each material. In most cases this involves using additives to counteract or neutralise the contaminant (see Control measure – Provision of decontamination additive). Oil-based chemicals require a detergent or degreaser, acids require an alkali, biological materials require bleach, other materials may require a combination of additives or no additives, opting for a safe (dry) undress instead.

Whichever option is selected, the decontamination process must minimise the risk of exposure to the chemical. The protective clothing will have prevented exposure, but in removing this clothing, there is a risk of exposure by cross contamination.

Depending on the level or type of personal protective equipment (PPE) worn, greater effort may be required in attempting to remove all contamination. If the PPE is considered re-usable then the

decontamination process needs to be sufficient to clean the clothing completely on scene, or to reduce the contamination to a level appropriate for transportation to a final location for further decontamination. Re-usable clothing is generally more expensive, so there is a sizeable potential for loss if decontamination does not remove the contaminant. Tests have shown that many contaminants can be difficult to remove – oils produce staining, biological contaminants can be very difficult to remove depending on their level of persistence. Fire and rescue services should provide access to hazardous materials advice to determine if items have been decontaminated and have a procedure for disposing of those items deemed unable to be decontaminated.

Strategic actions

Fire and rescue services should:

- Provide a range of decontamination methods that will counteract the potential range of contaminants
- Provide a decontamination method that allows for a dry/safe undress of contaminated personal protective equipment (PPE)
- Provide a range of 'emergency' decontamination methods where speed is required in preference to accuracy – when there has been a failure of air supply or personal protective equipment (PPE) or when contamination has occurred when only structural firefighting kit is being worn
- Consider a methodology for dealing with personal protective clothing (PPE) when decontamination has failed to clean away the contaminant
- Consider a process for disposing of items that are deemed disposable
- Provide arrangements for dealing with contaminated equipment that has been used inside the hot zone; this will require advice from specialist advisers
- Provide arrangements for dealing with the decontamination equipment once the process has been completed
- Provide a testing facility for re-usable personal protective equipment (PPE), which will confirm chemical protection clothing (CPC) may be safely returned to service after decontamination. This includes accepting the risk around re-using chemical protection clothing (CPC). See advice in 'The environmental protection handbook for the fire and rescue service', 2013, EA on decontamination of fire and rescue service equipment.

Tactical actions

Incident commanders should:

- Identify and prioritise personnel who require decontamination
- Ensure emergency decontamination procedures are implemented when necessary
- Nominate decontamination operatives to assist the contaminated members of personnel through the process where necessary
- Carry out decontamination of personnel and equipment following advice from specialist advisers and hazardous material advisers (HMA)

- Decontaminate or safely dispose of equipment used for the decontamination process – any item of clothing or equipment deemed still contaminated should be bagged or contained in a suitable container to allow transportation to either disposal or further specialist cleaning

Control measure – Provide emergency decontamination

Control measure knowledge

Decontamination procedures should be in place before fire and rescue service personnel enter the risk area. However, there may be situations where either the decontamination procedure has not been set up or a failure of equipment or personal protective equipment (PPE) leads to a requirement for a speedier decontamination procedure. For example:

- Personnel in structural firefighting kit entering an incident where the presence of hazardous materials was unknown and contamination occurs
- Damage to chemical protective clothing (CPC) causing an opening or tear in the level of protections
- Failure or malfunction of self-contained breathing apparatus (SCBA)
- Injury or ill health of personnel member

In these situations, using a decontamination shower structure or other designed approach for decontamination may either be too time consuming or unsuitable as it may exacerbate the problem (possibly by forcing a contaminant through a damaged suit). Procedures that will limit the potential for any cross contamination during the removal of the chemical protection should be designed.

Strategic actions

Fire and rescue services should:

- Develop a methodology for removing chemical protection clothing in emergency situations
- Develop a methodology for removing structural fire kit in emergency situations
- Investigate any circumstance that results in the need to perform emergency decontamination
- Recognise the possible need for health intervention for any personnel where emergency decontamination is required
- Ensure all personnel are aware of the procedures to be adopted for emergency decontamination
- Recognise that it may be unlikely for specialist advice to be available at the time when emergency decontamination is required and, therefore, put procedures in place to ensure personnel have access to guidance in the methods to be used

Tactical actions

Incident commanders should:

- Ensure emergency decontamination is undertaken immediately once a situation has been recognised
- Ensure personnel refer to any guidance provided to ensure the emergency decontamination procedure is carried out correctly

- Refrain from using water sprays or showers during the emergency decontamination procedure
- Ensure any member of personnel who has required emergency decontamination is considered for medical assistance

Control measure – Provision of decontamination additive

Control measure knowledge

Unless a contaminant is totally water soluble – based on advice from a hazardous materials adviser (HMA) – then a simple water decontamination process is unlikely to be completely effective. In these situations, it is likely that a decontamination additive would improve the procedure. Furthermore, if a chemical is water soluble, a large amount of water may be required to neutralise it, whereas a small amount of the appropriate additive may be just as effective, if not more so. Large amounts of water present the issue of containment from the decontamination process. Further information on environmental protection is provided in National Operational Guidance: Environmental protection and 'The environmental protection handbook for the fire and rescue service', 2013, EA'.

Testing has also found that simply adding an additive to decontamination water is not always the most effective method of application. Adding anything to water tends to dilute it and, when dealing with strong, concentrated or persistent chemicals, the additive may need to be applied neat and then agitated. Likewise, it has been found that additives that would normally be considered as domestic, such as bottled bleach or low foaming detergents may not have a suitable shelf life for fire and rescue service use. Household bleach (sodium hypochlorite) is already in solution and over time the amount of free chlorine reduces, and this is often further diluted before being used as a decontamination additive. This may be acceptable for minor biological materials such as effluent, but it has been shown to be unsuitable for pathogens and other biohazards. In these cases, bleach tablets are much more effective, as concentrated bleach can be prepared fresh at the incident. Commercially available degreasers are also far more effective against oils and oil based materials than low foaming detergents.

Strategic actions

Fire and rescue services should:

- Have a range of suitable additives for use with the decontamination process, taking advice from their hazardous materials adviser (HMA)
- Agree who will nominate the use of additives – usually a hazardous materials adviser (HMA), based on knowledge of the chemical contaminant
- Provide an appropriate method to deliver the additives to an incident in a fit for purpose condition, including adequate shelf life
- Ensure they have appropriate steps in place to determine the effectiveness of the additive/ decontamination process
- Consider whether disposing of chemical protection clothing (CPC) is the more suitable method of dealing with the clothing, rather than full decontamination

Tactical actions

Incident commanders should:

- Take advice from the hazardous materials adviser (HMA) regarding the correct use of decontamination additives
- Ensure that personnel are made aware of any hazards associated with the additive and are provided with additional protection where appropriate

Control measure – Operate agreed protocols for decontamination of inter-agency partners

Control measure knowledge

The equipment that the fire and rescue service uses for decontaminating firefighters is suitable for decontaminating other agencies. Decontamination methods should be designed around the capability and limitations of the levels of personal protection equipment (PPE) used. Partner agencies are known to have levels of chemical protection for their personnel that may be equivalent to those worn by fire and rescue service personnel. However, without an agreed protocol, fire and rescue services should refrain from using decontamination methods designed for their own personnel for partner agencies without specialist advice.

Fire and rescue services may have local agreements, where decontamination equipment can be used for partner agencies. In these situations, procedures should have been agreed based on the level of personal protective equipment (PPE) or clothing being worn.

Strategic actions

Fire and rescue services should:

- Consider liaising with all partner agencies who are able to wear personal protective equipment (PPE) in the hot zone, and, where necessary, design a procedure to decontaminate partner personnel
- Where the partner agency has their own methodology for decontaminating its personnel, the fire and rescue service may need to assist in the procedure, for example, by providing water
- Consider providing a specialist member of personnel who has specific knowledge about the methods and equipment used by the partner agency, and is aware of the requirements of the agency in question
- Provide hazardous materials advisers (HMA) who have sufficient technical knowledge to be able to review and supervise the decontamination process

Tactical actions

Incident commanders should:

- Identify whether multi-agency partners are operating in the hot zone and may require decontamination
- Implement agreed protocols between fire and rescue service and partner agencies
- Treat partner agencies as contaminated members of the public if no agreed protocols are in place

Uncontrolled release and/or spill of a hazardous material

Hazard	Control measures
Uncontrolled release and/or spill of a hazardous material	Approach the incident safely and estimate potential hazard zone Recognise hazards and risks from a safe location and implement effective cordons Consider the immediate life risk Gather information on the hazardous materials Access specialist hazardous material advice Identify the problem and likely impact of the hazardous materials incident Identify the objectives and develop a risk assessed response plan with specialist advisers and other agencies Control and/or contain the release Implement effective environmental protection Work with people and agencies that may provide additional advice and assistance

Hazard knowledge

Hazardous materials can only be encountered in two ways:

- Controlled
- Uncontrolled

The fire and rescue service is usually only called to uncontrolled hazardous materials incidents. Uncontrolled hazardous materials have a greater risk of affecting people, infrastructure and/or the environment, and can lead to harm if left uncontrolled.

Control measure – Approach the incident safely and estimate potential hazard zone

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Approach the incident safely and estimate potential hazard zone.

Control measure – Recognise hazards and risks from a safe location and implement effective cordons

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Recognise hazards and risks from a safe location and implement effective cordons.

Control measure – Consider the immediate life risk

See Hazard – Exposure of the general public to hazardous materials, Control measure – Consider the immediate life risk.

Control measure – Gather information on the hazardous materials

See Hazard – Undetected or unidentified hazardous materials at incidents, Control measure – Gather information on hazardous materials

Control measure – Access specialist hazardous material advice

See Hazard – Injury or loss due to insufficient pre-planning for hazardous materials risks, Control measure – Access specialist hazardous materials advice.

Control measure – Identify the problem and likely impact of the hazardous materials incident

See Hazard – Unsafe approach to hazardous material incidents, Control measure – Identify the problem and the likely impact of the hazardous materials incident.

Control measure – Identify the objectives and develop a risk assessed response plan with specialist advisers and other agencies

Control measure knowledge

Given the level of complexity there may be at incidents involving hazardous materials, it is important to develop a clear and risk assessed response plan. This will ensure important factors are not overlooked, and will help prioritise actions and tactics. Setting objectives is key to this process. Where more than one service or organisation is at the scene, this should be done on a multi-agency basis.

At a significant event, or as the incident develops, a specific hazardous materials risk assessment may be used to assist in this process. There is a standard form that is recognised nationally and provides a consistent approach that will be beneficial for cross-border responses (see appendix B, page 589 of Fire and rescue service operational guidance - incidents involving hazardous materials', 2012, DCLG, TSO.).

Strategic actions

See Hazard – Exposure of responders to hazardous materials, Control measure – Select the most appropriate personnel.

Tactical actions

Incident commanders should:

- Set clear objectives
- Develop a response plan that:
    - Is based on a hazmat-specific risk assessment carried out by a hazardous materials adviser (HMA)
    - Is shared with all interested parties involved in the multi-agency response
- Plan tasks or actions to achieve the prioritised objectives and:
    - Ensure public safety
    - Ensure safety of all responders
    - Prevent escalation and spread

  - Protect critical national infrastructure
  - Protect property
  - Protect the environment
- Ensure suitable personal protective equipment (PPE) is worn
- Ensure suitable decontamination takes place
- Ensure the response plan covers both on-site and off-site actions as required
- Ensure that the appropriate resources, personal protective equipment (PPE) and decontamination equipment are in attendance at the incident and ready for use, before implementing the response
- Ensure that a hazardous materials adviser (HMA) completes a hazmat-specific risk assessment and records significant findings

Control measure – Control and/or contain the release

Control measure knowledge

A hazardous materials incident can present many different scenarios, including a spill, chemical fire, vapour cloud or gas cloud. Whatever the scenario, it will usually involve intervention from the fire and rescue service in some form and will generally involve some form of containment. The principle of containment, wherever practicable, is always the preferred approach for managing hazardous materials incidents, especially when firefighting.

Contaminated cooling or firewater can affect the environment through direct run-off, which will then soak away into the ground and enter the drainage system. The drainage system may then transport pollutants into rivers, lakes, estuaries and the sea, or other sensitive receptors.

There is usually more than one way to resolve a hazardous materials incident:

- Do nothing – Consider this option if the risks to responders are high. Ask the questions: is it an emergency? Is it the responsibility of the fire and rescue service? Should the responsible person, owner, consigner, organisation or authority employ a specialist contractor?
- Defensive containment – Can the incident be resolved without committing personnel to the hazard zone?
- Offensive action – Proactive control and/or containment

Strategic actions

Fire and rescue services should:

- Provide personnel who deal with hazardous material incidents with specialist information, instruction and training on controlling and containing dangerous substances (see Hazard – Exposure of responders to hazardous materials, Control measure – Select most appropriate personnel)
- Provide access to specialised equipment to control and contain hazardous materials
- Develop partnerships with other agencies and the chemical industry to assist in containing and controlling hazardous materials that have released

Tactical actions

Incident commanders should:

- Control or extinguish fires; consider:
  - The effects of heat on personal protective equipment (PPE), such as the inability to use most chemical protective clothing (CPC) whilst carrying out aggressive firefighting tactics
  - Additional physical or chemical reactions with the hazardous materials, such as production of steam or rate of vaporisation
  - Fire/cooling run-off water containment – quantity and degree of contamination
  - Fire water recirculation
  - Isolation and/or protection of structural exposures using water curtain branches
  - Cylinder cooling using water spray
  - Manual valve closure under the protection of water spray branches
  - Foam attack
  - Dry agents
  - Bulk carbon dioxide
  - Protection of surrounding risks and controlled burn (refer to Environmental Protection considerations)

See National Operational Guidance: Fires and firefighting for further details on generic firefighting tactics

- Consider defensive hazardous materials containment actions, remembering:
  - Close liaison with the site occupier/owner/responsible person, environment agencies and statutory water undertakers, etc.
  - Remote isolation or valving down
  - Site drainage/ventilation shut-down
- Consider offensive hazardous materials spill control/mitigation actions (see the Environmental Protection Handbook for the Fire Service for further information):
  - Retention, for example drain blocking etc.
  - Absorption
  - Covering, for example, use salvage sheets or foam
  - Damming
  - Dilution
  - Diversion
  - Neutralisation
  - Aeration
- Consider offensive hazardous materials leak control actions:
  - Over-packing

  - Patching
  - Plugging
  - Pressure isolation
  - Solidification
  - Vacuuming
  - Water bottoming
  - Decanting
- Consider other offensive hazardous materials actions:
  - Monitor reactions with thermal imaging equipment
  - Manage reaction temperature, for example, water spray cooling
  - Vapour dispersion and dilution
  - Vapour suppression, for example, covering, cooling
  - Neutralisation
  - Site engineered actions
- Ensure that the response action does not create additional hazards, for example, a foam blanket breaking down and introducing water that then reacts with the substance
- Nominate safety officers, remembering to:
  - Ensure safety officers are competent in hazardous materials operations
  - Ensure they receive a focused briefing on their role, the hazards and the response plan
- Designate specific safety officer(s) to monitor offensive operations, the inner cordon and decontamination
- Ensure there is a rationale or justification for their actions

Control measure – Implement effective environmental protection

See National Operational Guidance: Environmental protection. The guidance relates to protecting the environment during the course of firefighting, rescuing or managing hazardous materials. See also The environmental protection handbook for the fire and rescue service, 2013, EA.

Control measure – Work with people and agencies that may provide additional advice and assistance

Control measure knowledge

Hazardous material incidents are often complex and protracted, requiring many resources and a great deal of specialist equipment to resolve them. Because of this complexity, it is essential that the incident commander works with all appropriate agencies when attempting to control and contain hazardous releases.

Fire and rescue service responders must remember that they are not the 'experts' when it comes to dealing with hazardous materials. For the successful conclusion of a hazardous material incident, fire and rescue services rely on other agencies and organisations for support in carrying out specialist tasks, such as weather monitoring (CHEMET), air quality monitoring at large scale incidents (environmental agencies), product disposal, site clean up, substance identification or specialist product advice. By working with a wide range of people, organisations and agencies, fire and rescue services can successfully resolve the emergency phase of hazardous materials incidents and ensure that those responsible for the substance and/or the site take back control when there is no significant risk to the community at large.

Strategic actions

Fire and rescue services must:

- Work and share information with other Category 1 and Category 2 responders under the Civil Contingencies Act

Tactical actions

Incident commanders should:

- Work with people and agencies that may provide additional advice and assistance
- Use the experience and knowledge of the hazardous materials adviser (HMA) to interpret and understand technical information and guidance
- Ensure understanding of any conflicting or competing interests of particular agencies, for example avoiding prosecution by site operator
- Consider joint working in hazard zones, ensuring that systems of work and emergency procedures are understood by all parties before entry
- Record joint or agreed actions
- Consider implementing environmental monitoring and/or health surveillance of personnel at protracted incidents,
- Ensure operators make environmental monitoring and/or health surveillance systems available to emergency responders by the operators at major risks such as top tier Control of Major Accident Hazards (COMAH) sites
- Consider using the Health and Safety Laboratory, Buxton, who may be able to offer advice on appropriate environmental monitoring and health surveillance and screening
- Liaise with environmental agencies to undertake site monitoring
- Liaise with the police service and local authorities if surrounding area evacuation or road closures are required
- Liaise with public health authorities on issuing public health advice
- Liaise with press and media to control unhelpful reporting and to provide safety advice and reassurance to the local community
- Ensure effective liaison and communication with off-site commanders and co-ordination centres

Unsafe and/or ineffective closure of incident

Hazard	Control measures
Unsafe and/or ineffective closure of incident	Provide a health monitoring system for all personnel Recording personnel exposure Use an appropriate method for dealing with waste from hazardous materials incidents Implement incident handover procedure Have an effective plan for return to operational readiness

Hazard knowledge

The fire and rescue service is responsible for the emergency phase of an incident. It has no legal responsibility to clean up releases of hazardous materials but is often dragged into the non-emergency phase of incidents. This is because they can be difficult and expensive to clean up, and they can present longer term health issues if people are exposed to harmful substances.

For further non-hazardous materials incident information see National Operational Guidance: Operations.

Control measure – Provide a health monitoring system for all personnel

Control measure knowledge

Exposure to many hazardous materials is likely to have an adverse effect on human health. The severity will vary from material to material, and may either have an acute or chronic effect. Early recognition of exposure will allow an individual's health to be monitored by a health professional and, where necessary, to be given treatment.

At some hazardous materials incidents, responders may feel that they may have been exposed to a substance simply because they were in the vicinity of the release. In these cases, incident commanders and hazardous materials advisers (HMA) need to deal with the perceived exposure seriously and sensitively but be very clear about the demarcation of hazard zones and the protection provided by the personal protective equipment (PPE) worn. Exposure can only have occurred if hazard zones were entered or set incorrectly, or the PPE worn has failed or was not appropriate. If this is not the case, then there may be no immediate need to seek medical attention.

Where 'exposure' has, or possibly has, occurred, such as personnel entering a 'warm zone' without appropriate respiratory protective equipment (RPE), it may be prudent to provide personnel with a form of documentation that will indicate any possible exposure to a medical professional. Systems such as a wristband giving basic information and contact details where more thorough information can be accessed are often used, and are generally worn by personnel for seven days following exposure. The period of time may be extended by a hazardous materials adviser (HMA) or health professional where necessary.

Strategic actions

Fire and rescue services should:

- Recognise that personnel may become exposed to hazardous materials and have procedures and policy to deal with delayed exposure symptoms
- Provide access to a medical professional/service for the purpose of monitoring health over a period of time and to administer treatment where necessary
- Have procedures for emergency exposure where rapid intervention from a health professional is required
- Consider providing a system to assist health professionals in identifying exposure to hazardous materials when personnel may subsequently have gone off duty; they may therefore not be identified as a member of a fire and rescue service and may be incapable of providing information
- Provide hazardous materials advisers (HMAs) who can assist the incident commander in determining the likelihood of exposure and the level of medical assistance required
- Consider trauma incident management; personnel should be supported and monitored to identify whether they are experiencing any adverse affects and to check whether they would benefit from accessing counselling and support services, such as reassurance briefings for potentially contaminated crews

Tactical actions

Incident commanders should:

- Identify when exposure or possible exposure may have occurred and:
    - Provide immediate first aid when personnel have been exposed
    - Request the attendance of an ambulance or other healthcare professional
    - Consider providing personnel with documentation to carry that will indicate the nature of the possible exposure
- Seek guidance from a hazardous materials adviser (HMA) or medical professional on the appropriate course of action.

Control measure – Recording personnel exposure

Control measure knowledge

Exposure to a hazardous material may have acute or chronic effects. In every case, the exposure needs to be recorded by the fire and rescue service in a manner that allows the information to be readily accessed in the days following the exposure. It also needs to form part of the individual's employment health record, as In some cases this is required by law, such as 'The control of asbestos regulations 2012, Part 1, Section 22 (b)' states that records of exposure to asbestos should be maintained for at least 40 years from the date of the last exposure. Radiation exposure records are also required.

Where information is stored for access in the days following exposure, it is advised that this information is stored so that it can be accessed 24 hours a day by a person with the authority to pass personal details to a medical professional, once all necessary confirmation of identity has been carried out.

Strategic actions

Fire and rescue services should:

- Keep a record of personnel and update this record with any exposure, or possible exposure, to hazardous substances
- Make records of any exposure immediately available to a suitably authorised member of personnel who can pass this information to a medical professional
- Have systems in place to ensure they are satisfied with the proof of identity provided by any medical professional who requests personal details of a member of personnel
- Store all information related to a member of personnel for a period of time agreed by legislation and, where legislation does not apply, for an absolute minimum of the duration that the member of personnel is in the employment of the fire and rescue service
- Provide access to specialist advice on both the nature of the hazardous materials and the effect that this may have on the member of personnel
- Provide a system that ensures the information is as detailed and as accurate as possible.

Tactical actions

Incident commanders should:

- Ensure that all records related to the exposure or potential exposure are completed as soon as possible
- Seek advice from hazardous materials advisers (HMA) regarding exposure

Control measure – Use an appropriate method for dealing with waste from hazardous materials incidents

Control measure knowledge

Any hazardous materials incident has the potential to produce waste. This may either be the hazardous material itself, equipment used to clean up any potential spillage or deal with the material, and/or any personal protective equipment (PPE) worn to protect personnel from the effects of the material.

Where waste is generated, it must be dealt with in an appropriate manner. This will normally involve passing the waste material either directly to a registered hazardous waste contractor, or to a responsible person who is instructed to dispose of the waste in an appropriate manner.

The fire and rescue service needs to be able to determine who is responsible for the waste material. Generally, this will be the owner of the material or the site on which it is discovered, which will extend to all waste produced as a result of dealing with the incident. However, waste material needs to be handed over to the responsible person in a state that is safe to handle and to transport to a location of final disposal. Where the material cannot be left in a state that is safe to handle, detailed instructions from a hazardous materials adviser (HMA) should be left, providing information on how the material should be handled and by whom.

On rare occasions, the fire and rescue service may need to provide a disposal route for hazardous materials. This needs to be done through an agreed protocol and registered waste contractor. However, this waste should be limited to disposable fire service equipment or equipment for secondary decontamination being transported for this purpose. It should not be for containers of hazardous materials, as these should not be transported on any fire service vehicle.

It should be noted that exemptions to the controls set out in the Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR) European Agreement concerning the international carriage of dangerous goods by road is in place in *volume 1: section 1.1.3.1(d)* where the carriage of dangerous goods is undertaken by a competent authority to transport material to the nearest appropriate safe place. Furthermore, *volume 1: section 1.1.3.1(e)* allows the material to be transported for the purpose of saving life and protecting the environment. Both these sections should allow for disposable equipment to be transported at the end of an incident if or when a responsible person cannot be determined.

See National Operational Guidance: Environmental protection.

Strategic actions

Fire and rescue services should:

- Ensure personnel that respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to recognise and deal with hazardous waste effectively
- Have agreed protocols concerning hazardous waste, including a procedure for handing the responsibility back to a responsible person
- Have equipment to contain hazardous waste, including any waste generated as a result of dealing with an incident – this should include equipment provided by the environmental agencies, and identified items of equipment for bagging up waste items or hazardous materials
- Provide access to a hazardous materials adviser (HMA) to give guidance on how waste can be contained and what precautions are required for dealing with it after the fire and rescue service have left the scene
- Provide a safe means of transporting hazardous waste from an incident to a point of collection by a hazardous waste contractor on rare occasions when a responsible person cannot be located and the fire and rescue service need to take responsibility for waste it has generated in dealing with an incident (for example, disposable protective clothing)

Tactical actions

Incident commanders should:

- Identify a responsible person for the site and/or hazardous materials.
- Seek the assistance of a hazardous materials adviser (HMA)
- Anticipate the production of waste and plan how to manage this
- Apply fire and rescue service hazardous waste protocols and procedures
- Liaise with environmental agencies on possible water strategies

Control measure – Implement incident handover procedure

Control measure knowledge

At a hazardous materials incident there may be further considerations when handing back responsibility for an incident. In addition to the points for a fire, there should be confirmation that the risk from the hazardous materials has either been neutralised or contained in a suitable condition to prevent a reoccurrence. Part of this handover may involve ensuring suitably qualified individuals are available to handle the hazardous materials.

For further information see National Operational Guidance: Operations.

Strategic actions

Fire and rescue services should:

- Ensure personnel that respond to hazardous materials incidents are provided with the necessary knowledge, skills and understanding to hand them over effectively
- Provide an appropriate system to record the handover procedure that details the significant findings of the hazardous materials risk assessment
- Liaise with enforcing authorities where legislation or regulation may have been contravened

Tactical actions

Incident commanders should:

- Liaise with the responsible person regarding incident handover and confirm what hazardous materials, waste or equipment will be left for them to dispose of
- Obtain support from hazardous materials advisers (HMA) and/or partner agencies to assist with handing over of the incident
- Document the handover to the responsible person
- Ensure that any identified responsible person is either suitably qualified or have immediate access to specialist advice on the hazardous material involved

Control measure – Have an effective plan for return to operational readiness

Control measure knowledge

At a hazardous materials incident staff and equipment should be decontaminated on scene, except when secondary decontamination for equipment is required. However, on advice from a hazardous materials adviser (HMA), it may be recommended that normal hygiene facilities should be used on return to stations and structural firefighting kit be laundered.

For further information see National Operational Guidance: Operations.

Strategic actions

Fire and rescue services should:

- Provide personnel with facilities on return to station to wash and maintain a suitable standard of hygiene
- Provide stocks of consumable items of hazardous materials protection equipment that are deemed to be disposable
- Provide secondary decontamination procedures and policy
- Ensure repatriation of impounded and/or contaminated equipment when safe to do so
- Assess and report any post-incident financial liability (for example, negligent actions, asbestos contamination)

Tactical actions

Incident commanders should:

- Ensure reusable equipment used at an incident is decontaminated; this should generally be carried out on-scene
- Arrange for secondary decontamination if necessary
- Consider advising responders to shower at the earliest opportunity for personal hygiene reasons as an additional safety precaution if necessary; this does not form part of decontamination
- Ensure that equipment that was lost to the incident is replaced on return to the station

Glossary

Term	Acronym	Description
Accord européen relatif au transport international des marchandises Dangereuses par voies de navigation intérieures	ADN	European agreements concerning the international carriage of dangerous goods by inland waterways.
Accord européen relatif au transport international des marchandises Dangereuses par Route	ADR	European agreements concerning the international carriage of dangerous goods by road.
Acid		An acid is a material that will liberate H^+ ions into solution in excess of any OH^- ions. It is a corrosive chemical substance whose aqueous solutions are characterized by a sour taste, the ability to turn pH paper red, and the ability to react with bases and certain metals (like calcium) to form salts. Aqueous solutions of acids have a pH of less than 7.
Acute		Severe, often dangerous, condition in which relatively rapid changes occur.
Additional personal protection	APP	Code used in the UK Emergency Action Code list (also known as HAZCHEM) to suggest when gas tight chemical protective clothing may be required.
Aerial Locations Of	ALOHA	Atmospheric dispersion model used for evaluating releases of

Hazardous Atmospheres		hazardous chemical vapours.
Aerosol		A colloidal suspension of liquid or solid particles dispersed in gas having a negligible falling velocity (generally considered to be less than 0.25 m/s).
Alpha (α) radiation	α-radiation	Type of radiation involving the emission of an alpha particle from the nucleus of a radioactive atom. Can only travel a few centimetres in air.
Asbestos		The generic name given to the fibrous forms of naturally occurring silicate minerals.
Asbestos containing material	ACM	Material that contains the fibrous forms of naturally occurring silicate minerals.
British Agrochemicals Safety Inspection Scheme	BASIS	Independent standards setting and auditing organisation for the pesticide, fertiliser and allied industries.
Carcinogenic		Agent, chemical physical or biological, capable of increasing the incidence of malignant neoplasms or causes cancer.
CBRN(E)	CBRN(E)	CBRN(E), CBRN(e) or CBRNe is a term used to describe chemical, biological, radiological, nuclear and explosive materials. CBRN/CBRN(E) terrorism entails the assumption or knowledge, based on intelligence or actual evidence, of actual or threatened dispersal of chemical, biological, radiological or nuclear material (either on their own or in combination with each other or with explosives), with deliberate criminal, malicious or murderous intent, targeted at a given population or economic or symbolic points.
Chemdata		A chemical information database provided by the National Chemical Emergency Centre (NCEC).
CHEMET		CHEMET can be used to track the dispersion of a chemical release. Telephone advice is available on demand which will give a simple short-range prediction of the anticipated behaviour of the plume. In an incident involving hazardous chemicals, local fire and police services can contact the Met Office Environment Monitoring and Response Centre (EMARC). For small-scale events, EMARC produces meteorological guidance and a plume prediction as a chemical meteorology (CHEMET) report. For larger release events, such as the Buncefield Oil Depot fire, more-sophisticated plume modelling techniques are used.
Chemical abstracts service number	CAS	A CAS registry number, also referred to as CASRN or CAS number, is a unique numerical identifier assigned by the Chemical Abstracts Service (CAS) to every chemical substance described in the open scientific literature, including organic and inorganic compounds, minerals, isotopes, alloys and non-structural materials.
Chemical protective clothing	CPC	The combined assembly of garments worn to provide protection against exposure to, or contact with, chemicals.
Chemical protective suit	CPS	Clothing worn to protect against chemicals that covers the whole or greater part of the body. A chemical protective suit may comprise garments combined together to provide

		protection for the body. A suit may also have various types of additional protection, such as hood or helmet, boots and gloves joined with it.
Chemical safety data sheet	CSDS	See safety data sheet (SDS).
Chronic		Substance whose effects develop after significant periods of time and usually following repeated exposure. For example, substances that cause cancer.
Clinical decontamination		See decontamination, clinical.
Cold zone		This is the uncontaminated area between the inner cordon and the outer cordon. It is the area in which key operational command positions and other essential activities will be set up. The police service, in liaison with the fire and rescue service and the ambulance service, should decide whether members of the public need to be evacuated from the cold zone.
Compressed gas		Gas, which, when packaged under pressure for transport, is entirely gaseous at all temperatures above –50 °C. NB All gases with a critical temperature below -50^{o}C belong to this category.
Contamination		Contamination occurs when a substance adheres to or is deposited on people, equipment or the environment, creating a risk of exposure and possible injury or harm (N.B. contamination does not automatically lead to exposure but may do. Alpha, beta and gamma emissions in themselves cannot cause contamination, although the actual source materials may, depending on their physical properties and their containment).
Control of Major Accident Hazards	COMAH	Control of Major Accident Hazards regulations (replaced CIMAH). Their main aim is to prevent and mitigate the effects of those major accidents involving dangerous substances, such as chlorine, liquefied petroleum gas, explosives and arsenic pentoxide which can cause serious damage/harm to people and/or the environment. The COMAH Regulations treat risks to the environment as seriously as those to people.
Corrosive		A substance that chemically attacks a material with which it has contact.
Control of Substances Hazardous to Health Regulations	COSHH	Legislation that requires employers to control substances that are hazardous to health.
Critical temperature		The temperature above which a gas can not be liquefied by the application of pressure alone.
Cryogenic		A substance used to obtain temperatures far below the freezing point of water (less than -78^{o}C).
Dangerous substance		Defined substances that may be hazardous to the fire and rescue service in an emergency (from the '*Notification and Marking of Sites Regulations* 1990').
Dangerous Substances and	DSEAR	Puts duties on employers and the self-employed to protect

Explosive Atmospheres Regulations 2002		people from risks to their safety from fires, explosions and similar events in the workplace; this includes members of the public who may be put at risk by work activity.
Decomposition		Chemical reaction whereby a substance breaks down into its constituent elements. In the case of acetylene this means carbon and hydrogen. This reaction gives out a great deal of heat.
Decontamination area		Area containing fire and rescue service (and possibly other emergency service) decontamination personnel, equipment and structures. It is a suitable area initially established outside the inner cordon, at first uncontaminated by the initial release, that becomes contaminated by the managed and controlled movement of people who require decontamination. Before decontamination commencing, the inner cordon will be adjusted to encompass the decontamination area.
Decontamination, clinical		The process where contaminated casualties are treated individually by trained healthcare professionals using purpose designed decontamination equipment.
Decontamination, emergency		A quick method of removing a responder from their personal protective equipment (PPE). It is an additional control measure for exceptional circumstances such as a breakdown of PPE, for example ripped chemical protective clothing, breathing apparatus (BA) malfunction or an injured wearer.
Decontamination, firefighter		The use of decontamination equipment in a planned and structured manner to minimise the risk of further harm occurring and to reduce cross contamination to a level as low as reasonably practicable. Firefighter decontamination may be divided into two levels, initial and full. These procedures usually involve two processes: firstly, 'contamination reduction' and then 'safe undressing'.
Decontamination, improvised		Public decontamination using an immediately available method (wet or dry) before the use of specialist resources, such as blotting with paper tissues, washing in on-site facilities etc.
Decontamination, interim		The use of standard fire and rescue service equipment to provide a planned and structured 'wet' decontamination process for members of the public.
Decontamination, primary		Primary decontamination is the physical and/or chemical process of reducing contamination to minimise the risk of further harm occurring and to minimise the risk of cross contamination to a level as low as reasonably practicable.
Decontamination, mass		The planned and structured procedure using purpose designed decontamination equipment where there are large numbers of contaminated casualties.
Decontamination, secondary		Secondary decontamination is additional off-site decontamination that may involve washing, scrubbing, thermal treatment and airing. This may render the chemical protective clothing (CPC) clean to visual inspection but does

		not necessarily assure the complete removal of the contaminant (depending on the nature of the contaminant). Accurate assessment of the degree of any remaining contamination of clothing or equipment should be made by competent people
Degradation		The continuing action of chemical attack to which chemical protective clothing (CPC) may be subject to in use or during storage.
Deliberate reconnaissance		Deliberate reconnaissance is distinct from scene assessment, which is a specific activity carried out before any formal structures being in place and as a necessary part of the initial response. Deliberate reconnaissance differs for each of the different agencies involved; for example, the police service may deploy for deliberate reconnaissance of a building or for the recovery of evidence, whereas the fire and rescue service will primarily deploy for substance analysis and identification.
Detection identification and monitoring (DIM) equipment	DIM	Government has provided a suite of detection identification and monitoring (DIM) equipment to the fire and rescue service. Detection is the recognition of the presence of a CBRN(E) material. Identification is the determination of the CBRN(E) material is present. Monitoring is a continuous or periodic process of qualitatively or quantitatively determining the presence or absence of CBRN(E) material.
Detonation		Explosion in which the flamefront advances at more than supersonic speed.
Downwind, dilution, obstacle, oscillation and retention.	DDOOR	These are the key factors to remember when dealing with a hazardous release in an urban environment.
Dust		Solid particles generated by mechanical action, present as airborne contaminant (less than 0.076 mm in size).
Emergency action code	EAC	Designed to cover the first vital step and gives an immediate indication of any actions that could be taken should it be necessary, without the use of reference materials or expert advice. (Also known as HAZCHEM).
Emergency decontamination		See decontamination, emergency.
Emergency Response Guidebook	ERG	Produced by the United States Department of Transport (USDOT) for first responders during the initial phase of a dangerous goods/hazardous materials incident.
Environmental agencies		The term ‘environmental agencies’ includes the Environment Agency (EA) England, Natural Resources Wales (NRW), the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment Agency (NIEA).
Environment Monitoring and Response Centre	EMARC	The Met Office Environment Monitoring and Response Centre.
Exclusion zone		This is an area containing hazards that have been risk assessed as so dangerous to health that nobody, including fire and rescue service personnel, should be allowed to enter (for

		example, the blast area around explosives involved in fire).
Exposure		Exposure occurs when a harmful substance enters the body through a route, for example, inhalation, ingestion, absorption or injection, or when the body is irradiated (N.B. radioactive exposure, in terms of irradiation, does not automatically mean you are contaminated).
Firefighter decontamination		See decontamination, firefighter.
FireMet		FireMet is a weather system designed to provide fire and rescue service responders with the latest weather information to help them identify a safe approach when dealing with a major incident.
Fume		Airborne solid particles (usually less than 0.0001mm) that have condensed from the vapour state.
Gas		Gas is one of three classical states of matter. Near absolute zero, a substance exists as a solid. As heat is added to this substance it melts into a liquid at its melting point, boils into a gas at its boiling point, and if heated high enough would enter a plasma state in which the electrons are so energized that they leave their parent atoms from within the gas. A pure gas may be made up of individual atoms (for example a noble gas or atomic gas like neon), elemental molecules made from one type of atom (for example oxygen), or compound molecules made from a variety of atoms (for example carbon dioxide). A gas mixture would contain a variety of pure gases much like the air. What distinguishes a gas from liquids and solids is the vast separation of the individual gas particles.
Gas-tight suit	GTS	Clothing that satisfies the requirements for 'leak tightness' when tested according to the internal pressure test given in the current British standard.
Globally Harmonised System	GHS	Globally Harmonized System of classification and labelling of chemicals. This is a UN scheme aiming to have, worldwide, the same criteria for; classifying chemicals according to their health, environmental and physical hazards; and hazard communication requirements for labelling and safety data sheets. The GHS is not a formal treaty, but instead is a non-legally binding international agreement. Therefore countries (or trading blocks) must create local or national legislation to implement the GHS.
Hazard		A hazard is anything that may cause harm.
Hazard identification number	HIN	Used to generically describe the hazards associated to dangerous goods transported in accordance with the European transportation of dangerous goods regulations. Sometimes referred to as the Kemler code.
Hazard manager		A weather information interface provided by the Met Office. It provides a range of services that help authorities prepare for and respond to emergency incidents that are caused or

		influenced by the weather. It contains access to FireMet and CHEMET.
Hazard zone		This is an area that contains hazards to which a risk assessment should be applied to determine a suitable inner cordon. A hazard zone is not necessarily an 'exclusion zone' and would encompass both the hot and warm zones if they exist. The hazard zone is sometimes referred to as the 'evacuation zone' by other agencies and generally means the area where they would seek to encourage all members of the public to leave or possibly shelter-in-place.
Hazardous materials		Also referred to as dangerous/ hazardous substances or goods. Solids, liquids, or gases that can harm people, other living organisms, property or the environment. They not only include materials that are toxic, radioactive, flammable, explosive, corrosive, oxidizers, asphyxiates, biohazards, pathogen or allergen substances and organisms, but also materials with physical conditions or other characteristics that render them hazardous in specific circumstances, such as compressed gases and liquids or hot/cold materials.
Hazardous materials adviser	HMA	HMA is a generic term for any person, with enhanced knowledge of hazardous material operations, used by a fire and rescue service to provide independent specialist advice to the incident commander at emergency incidents involving hazardous materials. It includes such roles as the hazardous materials officer, hazardous materials and environmental protection officer/adviser (HMEPO, HMEPA), scientic adviser, etc.
Hot zone		This is the contaminated area(s) where the initial release occurs or disperses to. It will be the area likely to pose an immediate threat to the health and safety of all those located within it and is the area of greatest risk. It is located inside the inner cordon and is part of the hazard zone.
Improvised decontamination		See decontamination, improvised.
Initial cordon		The initial cordon is temporarily established by the first wave of unprotected emergency responders, before any detailed scene assessment or any other scientific analysis has been conducted. It provides an initial means of controlling, safeguarding and co-ordinating the immediate response and adds an element of control to the incident.
Inner cordon		The inner cordon surrounds the area where potentially hazardous activity may be conducted and encompasses both the hot and warm zones. It is used to control access to the immediate scene of operations. Access to the area controlled by an inner cordon, which by definition is the hazard zone, should be restricted to the minimum numbers required for work to be undertaken safely and effectively.
Inter-agency liaison officer	ILO	See national inter-agency liaison officer (NILO).
Interim decontamination		See decontamination, interim.

Intermediate bulk container	IBC	Container used for transport and storage of fluids and bulk materials.
Ionisation		The process by which a neutral atom or molecule acquires or loses an electric charge. The production of ions.
Ionising radiation		Radiation that produces ionisation in matter.
Irradiation		An event where matter has been externally subjected to ionising radiation.
Joint Emergency Services Interoperability Programme	JESIP	Aims to improve the way in which the three blue light services work together at major and complex incidents.
Joint understanding of risk	JUR	Term used under Joint Emergency Services Interoperability Programme (JESIP) principles, the sharing information and understanding about the likelihood and potential impact of risks and the availability and implications of potential control measures will ensure, as far as is reasonably practicable, that the agreed aim and objectives are not compromised. This will include ensuring the safety of responders and mitigating the impact of risks on members of the public, infrastructure and the environment.
Liquid		Liquid is one of the three classical states of matter. Like a gas, a liquid is able to flow and take the shape of a container, but, like a solid, it resists compression. Unlike a gas, a liquid does not disperse to fill every space of a container, and maintains a fairly constant density. A distinctive property of the liquid state is surface tension, leading to wetting phenomena.
Liquid-tight chemical protective clothing	LTCPC	Resistant to puncture by liquids in the form of a continuous jet when considering chemical protective clothing (CPC).
Lower explosive limit	LEL	Lower explosive limit is the lowest concentration of vapour/gas in air at a given pressure and temperature that will propagate a flame when exposed to an ignition source.
Major incident		Event or situation requiring a response under one or more of the emergency services' major incident plans.
Mass decontamination	MD	See decontamination, mass.
Material safety data sheet	MSDS	See safety data sheet (SDS).
Mobile data terminal	MDT	Usually found on fire service vehicles to provide communications with the mobilising centre.
National inter-agency liaison officer	NILO	A fire and rescue rervice officer who can advise and support incident commanders, police, medical, military and other government agencies on the organisation's operational capacity and capability to reduce risk and safely resolve incidents at where an attendance may be required. This will include major incidents, public order, domestic or any other situation that would benefit from the attendance of the NILO.
National Chemical Emergency Centre	NCEC	The National Chemical Emergency Centre (NCEC) offers a 24-hour emergency hazardous materials response service that provides fast, trusted and up-to-the-minute advice to both the emergency services and businesses around the world. It is

		based in Harwell, Oxfordshire and operates under the CHEMSAFE scheme.
Numerical atmospheric-dispersion modelling environment	NAME	Met Office atmospheric pollution dispersal model that is a much more sophisticated tool than CHEMET for pollution forecasting. See Part B, Section 1, Chapter 2.23
ORCHIDS project	ORCHIDS	The ORCHIDS project aims to strengthen the preparedness of European countries to react to incidents involving the deliberate release of potentially hazardous substances. It was funded by the EU and finished in 2011.
Outer cordon		The outer cordon designates the controlled area into which unauthorised access is not permitted. It encompasses the inner cordon and the hot, warm and cold zones. It should be established and maintained by the police service.
Penetration		The process by which a chemical flows through holes or essential openings in the material of chemical protective clothing. The holes may be the result of mechanical damage.
Permeation		The process by which a chemical moves through a protective clothing material on a molecular level.
Persistence		Persistence of chemicals indicates that they are stable and long-lived in the environment, resisting degradation, such as lead, cadmium, mercury, PCBs, and many man-made organics.
Personal protective equipment	PPE	Equipment that will protect the user against health or safety risks at work.
Powered respirator protective suit	PRPS	Powered respirator protective suit.
Pressure		Pressure is the force per unit area applied in a direction perpendicular to the surface of an object. Units - 1 atmosphere or bar is approximately 100,000 pascals (100 kPa); 1 bar = 14.5 pounds per square inch (psi).
Radiation		The process by which energy is transmitted away from an energy source.
Radiation (emergency preparedness and public Information) regulations	REPPIR	Radiation (emergency preparedness and public information) regulations 2001 (REPPIR); statutory instrument 2002 No. 1093.
Radioactive material		A solid, liquid or gas which spontaneously emits ionising radiation.
Radioactivity		The phenomenon by which a radioactive atom transforms into a different atom with the spontaneous emission of ionising radiation.
Reglement International concernant le transport de marchandises Dangereuses par chemin de fer	RID	European regulations concerning the international carriage of dangerous goods by rail 2015.
Respiratory protective	RPE	Respiratory protective equipment (RPE) is equipment that will

equipment		protect the user's respiratory system from hazardous substances.
Responsible person		An individual who has responsibility for a particular area, site, premises, vehicle or other property through ownership (for example, owner, occupier or driver) or as a representative of a responsible authority or agency (for example, local authority, police, environment agency or highways agency).
Safety data sheet	SDS	Safety data sheets provide information on chemical products that help users of those chemicals to make a risk assessment. They describe the hazards the chemical presents, and give information on handling, storage and emergency measures in case of accident.
Scientific and Technical Advice Cell	STAC	Group of technical experts from those agencies involved in an emergency response that may provide scientific and technical advice to the Strategic Co-ordinating Group (SCG) chair or single service gold commander
Secondary decontamination		See decontamination, secondary
Self-contained breathing apparatus	SCBA	Self-contained, positive pressure, respiratory protective equipment (RPE).
Smoke		Particulate matter, usually less than 0.0005 mm in diameter, in air resulting usually from combustion, including liquids, gases, vapours and solids.
Solid		Solid is one of the classical states of matter. It is characterised by structural rigidity and resistance to changes of shape or volume. Unlike a liquid, a solid object does not flow to take on the shape of its container, nor does it expand to fill the entire volume available to it like a gas does. The atoms in a solid are tightly bound to each other, either in a regular geometric lattice (crystalline solids, which include metals and ordinary water ice) or irregularly (an amorphous solid such as common window glass).
Structural firefighting kit	SFK	Helmet, fire hood, fire gloves, tunic, overtrousers and boots suitable for entry into buildings that may be on fire. Must comply with the current European standards for firefighting operations.
Subject matter adviser	SMA	Subject matter advisers (SMA) are members of a team who have been identified in the fire and rescue service and work with national resilience capabilities on a day-to-day basis. The SMA will provide detailed tactical capability advice to the incident commander. SMAs will only be mobilised by the fire and rescue service National Co-ordination Centre.
Tactical adviser	Tac-Ad	A person with specific skills, knowledge and understanding of an aspect of the national resilience programme. At a large or serious incident they are available to provide tactical advice to the incident commander.
Vapour		Vapour refers to a gas phase at a temperature where the same substance can also exist in the liquid or solid state,

		below the critical temperature of the substance. If the vapour is in contact with a liquid or solid phase, the two phases will be in a state of equilibrium.
Warm zone		The area uncontaminated by the initial release of a substance, which may become contaminated by the movement of people or vehicles. It is surrounded by the inner cordon and is part of the hazard zone but usually contains lower risks than the hot zone.
Water bottoming		Technique for managing a leak using water in a container of a substance with lower density than water, to displace the substance above the point of the leak.
Wireless information system for emergency responders	WISER	A useful American hazardous materials database for emergency responders.
Workplace exposure limit	WEL	Workplace exposure limit - maximum concentration of an airborne substance to which employees may be exposed, averaged over a specific period of time, the two periods used are long term (eight hours) and short term (15 minutes). It is an offence to exceed them (COSHH 2005).

References

Fire and rescue service operational guidance, incidents involving hazardous materials, 2012, DCLG, TSO

H0.1 Tactical Operational Guidance - Hazardous Materials, 2014, Colaborative Partnership

Generic Risk Assessments 5.3 – Incidents involving chemical – 2011, DCLG, TSO

Generic Risk Assessments 5.4 – Incidents involving biological hazards – 2010, DCLG, TSO

Generic Risk Assessments 5.5 – Incidents involving radiation – 2011, DCLG, TSO

Generic Risk Assessments 5.7 – Incidents involving acetylene – 2014, DCLG, TSO

Generic Risk Assessments 5.7 – Incidents involving explosives – 2012, DCLG, TSO

Generic Risk Assessments 5.9 – Incidents involving asbestos containing materials (ACMs) – 2010, DCLG, TSO

Generic Risk Assessments 5.10 – Incidents involving petrochemical plant and pipelines – 2013, DCLG, TSO

Personal protective equipment at work (Second edition) Personal Protective Equipment at Work Regulations 1992 (as amended) Guidance on Regulations, 2005, HSE, TSO

'Initial Operational Response to a CBRN Incident' and 'CBRN INITIAL OPERATIONAL RESPONSE AIDE MEMOIRE' (Home Office July 2015).

'Health, safety and welfare framework for the operational environment', June 2013, DCLG (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209362/HSFrameworkJunecombined.pdf)

General Hazardous Materials Behaviour Model, Ludwig Benner Jr.

Website accessed 14/07/2015 - Health and Safety Executive website - http://www.hse.gov.uk/toolbox/ppe.htm

Website accessed 3/2/16 - Health and Safety Executive wedsite - http://www.hse.gov.uk/cdg/manual/consignment.htm#placarding

Website accessed 3/2/16 - Health and Safety Executive wedsite - http://www.hse.gov.uk/cdg/manual/commonproblems/adr-imdg.htm

Website accessed 14/07/2015 - Health and Safety Executive website INDG 467 - http://www.hse.gov.uk/pubns/indg467.htm

Website accessed 14/07/2015 - Chemsafe website - http://the-ncec.com/chemsafe/ (24/08/15)

Website accessed 14/12/2015 - Government Decontamination Service - https://www.gov.uk/government/groups/government-decontamination-service

Website accessed 01/02/2016 - Met Office website - http://www.metoffice.gov.uk/publicsector/hazardmanager