National Operational Guidance

Hazard - Inaccurate situational awareness: Release or spill of a hazardous material

Hazard Knowledge

Hazardous materials may be encountered in one of two states:

- Controlled
- Uncontrolled

Fire and rescue services are usually only called to the uncontrolled release or spill of hazardous materials. Uncontrolled hazardous materials have a greater risk of affecting people, animals, infrastructure and the environment. The deliberate controlled release or spill of hazardous materials may be classified as a CBRN(e) incident where the intent is malicious or murderous.

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 such as batteries. The presence of these containers is a key mechanism to recognise that hazardous materials may be involved at incidents.

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 that events can be accurately predicted, and risk controls implemented.

Hazard areas will vary in size depending on the:

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

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 affects a receptor. The 'Source – Pathway – Receptor' concept is discussed widely when considering environmental protection (See the Environmental Protection Handbook for the Fire and Rescue Service). However, when considering a hazardous materials incident, the receptor could be responders, people in the local vicinity, the local community, animals or infrastructure as well as the environment.

The impact of a release will also be affected by its size and the direction and way 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 factors is necessary to ensure responders identify the full effects of any incident.

Control measure - Specialist advice: Hazardous materials

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 fire control room 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
- Advise on the treatment of people who have been exposed
- Assess wider public safety concerns
- Assist with investigations and debriefings

There is significant capability for both on-site and remote scientific and specialist support for hazardous material incidents, particularly CBRN(e) incidents. Specialist advice may be provided by many sources and there is the possibility of duplicated, confused or even contradictory advice being provided to the incident. There may also be confusion between the scientific advice and responders in terms of language and technical knowledge.

There are a number of fire and rescue service specific resources.

National Resilience Assurance Team

A national cadre of advisers from the fire and rescue National Resilience Assurance Team (NRAT) and National Strategic Advisory Team (NSAT), who provide tactical National Resilience capability advice to the fire and rescue service tactical and strategic commanders. These advisers are also able to provide communication conduits to the National Resilience Fire Control (NRFC) or Home Office Operations Centre where required.

For further information see the National coordination and advisory framework for the fire service in England (NCAF)

Tactical commanders with specific CBRN(e) training

CBRN(e) tactical commanders understand the structures which support the tactical function of the delivery of scientific and operational support to the incident and can assist the on-scene commander in creating, implementing and reviewing an appropriate tactical plan in line with the strategy and parameters determined by strategic command and with due regard for partner agency needs.

CBRN(e) tactical advisers

Tactical advisers have been identified within individual fire and rescue services to provide detailed tactical and capability relevant advice to on-scene incident, operations and sector commanders.

Hazardous materials advisers (HMA)

These officers provide specialist advice to the on-scene commander and where appropriate, tactical and strategic co-ordinating groups. They will liaise with other specialist advisers and emergency services to provide information on:

- The extent of the hazard zones
- Personal protective equipment (PPE) selection and decontamination procedures
- Safe systems of work for those within the ‘hot zone’
- The potential for escalation of the incident
- Interpretation of any information from other experts

Where available, the hazardous materials specialist may be supported by a:

- Detection, identification and monitoring (DIM) adviser
- CBRN(e) tactical adviser

- Multi-agency Scene Assessment Team (MASAT)

Police staff with an enhanced level of skill, knowledge and understanding

These include:

- Police CBRN(e) tactical advisers
- Police duty officers at the National CBRN Centre (N CBRN C) Operations Room
- Government Decontamination Service (GDS)

The UK Government Decontamination Service (GDS), is part of the Department for Environment, Food and Rural Affairs (Defra). GDS helps the UK prepare for recovery following a deliberate act involving chemical, biological, radiological and nuclear (CBRN) materials, or an accidental release of hazardous materials (HazMat), by providing a permanent on-call team for advice and guidance following a CBRN or major HazMat incident. Their role includes:

- Providing advice, guidance and assistance on decontamination to responsible authorities in their contingency planning for, and response to, CBRN and HazMat incidents
- Plan and arrange for decontamination operations to be available to the responsible authorities should the need arise
- Responsibility for maintaining and building the GDS framework of specialist providers and ensuring that responsible authorities have access to them
- Advising central government on the national capability for the decontamination of buildings, infrastructure, transport and open environment

Other specialist service personnel and organisations

- Ambulance services have specialist officers, such as:
    - Hazardous Area Response Team (HART)
    - Medical Emergency Response Incident Team (MERIT)
    - Specialist Operational Response Teams (SORT) etc. who can provide advice on clinical care and decontamination of casualties
- Other specialists or service providers with specific knowledge of CBRN or hazardous materials, for example: scientific advisers, radiation protection advisers etc.
- Other agencies including Environment Agency, Public Health agencies (PHE) etc.
- 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
- Government agencies, for example:
    - The Met Office
    - Atomic Weapons Establishment (AWE)
    - Defence Science and Technology Laboratory (DSTL)
    - Environmental agencies
    - Public health agencies
- Industry response schemes such as Radsafe or Chlor-Aid

Incident commanders will also be able to access information sources, both printed and in electronic format. Printed information sources include:

- The Dangerous Goods Emergency Action Code List (EAC)
- The Emergency Response Guidebook (ERG)
- Safety Data Sheets (SDS) also referred to as Material Safety Data Sheets (MSDS) and Chemical Safety Data Sheets (CSDS)
- Transportation instructions in writing (IIW)

Electronic information sources include: The Met Office Hazard Manager application, CHEMDATA, Wireless Information System for Emergency Responders (WISER), the ERG application, etc.

All fire and rescue services have access to specialist advice both from their own resources and from external sources, including scientific advisers and public health agencies. These are good sources of specialist knowledge but are not always available immediately on the incident ground.

Strategic actions

Fire and rescue services should:

- Have arrangements 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 role

- Ensure that key dangerous substance information sources are immediately available, reliable and resilient

- Have policies and procedures that identify levels of specialist advice and how this advice can quickly be made available to the incident commander

- Have arrangements to access risk critical information from remote specialists quickly during incidents

- Provide access to enhanced skills, knowledge and understanding in CBRN(e) operations to perform the key advisory roles at incidents

Tactical actions

Incident commanders should:

- Consider requesting the attendance of tactical advisers or subject matter experts
- Consider requesting the attendance of hazardous materials adviser (HMA)

Control measure - Substance identification

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. Examples include during a fire, or where hazardous materials are badly controlled or used illicitly.

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 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.

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 provide information on a substance, process or premises, or may provide assistance in interpreting information gained.

Signs, labels and other marking system

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.

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.

The 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 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. It is primarily used by shipping operators, but it is also relevant to those transporting dangerous goods on journeys involving a sea crossing.

Fixed sites

For static sites, warning signage is governed by the dangerous substances Notification and Marking of Sites) (NAMOS) Regulations. 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 warning signs at access points.

See the Health and Safety Executive website for further details. Dangerous Substances (Notification and Marking of Sites) Regulations (NAMOS)

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.

Equivalent legislation in Northern Ireland is The Dangerous Substances (Notification and Marking of Sites) Regulations (Northern Ireland).

Under the Control of Asbestos Regulations (CAR), there are specific labelling requirements for asbestos in non-domestic buildings. Responders should recognise these labels.

Containment systems

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.

It is important that during incidents, responders can:

- Recognise typical container shapes or 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

For further information on substance identification see National Operational Guidance: Health Hazards and National Operational Guidance: Physical Hazards

Strategic actions

Fire and rescue services should:

- Consider developing systems to gather pre-planning information on local risks and incident specific information

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

- Provide access to appropriate detection, identification and monitoring (DIM) equipment

- Ensure that Information on the recognition of hazardous materials is immediately available to personnel

- Ensure that responders can recognise signs, labels and other markings on hazardous materials packages

Tactical actions

Incident commanders should:

- Use signs, labels, markings, container types and detection equipment to identify substance
- Identify if containers indicating the presence of general or specific hazardous materials are involved
- Use available fire service or on-site detection equipment to identify the substance involved

Control measure - Identify substance: National resilience

Control measure knowledge

The DIM adviser will make arrangements for the required sampling and analysis to be carried out, using the appropriate techniques and equipment. The nature and process of these tasks will depend on:

- The type of substance, if known
- Any intelligence about the incident
- The equipment that is provided for the DIM capability

The procedures for sampling and analysis of substances have been produced for:

- Solids, powders, pastes, gels and non-volatile liquids
- Vapours and gases, including volatile liquids
- Radiological materials
- Biological agents

These are detailed in the National Resilience (NR) DIM procedures.

The DIM adviser and DIM support team will conduct a continuous risk assessment process throughout their deployment in the hazard area. Any deviations to the operational plan should be recorded as soon as practicable after exiting the hazard area.

The DIM adviser will operate all DIM equipment as detailed in the NR Equipment information. The DIM support team may be required to carry out monitoring and/or carry equipment as required by the DIM adviser.

Substances should not normally be removed from the hazard area, but if it is essential that samples are moved to another location, this should be recorded.

If further deployments into the hazardous area are required, they should be subject to a risk assessment carried out by the DIM adviser. Such deployments should take into account the findings of the initial analysis, the physical working conditions and the availability of suitable personal protective equipment (PPE).

The task of the DIM adviser is to identify or verify the identity of the substance where possible. The DIM adviser should not be pressured to produce the identification results.

If the DIM adviser is able to identify the substance, this information should be passed as soon as

possible to the fire and rescue service's incident commander and the police on-scene commander. However, if it is not possible to identify the substance, its classification (acid, alkali, physical properties) should be determined.

Following this, the information should be passed to the medical responders to assist them in determining the appropriate clinical treatment. When liaising with other agencies, the DIM adviser should state the limitations of any equipment that has been used, where that may impact on the accuracy of analysis results.

If sampling and analysis indicates that the cause of the incident could be a CBRN(e) event, it will lead to a multi-agency response as detailed in the JESIP publication, Responding to a CBRN(e) event: Joint operating principles for the emergency services.

If a CBRN(e) event is declared by the police, the National Resilience Fire Control (NRFC) should be notified about its location and what NR DIM assets have already been deployed.

Strategic actions

National Resilience should:

- Ensure that information about DIM equipment and its application is kept up to date
- Ensure that any equipment with expiry dates is replenished when required

Fire and rescue services should:

- Ensure that equipment is calibrated and tested according to the manufacturers' guidelines

Tactical actions

Specialist responders should:

- Wear the appropriate personal protective equipment (PPE) as recorded in the deployment plan
- Ensure that equipment deployed is functioning correctly
- Understand the limitations of the equipment and communicate this to the requesting fire and rescue service and other agencies
- Notify the police on-scene commander if sampling and analysis indicates that the cause of

the incident could be a CBRN(e) event

- Ensure that the NRFC is notified about a declared CBRN(e) event, its location and what National Resilience DIM assets have already been deployed

Control measure - Identify cause of release or spill

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, animals, 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 way containment fails can also have significant effect on the outcome and scale of the incident. There are a limited number of ways in which a container can breach; these will lead to a specific type of release that will affect the scale and level of risk.

Type of Breach	Potential Release
Catastrophic failure	Full release
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 construction, condition and stressors acting on the ineffective containment systems
- Consider the type of stressors involved and the ability of the container to tolerate the stresses on it

Control measure - Estimate quantity of release or spill

Control measure knowledge

At any hazardous materials incident, the level of risk, scale and impact will be affected by the amount of material that is released or spilled in an uncontrolled state.

The actions and tactics adopted should be based on the scale and likely impact of the incident, which will be influenced 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 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 the spill, not 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:

- Provide staff with equipment and the necessary skills to quickly and safely estimate the quantity involved

Tactical actions

Incident commanders should:

- Use incident indicators and container volume to estimate the quantity of material involved

Control measure - Assess impact of release or spill

Control measure knowledge

Once the spread and scale of the 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)
- Animals
- 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. 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

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 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:

- Assess the impact of hazardous materials on people, animals, infrastructure and the environment

- Consider a shelter-in-place strategy based on the number of people already exposed or potentially at risk

Control measure - Hazardous materials assessment

Control measure knowledge

Given the potential complexity of hazardous materials incidents, 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 by establishing a joint understanding of risk (JUR).
Hazardous materials incidents should follow the same dynamic risk assessment (DRA) or analytical risk assessment (ARA) as any other emergency. However, at hazardous materials incidents a specific assessment of the substances and their hazards will need to be carried out to inform the incident risk assessment.
Incident risk assessment considers information from:

- Site-specific premises risk information
- Operational guidance, including those for hazard specific incidents, for example radiation, asbestos and acetylene cylinders.
- Observation of incident circumstances
- Eye witnesses at the time of the incident

The selected safe systems of work (SSoW) should be implemented, developed, maintained and reviewed throughout the life of any incident. There are several 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 assessment

The hazardous materials assessment process requires personnel who have received specific training on the subject. 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 dynamic risk assessment.
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 assessment may require additional support to ensure the required tasks are completed in a precise, detailed and timely manner.

Strategic actions

Fire and rescue services should:

- Ensure personnel who respond to hazardous materials incidents receive specific information, instruction and training on conducting an initial hazardous materials assessment

- Ensure hazardous materials advisers receive specific information, instruction and training on the conducting a comprehensive hazardous materials assessment

- Consider using consistent systems and formats to record information from all hazardous

materials incidents

- 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

- Ensure that any information gathered is treated as confidential unless disclosure is required for legal reasons

Tactical actions

Incident commanders should:

- Use specialist advisers to carry out hazard specific assessments and interpret information and advice

- Make a record of the hazardous materials assessment and incorporate into analytical risk assessment

Control measure - Effective communication: Hazardous materials

Control measure knowledge

Effective communication is a prerequisite 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 may be caused by wearing bulky personal protective equipment (PPE) ensembles.
Equipment for use in places in which explosive atmospheres may occur must be selected based on the requirements set out in the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations (EPS) unless the risk assessment finds otherwise.
For further information see Fireground Radios Guidance

Strategic actions

Fire and rescue services should:

- Have access to communications systems that are suitable for use at hazardous materials incidents such as ATEX approved radio equipment
- Provide specific information, instruction and training on hazardous material communication systems
- Provide additional information, instruction and training to personnel who deal with hazardous material incidents on the briefing of personnel who operate in the hazard area

Tactical actions

Incident commanders should:

- Use waterproof chemical/substance information boards to retrieve information from the scene
- Use ATEX approved communications equipment when crews enter any potentially flammable or explosive atmosphere