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CHIEF FIRE & RESCUE ADVISER

Fire and Rescue Service Operational Guidance

GRAs
generic risk assessments

GRA 5.7
Incidents involving explosives

Generic Risk Assessment 5.7

Incidents involving explosives

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The generic risk assessments in this series only apply to England.

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Generic risk assessment 5.7 Incidents involving explosives

Scope

This generic risk assessment examines the hazards, risks and control measures that relate to incidents involving 'commercial' explosives, whilst in manufacture, storage or transportation. It does not cover improvised explosive devices.

Depending on the nature and scale of the operational incident, a variety of significant hazards may be present. Fire and Rescue Services may therefore need to consider the contents of other specific generic risk assessments in this series.

Details of documents that contain technical and supporting information can be found in the Technical reference section of this generic risk assessment.

This, as with all generic risk assessments provides a starting point for the Fire and Rescue Service to conduct their own assessments within the context of local conditions and existing organisational arrangements.

Significant hazards and risks

The significant hazards from explosives are essentially the same irrespective of whether they are in manufacture, storage or during transportation.

The term explosive covers a vast range of energetic materials and products, with widely varying properties, dependant upon a large number of parameters. Even though the likelihood of an incident involving explosives is low, the potential consequences can be catastrophic.

It is not only 'high explosives' which can have a catastrophic effect therefore it is imperative that fireworks are not considered to be anything other than explosives.

EXPLOSIVES INCIDENTS

Although there are wide varieties of potential incidents the most common one Fire and Rescue Services are likely to attend will involve fireworks either in storage or during transportation.

Fireworks present hazards that have resulted in catastrophic destruction, serious and fatal injuries to firefighters, other responders and the public.

In addition the hazards posed by fireworks can be exacerbated by 'illegal' factors.

ILLEGAL FIREWORKS

A proportion of fireworks stored/sold in the UK maybe via the 'illegal industry' eg:

- 'white van man' selling door to door
- unlicensed storage sites may be encountered at any time but there is greater likelihood during the 'firework season'
- ISO containers[1] have been used for storage at sites where it would not normally be expected to find fireworks stored
- imported fireworks of a lower standard than legislation permits
- importation of illegal fireworks in unexpected ways eg in an ISO container whose paperwork or hazard warning placards indicates that the contents are not fireworks and 'legal'
- theft from licensed premises.

UNLAWFUL ACTIVITY AT LICENSED SITES

Although there is legislation in respect of manufacture, storage and transportation requiring the highest degree of care and precaution, there may be occasions when these have not been properly implemented, even at licensed sites:

- storage areas may be incorrectly marked for the explosives held
- more explosives maybe stored than the license allows
- explosives of a different, ie higher hazard type maybe stored, than their license allows
- illegal explosives eg imported fireworks of a lower standard than legislation permits
- separation distances maybe inappropriate for the explosives held giving the potential for a quicker fire spread and mass explosion
- the on-site responsible person may provide inaccurate or misleading information about the site's contents or they may not have the level of competency that would be expected.

How explosives react

Explosives are generally divided between those which detonate (ie explode) and those which deflagrate (ie burn violently). However it MUST NOT be assumed that because the explosives have deflagrated rather than detonated the fire can be fought. Once ignited, explosives will not be extinguished by the application of water, irrespective of the amount of water used.

The potential for a transfer from deflagration to detonation is present at all incidents involving explosives, especially when there is an element of confinement.

1 ISO (International Standards Organisation) container is the standard international transport/shipping container and is commonly used for storing explosives.

This has been a key factor in most of the fatal accidents involving explosives.

The fundamental distinction between detonation and deflagration is elaborated upon in the United Nations classification system where explosives are divided into hazard divisions (HD1.1 to HD1.6) with HD1.1 being the most hazardous.

NOTE:
The classifications are based on the behaviour of the explosive when burnt in its' packaging, in the open air on a bonfire. The same explosives may behave very differently when confined eg in an ISO container because the build-up of pressure, can lead to a mass explosion or a fireball.

The Manufacture and Storage of Explosives Regulations 2005 uses the term hazard type to differentiate between explosives, with Hazard Type 1 the most hazardous and Hazard Type 4 the least. In general terms the hazard type equates to the hazard division. However, there may be circumstances when, depending on the method of storage and the degree of confinement, the hazard type will differ.

Explosives, irrespective of whether they deflagrate or detonate produce large quantities of hot gases without consuming oxygen from the surroundings.

Explosives can remain 'live' when buried under ash/debris even if they have been involved in a very intense fire, and/or unexploded parts have been ejected some considerable distance.

Even if no explosion takes place the ignition of certain Hazard Type 3 and Hazard Type 4 can result in a significant fireball eg the burst diameter of an aerial firework shell can be in excess of 100m.

Explosives generate considerable noise when they explode which can make communication difficult especially if explosions occur over a protracted time eg Hazard Type 4 fireworks.

Where explosives can be found

MANUFACTURE

There are only a few sites in the UK manufacturing high explosives or munitions that use high explosives and most are also subject to the *Control of Major Accident Hazards Regulations 1999*.

Other sites manufacture ammunition, pyrotechnics, detonators etc.

STORAGE

All storage sites should correctly identify the contents of ALL their storage facilities through the use of hazard placards. However, it is known that at some, even licensed sites, the placards maybe incorrect or not present at all.

ISO containers are routinely used for the storage and the transportation of ALL types of explosives.

Storage of fireworks

Premises storing fireworks account for the overwhelming majority of storage sites. They can be split into three distinct groups.

SHOPS

Shops usually hold stocks only during the 'firework season' (although they can do so at other times) either within the shop or in an ISO container, however they account for the majority of premises.

In addition to other requirements *The Pyrotechnic Articles (Safety) Regulations, 2010* categorises fireworks into the following four categories.

Category 1 Fireworks suitable for use inside domestic buildings.

Category 2 Fireworks suitable for outdoor use in relatively confined areas.

Category 3 Fireworks suitable for outdoor use in large open spaces.

Category 4 Professional display fireworks.

Each category has general performance and labelling criteria that have to be met.

There are however transitional arrangements for Category 4 fireworks whereby until July 2013 they continue to be subject to the *Fireworks (Safety) Regulation 1997*.

All fireworks must comply with the relevant British Standard.

FIREWORK IMPORTERS

Importers are concentrated at a relatively small number of sites but they hold large quantities. At peak times they may be holding thousands of tonnes, mainly Hazard Type 4.

FIREWORK DISPLAY OPERATORS

PERMANENT STORAGE

Firework display operators are likely to be storing at their permanent storage site Hazard Type 1 substances and articles and Hazard Type 3 and 4 fireworks. There are two main implications from this:

– Hazard Type 1 present a mass explosion hazard
– when Hazard Type 1 are present together with Hazard Type 3 and 4 the whole quantity may behave like and is regulated as if it is, Hazard Type 1.

TEMPORARY STORAGE

When firework displays are being set up at locations, fireworks are likely to be found on site for between 24 hours and three days without a requirement for a licence or registration. In addition, a licence for the storage of fireworks is not required in the following circumstances:

(i) the storage of no more than 7 kilograms of:

- Hazard Type 1 or 2 explosives, or
- a combination of Hazard Type 1 or 2 explosives with explosives of another hazard type, for no longer than 24 hours.

(ii) the storage of Hazard Type 3 or 4 explosives for no longer than 24 hours.

(iii) the storage of no more than 100 kilograms of:

- Hazard Type 3 explosives consisting of fireworks, shooters' powders or a combination of shooters' powders and Hazard Type 3 and 4 explosives consisting of fireworks, provided that the explosives are stored for no longer than three days in their place of intended use.

(iv) the storage of:

- no more than 250 kilograms of Hazard Type 4 explosives provided that the explosives are stored for no more than three days in their place of intended use; or
- no more than 50 kilograms of Hazard Type 4 explosives consisting solely of fireworks provided that the fireworks are stored for no longer than 21 days and are not for sale or for use at work.

Fire and Rescue Services should therefore consider any container or vehicle at a fireworks display site as having the potential to hold fireworks in the period before a display.

Other storage sites

QUARRIES AND MINES

The majority of sites storing blasting explosives will be quarries. The explosives typically held in a steel store, some sites will also have a detonator annexe. Most explosives are mixed on-site from non-explosive ingredients.

MINISTRY OF DEFENCE SITES

The Secretary of State for Defence can in the interest of national security exempt Her Majesty's Forces, visiting forces or civilian Ministry of Defence employees from the requirements of the *Manufacture and Storage of Explosive Regulations*.

OTHER PREMISES

There are many thousands of premises holding generally small quantities of the least hazardous types of explosives that present a hazard comparable to items such as camping gas cylinders and aerosols.

INDIVIDUALS

There are certain circumstances when a licence is not required for storage, this includes, the storage of one or more of the following:

- no more than 10kg of black powder
- no more than 5kg of shooters' powder

Certain explosives require a Police Certificate for persons to acquire or acquire and keep, these include but are not limited to, gunpowder, blasting explosives, detonating fuses, detonators, cutting charges and various types of 'military equipment' held for historical/recreating purposes

Fire and Rescue Services may want to consider setting up arrangements with the police to obtain details of certificate holders.

TRANSPORTATION

Explosives may be carried by road, rail, sea, inland waterway and air.

Fireworks are mainly imported through the port of Felixstowe and whilst this can occur throughout the year the busiest time is usually in July and August prior to the 'firework season'.

Road – specific hazards

Certain explosives eg 50kg of fireworks or 30kg of mixed explosives maybe carried by private individuals.

There maybe occasions when in the interest of national security armed services vehicles do not display warning placards.

The illegal carriage of explosives (used for legitimate reasons) is rare, however, there is the possibility of their carriage for illegal purposes.

Rail, inland waterways and at sea – specific hazards

Due to the carrying capacity of trains, larger inland waterway vessels and ships, there may be occasions when explosives are being carried along with other hazardous substances or materials. In addition, there are the usual hazards associated with incidents involving these modes of transport.

Air-civil-specific hazards

Civil aircraft do not normally carry explosives although certain ammunition can be carried in passenger's hold baggage and some specific explosives can also be carried as cargo.

Some HD 1.3 explosives and most HD 1.4 can be carried on cargo aircraft.

Exemption certificates can be, and very occasionally are, issued by the Civil Aviation Authority for cargo aircraft (never for passenger aircraft) to carry HD 1.1 and HD 1.2

Armed services – specific hazards

Military aircraft and naval vessels will 'routinely' carry explosives and munitions that present a wide variety of hazards eg high explosives, sub-munitions that arm on ejection, incendiaries and possible radiation hazards from depleted uranium ammunition.

In addition there are the usual hazards associated with any incident involving the above modes of transport.

Communications

Electromagnetic energy emitted from radio transmitters and devices such as mobile phones, pagers etc are possible sources of ignition for explosives.

Explosives such as electro explosive devices are particularly sensitive to this type of energy.

Health

The direct affect on personnel of an explosives incident may include:

- blast injuries
- hit by projectiles
- impact injuries caused by being 'blown' against a hard surface by the blast wave
- hearing damage – usually temporary loss or ringing in the ears
- lung damage
- burns
- entrapment following collapse of a structure
- exposure to radiation and toxic materials used in military munitions.

The environment

Smoke plumes and water run off may contain concentrations of chemicals.

Debris maybe dispersed over large areas following a mass explosion.

Key control measures

Planning

Planning is key to enhancing the safety of firefighters and others likely to be affected by Fire and Rescue Service operations. Each Fire and Rescue Service's strategic plan will set standards and identify the resources required to ensure safe systems of work are maintained.

Each Fire and Rescue Service should assess the hazards and risks in their area relating to this generic risk assessment. This assessment should include other Fire and Rescue Service's areas where 'cross border' arrangements make this appropriate.

Site-specific plans should be considered for locations where the hazards and risks are significant. Plans should take into account and specify any variation from the normal operational capability of personnel, appliance and equipment. In particular, recognition should be given to the physical and physiological pressures that an operational incident may apply to Fire and Rescue Service personnel.

Site-specific plans should include:

- levels of response
- consideration that emergency responders may lack experience in attending incidents involving explosives
- reference to relevant Standard Operating Procedures
- tactical considerations. Including rendezvous points, appliance marshalling areas and access points.
- Identification and where necessary, the formal notification to person(s) responsible for the site of any Fire and Rescue Service limitations.

Planning is underpinned by information gathering, much of which will be gained through inspections or visits by Fire and Rescue Service personnel – for example, those covered by section 7(2)d of the *Fire and Rescue Services Act 2004*.

Information should also be gathered and used to review safe systems of work, etc from sources both within and outside the Fire and Rescue Service, including:

- fire safety audits
- incident de-briefs
- health and safety events
- local authorities
- local resilience fora.

Involving others in pre-planning is also an effective way to build good working relations with partner agencies and other interested parties, such as site owners.

Many agencies eg Revenue and Customs, Maritime and Coastguard Agency, the Health and Safety Executive, the police and local trading standards are all involved in monitoring the manufacture, storage and transportation of explosives. Effective liaison and exchange of information with these agencies is a key element in the Fire and Rescue Service's planning.

An example of such communication is the legal requirement for firework importers to provide information on their load and destination to Revenue and Customs who inform Suffolk County Council Trading Standards who in turn notify the enforcing authority into whose area the load is to be delivered. The local Fire and Rescue Service can then obtain the load details from the enforcing authority.

Fire and Rescue Services should ensure systems are in place to record and regularly review risk information and to ensure that new risks are identified and recorded as soon as practicable.

Fire and Rescue Services must ensure that the information gathered is treated as confidential, unless disclosure is made in the course of duty or is required for legal reasons.

Fire and Rescue Services should consider the benefits of using consistent systems and formats to record information from all sources. Consideration should also be given to how timely access will be provided to information to support operational decision-making.

Information needs will vary in proportion to the size and nature of the incident. The capacity of Fire and Rescue Service staff to assimilate information will vary in relation to the complexity of the incident. Therefore, arrangements may need to be flexible and may be based on more than one system.

Further guidance on planning can be found in the **Fire and Rescue Service Operational guidance – Operational risk information** and any other relevant sources.

http://www.communities.gov.uk/documents/fire/pdf/2124406.pdf

Manufacturing and/or storage sites

Identification of sites is a key element as it enables Fire and Rescue Services to determine those sites that present the greatest potential hazard which in turn permits Fire and Rescue Services to prioritise each site for gathering information, pre-planning, response plans etc.

The *Manufacture and Storage of Explosives Regulations Approved Code of Practice* requires that manufacturing and/or storage sites should contact the Fire and Rescue Service who may wish to undertake familiarisation visits to explosives sites. However, it is good practice for Fire and Rescue Services to be proactive and not rely upon the manufacture and or storage site contacting them.

The relevant licensing authority maintains a register of licensed and registered sites and will be able to provide details.

Close liaison with the licensing/enforcing authority, ideally via joint site visits, will assist the Fire and Rescue Service to:

- establish the explosives that should be on site
- identify the buildings etc where they are processed or stored
- determine that the buildings etc are correctly marked to identify their contents
- determine any special conditions imposed by the sites license
- ensure all of the above conform with the site's license
- obtain other valuable information about the site eg it's layout, water supplies etc
- obtain a copy of the site operator's emergency arrangements.

Accurate, clear and up to date information is essential and should be gathered by the Fire and Rescue Service through regular visits (in addition to any joint visits) supplemented by other sources eg operational intelligence. The above bullet points being the minimum that Services should be considering as part of their operational tactical planning.

Ministry of Defence sites

The safety of explosives at Ministry of Defence sites and whilst being transported, together with fire fighting recommendations is determined by the Ministry of Defence. Fire and Rescue Services should make themselves aware of these procedures via good liaison with the sites. Fire and Rescue Services may also want to consider developing a Memorandum of Understanding with the Ministry of Defence sites.

Response plans

There should be in place response plans for all locations where explosives maybe found including 'temporary arrangements' eg during loading/unloading of ships in harbours. The plans will be a mixture of those required by legislation and the Fire and Rescue Service's tactical plan. The size and complexity of the plan should reflect the type of site eg *Top Tier Control of Major Accident Hazard Regulations 1999* sites are required to have a safety case which will include an on site plan and in addition an integrated offsite plan must be prepared by the local authority.

At smaller sites when an incident occurs outside of normal working hours eg retail storage of fireworks, their plan may not be readily available. Consideration should therefore be given to obtaining a copy as part of the 7(2)(d) process.

Transportation

Fire and Rescue Services should determine the types of transport used in their area along with their customary travel routes.

ROAD

The number of vehicles carrying explosives by road is relatively small and the route of any journey involving more than five tonnes of HD1.1 explosives must be agreed by the carrier with the police.

INLAND WATERWAYS

Fire and Rescue Services should liaise with the appropriate controlling authority for their area. Usually, but not always, the British Waterways Board, to gather information such as the types of vessel eg barges, small craft, moorings, storage areas and emergency access points.

HARBOURS AND AT SEA

With certain exceptions, a licence is required for explosives being brought into or handled in a harbour and the loading/unloading of explosives on a vessel up to and within the territorial waters of the United Kingdom.

The licence specifies any conditions or restrictions, including limits on the type and quantities of explosive and where their handling may take place and provides valuable information for Fire and Rescue Services.

ROYAL NAVY VESSELS

All Royal Navy vessels have a liaison officer who will inform the Fire and Rescue Service whenever the vessel is in port.

Courtesy visits should be arranged on a regular basis especially if different types of vessels visit. If a vessel is in port for any length of time consideration should be given to holding an onboard exercise.

Communications

Fire and Rescue Services should be informed by the manufacture and/or storage site if explosive devices sensitive to radio energy are, or maybe, present in order that the Fire and Rescue Service can carry out a risk assessment of their own communications equipment.

Competence and training

When formulating a competence and training strategy the Fire and Rescue Service should consider the following points:

- Ensure specific risk assessments for this incident are suitable and those tasked with carrying out the assessment and developing procedures are competent to do so
- Fire and Rescue Services must ensure their personnel are adequately trained to deal with hazards and risks associated with operational incidents involving explosives
- The level and nature of training undertaken should be shaped by informed assessment of operational and individual needs in accordance with the Fire and Rescue Service guidance on the integrated personal development system, national occupational standards and any internal training plan

Training and development should:

- follow the principles set out in national guidance documents
- generally be structured so that they move from simple to more complex tasks and from lower to higher levels of risk
- typically cover standard operational procedures as well as ensuring knowledge and understanding of equipment and the associated skills that will be required to use it
- consider the need for appropriate levels of assessment and provide for continuous professional development to ensure maintenance of skills and to update personnel whenever there are changes to procedure, equipment etc.
- also involve personnel involved in other processes that support the emergency response, such as planners devising procedures and people procuring equipment.

Specific training requirements for incidents involving explosives will include:

- dissemination of the standard operating procedure and site-specific operational tactical plans
- familiarisation visits to manufacturing and/or storage sites along with, where applicable, any vehicles, rolling stock, ships, boats or barges etc used to transport the explosives
- site-specific tactical exercises should be undertaken with other agencies or staff likely to assist at an actual incident.

Training outcomes should be evaluated to ensure that the training provided is effective, current and meets defined operational needs as determined by the Fire and Rescue Service's integrated risk management plan.

Command and control

The Incident Commander should follow the principles of the current national incident command system. Prior to committing personnel to any hazard area the Incident Commander must take account of the actual information about the incident that is available to make operational decisions in what are recognised as sometimes dangerous, fast moving and emotionally charged environments.

Communication of new or changed risks should continue throughout the incident.

Safety Officer(s)

The early appointment of one or more Safety Officer(s) will assist in supporting a tactical plan to address risks so they can be eliminated or reduced to an acceptable level.

A safety decision-making model should be used to brief Safety Officers regarding the nature of the incident, the allocated task and prevailing hazards and risks. The Incident Commander should confirm that the Safety Officer understands:

- their role and area of responsibility

- allocated tasks
- lines of communication.

Those undertaking the Safety Officer role should:

- be competent to perform the role
- ensure personnel are wearing appropriate personal protective equipment
- monitor the physical condition of personnel and/or general or specific safety conditions at the incident, in accordance with their brief
- take any urgent corrective action required to ensure safety of personnel
- update the Incident Commander or senior safety officer regarding any change in circumstances
- not be engaged in any other aspect of operations, unless this is required to deal with a risk critical situation.

The activities of a Safety Officer can be carried out by any of the Fire and Rescue Service roles, but the complexity of the task, size of the incident and scope of responsibility should be considered by the Incident Commander when determining the supervisory level required.

Safety Officers should wear nationally recognised identification to indicate they are undertaking the 'Safety Officer' role.

The Fire and Rescue Services should ensure that training and other measures (such as aide-memoires) are in place and available to support those staff liable to undertake this role.

Specific control measures

All aspects involving the use of explosives are closely regulated and the regulations require duty holders to take the highest degree of care and precaution when dealing with explosives.

However, there is evidence from incident investigations and legislative enforcement of some non-compliance.

Therefore, irrespective of the legal requirements, Fire and Rescue Service personnel should always exercise the highest degree of caution when dealing with **ALL** explosive incidents.

KEY CONSIDERATIONS WHEN MANAGING ALL INCIDENTS INVOLVING EXPLOSIVES

Because there are many factors which determine how explosives react a defensive tactical mode should be the immediate default position of Fire and Rescue Service personnel no matter if the incident is involving high explosives or fireworks.

CORDONS

Implement a cordon around the suspected hazard zone and strictly control access into it. The cordon distance will be based on the quantities of explosives that might be present.

As it may not always be possible to determine the quantity of explosives present at the early stage of the incident, Incident Commanders should always default to the maximum distances as outlined in *Operational Guidance Hazardous Materials Manual*. As with any hazard zone, it can be increased or decreased once information has been gathered and a risk assessment carried out.

All non-essential personnel should be excluded from the hazard zone.

Once explosives are confirmed to be involved in a fire an exclusion zone must be set-up and everyone, including Fire and Rescue Service personnel must withdraw.

Constant assessment of the inner cordon will be necessary due to the possibility of "live" explosives remaining under debris. Fire and Rescue Service personnel should not enter a manufacture or storage site post incident as simply stepping on the explosives can generate sufficient friction to set them off and potentially cause severe injury.

EXPLOSIVES NOT ALREADY INVOLVED IN A FIRE

The primary objectives when dealing with any incident that could result in the involvement of explosives are that the fire is extinguished AND prevented from spreading to structures and other areas containing explosives.

If fire fighting is undertaken the site response plan for dealing with the incident will assist the Incident Commander in only exposing the minimum number of personnel.

EXPLOSIVES ALREADY INVOLVED IN A FIRE

If fire has already spread to the explosives, the application of water WILL NOT extinguish the explosives. The fire should therefore not be fought as it is impossible to predict both the timing and the extent of any mass explosion.

If there is any doubt about the type or location of the explosives or if it is unclear if the explosives are/are not already involved in the fire, the fire should not be fought.

Earth embankment or similar substantial cover will provide some protection but consideration must always being given to the consequences of a blast wave.

Small buildings or vehicles offer little protection and sheltering behind walls can be dangerous because they will only stop small projectiles. Any explosion may overturn vehicles, demolish walls and in doing so create more projectiles and associated hazards.

Once an explosion has occurred, secondary explosions can take place for some considerable time. The fighting of secondary fires should not take place until there is confirmation that no more explosives remain.

LIAISON BETWEEN MANUFACTURING AND/OR STORAGE SITES AND THE FIRE AND RESCUE SERVICE

Good liaison is a key element when managing the incident.

Information on the buildings where explosives are present and the explosives involved should be prepared in advance by the manufacturing and/or storage sites and provided to the Fire and Rescue Service in the event of a fire.

The manufacturing and/or storage site should have a competent person to advise the Fire and Rescue Service in the event of an incident.

On arrival at the scene the Fire and Rescue Service should be told where the fire is located and the hazards involved.

Other considerations

MANUFACTURE AND STORAGE SITES

Sites normally consist of many buildings with appropriate separation distances between each. This is to ensure that any incident occurring in one building will, as far as possible, only affect that building.

In order to mitigate the effect of explosive blasts the buildings may also be of a light construction or have light roofs or blow out panels. The light construction means the building will easily 'collapse' upon itself leaving the support pillars etc in-situ.

However if the explosion is severe enough the pillars may fragment and create potentially lethal projectiles.

Protective mounds may also wholly or partly surround buildings.

Some former ordnance magazines are constructed of robust concrete or bricks and covered with earth.

FIREWORK DISPLAY OPERATORS

At firework display operator sites all buildings and containers should be treated as if they potentially contain Hazard Type 1 explosives unless there is reliable information, to the Incident Commander's satisfaction, that they either contain no explosives or only Hazard Type 4.

If the Incident Commander is not satisfied about the accuracy of the information received then a defensive tactical mode should be implemented until further information, to the Incident Commander's satisfaction, is received.

ISO STORAGE CONTAINERS

Where only Hazard Type 4 fireworks are stored eg at a supermarket the containers should be suitably marked (but only when the container is in use).

At manufacturing and storage sites a large number of ISO containers may be found in close proximity (within 1m) of each other. In these circumstances it is possible for a fire involving one container to affect another.

ISO containers, even on licensed sites, have been known to be either incorrectly or not marked with hazard placards. Any fire involving an ISO container at any location, should therefore be treated with caution until information on its contents, to the satisfaction of the Incident Commander, is obtained.

Even if the fire appears to be extinguished, the ISO container should be treated as a potential source of explosion and under no circumstances should the ISO container doors be opened for at least 24 hours.

TRANSPORTATION

The European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) and the European Agreement Concerning the International Carriage of Dangerous Goods by Rail (RID) are implemented in the UK by The Carriage Regulations which require identification of packages (by labelling) and vehicles (by placards) which must be displayed at all times.

The European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) also applies however the labelling and placarding element has not been adopted by the UK.

All dangerous goods carried by ship must be identified using the international maritime organisation shipping standard (IMDG) which is similar to ADR and RID. IMDG also applies to vehicle journeys which involve a sea crossing. If full compliance with IMDG is followed vehicles do not have to display placards under The Carriage Regulations.

Road

Vehicles carrying more than five tonnes of HD 1.1 explosives must have a driver and attendant both of who will have received training to the ADR standard that enables them to take measures for their own safety, that of the public and the environment. If less than five tonnes HD1.1 or other hazard divisions are carried no attendant is required.

The crew should always be consulted. However if they cannot be consulted eg due to injury, documentation on the load and any special action required can be found in the cab.

> **NOTE:**
> Whilst the paperwork is in standard format it is also in a language that the driver understands and therefore may not be in English.

On those occasions when Her Majesty's Armed Forces in the interest of national security do not comply with The Carriage Regulations liaison with the crew of the vehicle is paramount.

Although small quantities of explosives maybe carried by private individuals without having to comply with The Carriage Regulations, the carrier still has a responsibility to move them safely and securely.

Rail

Explosives are clearly marked and packed in specific wagons or containers which display placards similar to those required for road transport.

Information in writing is carried by the crew detailing the explosive carried and any special action required. The crew will also have received specific training to the RID standard and if uninjured, should always be consulted.

The incident should be managed in a similar manner to that involving road transport but modified as necessary to ensure the safety of personnel working on the rail infrastructure.

Inland waterways

Although the UK has not adopted the ADN standard of labelling, craft on inland waterways may well display warning signs in line with British Waterways Board guidance and these will be similar to those for road and rail.

In addition packages, unless carried for their entire journey on inland waterways must comply with The Carriage Regulations for that part of their journey by road or rail.

On canals and many rivers it will often be possible to deal with the incident from on land and similar methods as those for dealing with road and rail transport can often be used.

Harbours

Once the loading/unloading of a vehicle is completed, the vehicle will be taken out of the harbour as soon as is reasonably practicable.

Once the loading/unloading of a vessel is completed the vessel will be taken out of the harbour as soon as is reasonably practicable unless the harbour master and if berthed, the berth operator agree.

Vessels will, between sunrise and sunset, display a red warning flag and when moored or anchored between sunset and sunrise and during the day if restricted visibility, display an all-round, uniform and unbroken red light visible in good night time conditions for at least two nautical miles.

Royal Navy vessels

In the event of an incident onboard a Royal Navy vessel the Incident Commander must ensure that they clearly establish and understand the Royal Navy's priorities. On a warship protection of the ships magazine will often be the top priority and the action taken to achieve this may appear to be contrary to the priorities that are the norm to Fire and Rescue Services.

Civilian aircraft

In the event of an incident occurring eg aircraft overshooting the runway the operator must inform the emergency service of any dangerous goods being carried. The airport fire service will usually be the first emergency service to be informed. In addition, the aircraft operator is required to ensure that a copy of the dangerous goods documentation (or the information contained in it) that had been provided to the aircraft captain is readily available at the points of departure and intended arrival.

Military Aircraft

If military aircraft are involved in any incident, guidance must always be sought from Ministry of Defence or armed services personnel.

HEALTH

The implementation of an appropriate safe system of work should eliminate and/or significantly reduce the likelihood of injury or health issues.

THE ENVIRONMENT

Implement environmental control measures, if safe to do so, as per local procedures.

PERSONAL PROTECTIVE EQUIPMENT

Fire and Rescue Services must ensure that any personal protective equipment provided is fit for purpose and meets all required safety standards. When choosing suitable protective garments, the standard of clothing worn beneath the specialist personal protective equipment should also be taken into account. Consideration should also be given to the selection of suitable sizes and gender specific requirements of personal protective equipment.

Personal protective equipment should also take account of the need for rescuers to be visible against the operational background including night working and for the Incident Commander and other managerial and functional roles (defined in the national incident command system) to be distinguishable.

All personnel must use appropriate levels of service provided personal protective equipment and respiratory protection equipment as determined by the safe system of work.

POST INCIDENT

The following measures should be considered to help eliminate or remove risks after an incident, as appropriate to the nature and scale of the incident.

Any safety events; personal injuries, exposure to hazardous substances or near-misses should be recorded, investigated and reported in line with legislative requirements such as *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995*, etc.

Arrangements should be in place to either remove all contamination from personal protective equipment or to ensure it's safe and appropriate disposal and to check that the equipment maintains the agreed levels of integrity and protection for the wearer throughout it's lifecycle

As appropriate, occupational health support and surveillance follow up.

Conduct a de-brief to identify and record any 'lessons learned' from the incident. De-briefs will range in complexity and formality, proportionate to the scale of the incident and in line with individual Fire and Rescue Service's procedures.

Consider any changes required to safe systems of work, appliances or equipment in the light of any lessons learned from debriefs or from safety events.

Consider the need to review existing information held on a premises or location, or the need to add a new premises or location into future planning eg by adding to a visit or inspection programme.

Consider the need to refer to other agencies any concerns or issues that are identified at an incident eg referral of vulnerable person to social services, referral of possible environmental health problems at a premises serving food to the local authority, etc When sharing information, due regard must be paid to the need for confidentiality and the legal requirements arising from the Data Protection Act.

Staff 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.

Consideration should be given to arranging for staff to make a contemporaneous written record of their actions. This information may be used to assist in any internal or external investigations or enquiries that follow any incident eg coroners court, public enquiry, etc.

Technical references	
1.	British Standard BS7114
2.	British Waterways Board Website
3.	Civil Aviation Authority Dangerous Goods Office
4.	The Carriage of Dangerous Goods and Use of Transportable Pressure equipment (Amendment) Regulations 2011
5.	Control of Explosives Regulations 1991
6.	Control of Major Accident Hazards (COMAH) Regulations 1999
7.	Dangerous Substances in Harbours Regulation 1987
8.	European Agreement on Carriage of Dangerous Goods by Rail (RID)
9.	European Agreement on Carriage of Dangerous Goods by Road (ADR)
10.	Explosives Industry Forum
11.	Fire and Rescue Services Act 2004
12.	Fire Service Manual Volume 2 Fire Service Operations Marine Incidents
13.	HSE Commentary on the Manufacture and Storage of Explosives Regulations 2005 (page3)
14.	HSE Website – Carriage of Dangerous Goods Page
15.	HSE Website – Explosives Page
16.	International Maritime Organisation – IMDG Code
17.	Management of Health and Safety at Work Regulations 1999
18.	Manufacture and Storage of Explosives Regulations 2005 and ACOP L139
19.	MOD Explosives, Storage and Transport Committee Guidance Notes (D/ESTC series)
20.	Manufacture and Storage of Explosives Regulations 2005 ACOP Para 221 and further guidance on interpretation of the paragraph from HSE Explosives Branch
21.	Regulatory Reform (Fire Safety) Order
22.	Technical Bulletin 1/1992 Explosives – to be replaced by Operational Guidance Hazardous Materials Incidents
23.	The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 – “The Carriage Regulations”
24.	The Firework (Safety) Regulations, 1997
25.	The Fireworks Regulations 2004
26.	The Merchant Shipping (Dangerous Goods and Marine Pollutants) Regulations 1997
27.	The Pyrotechnical Articles (Safety) Regulation 2010
28.	UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria
29.	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009
30.	Explosives Industry Group – Industry Guide and Code of Practice for the Classification and Labelling of Explosives in respect of The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations 2011
31.	The Identification and Traceability of Explosives Regulations 2010 – The Regulations are applicable from April 2013

SECTION 2

Summary of Generic Risk Assessment 5.7

Explosives

Task – Pre Incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1	Manufacturing and or storage sites	Type of explosives Other hazardous materials Site location eg how close to neighbours	None pre incident	No one pre incident	Liaison with licensing authority to establish site locations Site Familiarisation eg 72(d) inspections site visits, exercises Establish types of explosives that are stored or manufactured Develop as appropriate specific response plans.
2	Transportation by road or rail	Type of explosives carried	None pre incident	No one pre incident	Establish type of explosives that are routinely carried Establish regular travel routes Develop as appropriate specific response plans.
3	Transportation by air or sea	Type of explosives carried	None pre incident	No one pre incident	Establish which explosives are routinely carried Establish regular travel routes Visits to harbours berths where explosives are loaded/unloaded Develop as appropriate specific response plans.

Summary of Generic Risk Assessment 5.7

Explosives

Task – Initial stages of the incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1	Manufacture and/or storage site – explosives ALREADY involved	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Incident command Training/pre-planning Liaison with site management/competent person Action already taken by on site personnel.
2	Transportation – explosives ALREADY involved	Mass explosion Secondary explosions Projectiles Water will NOT extinguish fire	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Incident command Training/planning Liaison with vehicle crews Action already taken by vehicle crews.

Summary of Generic Risk Assessment 5.7

Explosives

Task – As the incident develops

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1	Manufacture and/or storage site – Explosives NOT Involved	Fire Spreading to Explosives *RESULTING IN* Mass explosion Secondary explosions Secondary fires Projectiles	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Familiarisation visits Training/planning Implement specific response plan Liaison with site management/competent person Keep numbers to a minimum Evacuation/exclusion zone Use earth mounds as protective barriers not walls cars etc Ground monitors Prevent fire spreading to explosives.
2	Manufacture and/or storage site – explosives ALREADY involved	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Familiarisation visits Training/pre-planning Implement specific response plan Liaison with site management/competent person Evacuation of EVERYBODY from the hazard zone DO NOT fight fire DO NOT open ISO Containers for 24hrs even if fire extinguished Potential for detonation of explosives post incident.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
3	ISO container storing explosives involved in fire	Mass explosion Secondary explosions Secondary fires Projectiles Hazardous gases	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Training/planning Do not fight fire Evacuation/exclusion zone **Do not open container** for 24hrs even if fire appears to be extinguished.
4	Road or rail vehicle – explosives NOT involved in a fire	Fire spreading to explosives *resulting in* mass explosion Secondary explosions Secondary fires Projectiles	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Training/planning Implement any specific response plan Liaison with crew Documentation/placards Evacuation/exclusion zone Keep number of firefighters to a minimum Ground monitors Prevent fire spread to explosives.
5	Road or rail vehicle – explosives ALREADY involved in a fire	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies	Training/planning Implement any specific response plan Liaison with driver/crew Documentation/placards Keep number of firefighters to a minimum Evacuation of EVERYBODY from the hazard zone Exclusion zone DO Not fight fire.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
6	Military aircraft	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire Radiation HazMats	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies Her Majesty's forces	Training/planning Always obtain expert advice from Her Majesty's forces Evacuation/exclusion zone.
7	Civil aircraft	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Public Personnel from other agencies Air crew	Training/planning Implement specific response plan Liaison with airport fire service Evacuation/exclusion zone.
8	Ship in harbour or inland waterway vessel at berth – explosives ALREADY involved	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire Fall into water	Blast injuries eg organ or hearing damage Burns Death Drowning	Fire and Rescue Service personnel Public Personnel from other agencies Ship's crew	Training/planning Implement specific response plan Liaison with berth operators Exclusion zone Evacuate EVERYBODY DO NOT fight fire Lifejackets NO lone working.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
9	Ship in harbour or inland waterway vessel at berth – explosives NOT Involved	Fire spread to explosives Resulting in: • mass explosion • secondary explosions • secondary fires • projectiles • water will NOT extinguish fire • fall into water • confined spaces	Blast injuries eg organ or hearing damage Burns Death Drowning	Fire and Rescue Service personnel Public Personnel from other agencies Ship's crew	Training/planning Implement specific response plan Keep number of firefighters to a minimum Liaison with berth operators Evacuation/exclusion zone Prevent spread to explosives Ground monitors Use earth mounds as protective barriers not walls cars other boats etc Lifejackets, safety lines, NO lone working.
10	Inland Waterway vessel on canal or river – Explosives NOT Involved in a fire	Fire spreading to explosives *resulting in:* • mass explosion • secondary explosions • secondary fires • projectiles • fall into water	Blast injuries eg organ or hearing damage Burns Death Drowning	Fire and Rescue Service personnel Public Personnel from other agencies Vessel's crew	Training/planning Implement any specific response plan Liaison with crew Documentation/placards Evacuation/exclusion zone Prevent fire spread to explosives Fire fighting from on land Lifejackets, safety lines, NO lone working Keep number of firefighters to a minimum Ground monitors.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
11	Inland waterway vessel on canal or river – explosives ALREADY involved in a fire	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire Fall into water	Blast injuries eg organ or hearing damage Burns Death Drowning	Fire and Rescue Service personnel Public Personnel from other agencies Vessels crew	Training/planning Implement any specific response plan Liaison with crew Documentation/placards Evacuation of EVERYBODY from the hazard zone Exclusion zone DO Not fight fire Lifejackets NO lone working.
12	Royal Navy vessel – In harbour	Mass explosion Secondary explosions Secondary fires Projectiles Water will NOT extinguish fire Radiation Hazardous materials Drowning Confined spaces	Blast injuries eg organ or hearing damage Burns Death Drowning	Fire and Rescue Service personnel Public Personnel from other agencies Her Majesty's forces	Familiarisation visits Joint exercises Training/pre-planning Liaison with the Royal Navy Establish the Royal Navy's priorities Lifejackets, safety lines, NO lone working.

Summary of Generic Risk Assessment 5.7

Explosives

Task – Post Incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1	Post incident	Further explosion due to unexploded explosives	Blast injuries eg organ or hearing damage Burns Death	Fire and Rescue Service personnel Personnel from other agencies	Do not re-enter site If necessary to re-enter DO NOT until site is declared safe by a competent person.