

CHAPTER 3

EXPLOSIVE LEGISLATION AND REGULATION

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3 EXPLOSIVES LEGISLATION AND REGULATION

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NOTE – As regulations and guidance are subject to continuous improvement, the reader should always refer to [DSA 02.OME: Defence Ordnance, Munitions and Explosives \(OME\) regulations](#) for the definitive regulations and guidance.

3.1 INTRODUCTION

This chapter provides the background of the need for regulatory control of explosives and describes the extant regulations. It is recognised that legislation and regulation may change and it should be noted that defence regulations are currently under review with new documents being prepared. The chapter will be updated when the new Defence Safety Authority documents are issued.

Significant aspects of the various regulations are presented, however, for a complete understanding of any specific regulation the relevant document should be consulted.

3.1.1 Explosives Hazards

Explosives materials and devices containing explosives have the capacity to cause harm. When they function they can generate a range of effects that could include blast in air and water, projection hazards, fragments, shock, thermal effects and toxic products. These effects can be used in civil applications such as blasting operations, demolition, special effects and seismology and in military applications for guns, missiles, warheads, military pyrotechnics, demolition stores and safety devices such as aircraft ejection systems. When operated in their design mode explosives have the capacity to cause considerable damage and harm and, in the case of military explosives, are often optimised to cause maximum harm to people and equipment. However that harm can also be realised in the event of an accident involving explosives as the following examples illustrate.

3.1.1.1 Macclesfield Bridge (1874)

In the early hours of October 10, 1874 the barge Tilbury was being towed by a steam tug westwards along Regent's Canal in central London. It had a cargo of sugar, nuts, two or three barrels of benzol and five tons of gunpowder. A naked flame is thought to have ignited benzol vapour and as a result the gunpowder ignited, causing a huge explosion as the barge was passing under the Macclesfield Bridge. The crew were killed, the bridge destroyed and windows were blown out a mile away. The explosion caused such havoc that a detachment of Horse Guards were brought in to help keep order and to ensure safety from wild animals at the Zoo. It was also one of many explosions involving gunpowder that had occurred in the preceding years. At that time

gunpowder manufacture, storage, transport and use were essentially unregulated and this was thought to be a major contributor to the accident.

3.1.1.2 Halifax Harbour (1917)

On the morning of 6 December 1917 SS Mont-Blanc, a French cargo ship laden with high explosives, collided at low speed (approximately 1knot) with the unladen Norwegian vessel SS Imo in Halifax Harbour, Nova Scotia. A fire began on board the French ship that quickly grew out of control. Approximately 20 minutes later Mont-Blanc exploded. The blast was the largest man-made explosion prior to the development of nuclear weapons, releasing the equivalent energy of roughly 2.9 kilotons of TNT. Nearly all structures within an 800-metre (2,600 ft.) radius, including the entire community of Richmond, were obliterated. The blast wave snapped trees, bent iron rails, demolished buildings, grounded vessels, and scattered fragments of Mont-Blanc for kilometres. Hardly a window in the city proper survived the blast. Across the harbour, in Dartmouth, there was also widespread damage. A tsunami created by the blast wiped out the community of Mi'kmaq First Nations people who had lived in the Tuft's Cove area for generations. Approximately 2,000 people were killed by blast, debris, fires and collapsed buildings, and an estimated 9,000 others were injured.

Relief efforts began almost immediately, and hospitals quickly became full. Rescue trains began arriving from across eastern Canada and the north-eastern United States, but were impeded by a blizzard. Construction of temporary shelters to house the many people left homeless began soon after the disaster. The initial judicial inquiry found Mont-Blanc to have been responsible for the disaster, but a later appeal determined that both vessels were to blame. There are several memorials to the victims of the explosion in the North End.

3.1.1.3 USS Forrestal (1967)

On 29 July 1967, the aircraft carrier USS Forrestal (CVA-59) was part of a task force operating in the Gulf of Tonkin off North Vietnam. A 5-inch Zuni rocket loaded in the pod under the wing of an F-4 aircraft was accidentally fired. The warhead crossed the flight deck, struck an A-4 aircraft puncturing the fuel tank, and igniting a fire. Two A-4 aircraft each loaded with two 500 pound bombs and SHRIKE missiles, one A-4 loaded with two 500 pound and two 750 pound bombs, and seven A-4's each loaded with two 1,000 pound bombs were engulfed in the fire.

Sailors on the hangar deck were pushing bombs and missiles over the side of the ship. Chief Aviation Boatswain's Mate Gerald Farrier, took a fire extinguisher and tried to reach a bomb that was already in the flames. It detonated in front of him and the blast and bomb fragments decimated the first wave of fire fighters as they were approaching to fight the blaze. A further series of fires and explosions ensued causing further damage.

The consequence was that 131 servicemen lost their lives with a further 161 injured. The carrier was to return to the US for major repairs and was out of

commission for almost 10 months. 21 aircraft were lost as was a considerable quantity of munitions.

The Forrestal incident was one of several explosive accidents involving US aircraft carriers. These included the USS Oriskany where 44 were killed with 138 injured and the USS Enterprise where 28 servicemen were killed with 314 injured. None of the incidents involved enemy action.

3.1.1.4 Enchede (2005)

The Enschede fireworks disaster was a catastrophic fireworks explosion occurring at the SE Fireworks depot on 13 May 2000 in the Dutch city of Enschede.

The incident commenced with a fire which resulted in a series of explosions. The first explosion had a strength in the order of 800 kg TNT equivalence, while the strength of the final explosion was within the range of 4000–5000 kg TNT. The biggest blast was felt up to 30 kilometres (19 mile) from the scene. A 40-hectare (100 acres, or 0.4 square kilometres) area around the warehouse was destroyed by the blast. The explosion killed 22 people including four firefighters, and injured 947 people. 400 homes were destroyed and 1500 buildings damaged. The fire spread to the nearby Grolsch Beer brewery which had an asbestos roof. It was later demolished and closed. Fire crews were called in from across the border in Germany to help battle the blaze; it was brought under control by the end of the day.

Ten thousand residents had to be evacuated, 1,250 people were made homeless and damages eventually exceeded 1 billion guilders (€454 million).

3.1.1.5 Lessons Learnt

Each of the examples cited were unintended events and were subject to significant post-accident enquiries. They illustrate that when an accident involving explosive occurs the consequences are often very serious. These accidents led to major loss life in the case of Halifax, Forrestal and Enchede, major damage to infrastructure in the case of Halifax, Enchede and Macclesfield Bridge a significant loss of military capability in the case of Forrestal and Halifax and major environmental impact at Enchede. Furthermore these are not isolated incidents. The USS Forrestal incident was one of four serious aircraft carrier incidents involving explosives that occurred over a 20 year period. At a global level there have been many other explosives accidents involving pyrotechnics and military or civil explosives during their manufacture, transportation, storage, use and disposal.

Given the relatively high frequency of such events and the often serious consequences one could conclude that activities involving explosives are high risk. As such there is a need for such activities to be carefully controlled and managed. One of the principle tools to achieve such control is a body of legislation and regulation.

3.2 EXPLOSIVES LEGISLATION

3.2.1 Explosives Acts 1875 and 1923

Following the 1874 explosion at Macclesfield Bridge at the centre of the Nation's capital there was considerable pressure to introduce legislation to control the manufacture, storage, transport handling and use of explosives. The result was the 1875 Explosives Act. This legislation which remained extant for more than a century provided the foundation for explosives law and regulation in the UK and in many other countries. The 1923 Act added some minor amendments to the original 1875 Act.

The Acts required that places where explosives were manufactured, and stored and handled were licensed and that they were constructed and operated in such a way that reduced the risks of explosion. It also introduced the concept of classification of explosives and that the prohibition of particularly hazardous materials. The new licensing regime placed obligations on local authorities and government and introduced an inspection regime to satisfy the Secretary of State that operators were complying with the law. Many of the licensing principles laid down in 1875 are still applicable today and are widely applied around the globe.

The Explosives Act 1875 and 1923 (EA75) and subsequent Orders in Council made under the Acts were not applicable to Crown Establishments with the exception that any person who enters an explosives area without permission, or any person within an explosive area committing an act liable to cause an explosion without proper authority is subject to instant arrest. Hence Crown establishment and in particular those in the Defence domain had to develop and maintain regulations that mirrored the requirements of (EA75).

3.2.2 Other Explosives Legislation

Whilst EA75 served the community well, additional legislation has been enacted since its introduction to further control aspects of explosives activity.

3.2.2.1 Carriage of dangerous goods by road

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (Carriage Regulations 2009) & The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (Amendment) 2011 (Carriage Regulations 2011), together with the European agreement ("Accord européen relatif au transport international des marchandises dangereuses par route", known as ADR) regulate the carriage of dangerous goods including explosives by road and are highly prescriptive. The GB regulations were substantially restructured for 2009 with direct referencing to ADR for the main duties. Amending regulations were made in 2011, mainly to reflect changes to the EU Transportable Pressure Equipment Directive. The Carriage Regulations 2009 (SI 2009 No1348) came into force on 01 July 2009. These regulations are aligned to ADR, A European agreement covering the

classification, packaging, labelling and transport of all classes of dangerous goods. It also details the duties by all participants in the supply chain, including loaders, packers, hauliers' etc.

The Carriage Regulations 2009 place general duties on everyone with a role in the carriage of dangerous goods, and specific duties on those in the transport chain, i.e. consignors, carriers, loaders, packers, etc. The main duties are now covered by a single regulation, namely Regulation 5.

JSP800 Volume 4b details the MOD arrangements in implementing the Carriage Regulations, including class 1 Explosives, and offers advice and guidance to ensure that Units and users remain in compliance with the statutory requirements.

3.2.2.2 Dangerous Substances in Harbour Area Regulations (DSHAR) 1987

Statutory Instrument 37/1987 regulates all classes of Dangerous Goods including explosives (Class 1) for carriage, loading, unloading and storage in harbours and harbour areas. It is supported by an Approved Code of Practice (ACOP). In accordance with DSHAR Regulation 5, the regulations apply to all harbours and harbour areas in Great Britain including any premises or activities in the territorial waters of Great Britain, including any premises or activities in the territorial waters of Great Britain to which the HSW Act applies. The regulations do not apply to nuclear weapons or their components.

The Secretary of State for Defence may, in the interests of national security by a certificate in writing, exempt from all or any requirements or prohibitions imposed by these Regulations:

1. Her Majesty's forces
2. Visiting forces within the meaning of any of the provisions of Part 1 of the Visiting Forces Act 1952
3. Any headquarters or organisation designated for the purposes of the International Headquarters and Defence Organisations Act 1964
4. Any person engaged in the carriage, keeping or supply of any military explosives, if that person is under the direct supervision of a representative of the Ministry of Defence

And any such exemption may be granted subject to conditions and to a limit of time and may be revoked by a certificate in writing at any time.

3.2.2.3 Manufacture and Storage of Explosives Regulations (MSER)

MSER provided guidance on the regulations on the manufacture and storage of explosives. These regulations covered the manufacture storage and handling of all explosives including: blasting explosives; propellants; detonators and detonating cord; fireworks and other pyrotechnic devices; ammunition; and other explosive articles such as airbags and seat belt pre-tensioners.

The activities covered included manufacture of explosives and intermediate products for on-site mixing, storage, and other handling operations such as:

fusing of fireworks; the assembly of fireworks displays from components; filling shotgun cartridges. The regulations did not cover the transport or use of explosives.

MOD had a disapplication from certain parts of MSER, for instance the regulations covering the licensing of premises. DSA 03.OME Part 3 incorporates those aspects of MSER which are applicable and details any alternative arrangements for the MOD where MOD was disappplied.

This regulation was revoked when Explosives Regulations 2014 (ER 2014) were enacted that included similar or identical requirements.

3.2.2.4 The Control of Explosives Regulations 1991 (COER)

The Control of Explosive Regulations (COER) 1991, Statutory Instrument 1531/1991, including amendments made under the Manufacture and Storage of Explosives Regulations 2005 (MSER 2005), placed duties on those with responsibility for explosives.

COER regulated any person (including a body corporate) who acquired; had access to; possession of or control over any explosives, save those explosives specifically exempted from COER. These regulations created a number of requirements, breaches of which constitute offences contrary to section 33 of the 1974 Act. These were:

- Acquiring and or keeping Explosives without an explosive certificate Regulation 7
- Transferring explosives to a person not authorized Regulation 8
- Knowingly employing a "Prohibited Person" (as defined in Regulation 2) Regulation 9(1)
- A "Prohibited Person" acquiring, handling or having control over explosives Regulation 9(2)
- Failure to keep records Regulation 12
- Failure to report loss of explosives Regulation 13.

This regulation was revoked when Explosives Regulations 2014 (ER 2014) were enacted that included similar or identical requirements.

3.2.2.5 The Firearms Act 1968 (as amended)

Since 1968, the act has been extensively amended. Following the Hungerford massacre, the Firearms (Amendment) Act 1988 extended the class of prohibited weapons. Following the Dunblane school massacre, two acts were passed, the Firearms (Amendment) Act 1997 and, after the general election that year, the Firearms (Amendment) (No. 2) Act 1997, which in effect banned almost all handguns. The Policing and Crime Act 2017 brought clarity to aspects of the act, following a recommendation from the Law Commission.

The Act is in several parts and covers:

1. PART I PROVISIONS AS TO POSSESSION, HANDLING AND DISTRIBUTION OF WEAPONS AND AMMUNITION; PREVENTION OF CRIME AND MEASURES TO PROTECT PUBLIC SAFETY
 - a. General restrictions on possession and handling of firearms and ammunition
 - b. Prohibition of certain weapons and control of arms traffic
 - c. Special exemptions from sections 1 to 5
 - d. Prevention of crime and preservation of public safety
2. PART II FIREARM AND SHOT GUN CERTIFICATES; REGISTRATION OF FIREARMS DEALERS
 - a. Grant, renewal, variation and revocation of firearm and shot gun certificates
 - b. Issue etc. in Great Britain of documents for European purposes.
 - c. Registration of firearms dealers
 - d. Supplementary
3. PART III LAW ENFORCEMENT AND PUNISHMENT OF OFFENCES
4. PART IV MISCELLANEOUS AND GENERAL

3.2.2.6 Placing on the Market and Supervision of Transfers of Explosive Regulations 1993 (POMSTER)

The Regulations, Statutory Instrument 2714/1993, were mainly concerned with safety requirements for explosives and security controls on their transfer. They applied to explosives intended for use in the civil sector

The transfer controls required competent authorities to approve movements of explosives within, through and between Member States of the EU. These controls supplemented domestic security controls on acquisition and keeping of explosives in the Control of Explosives Regulations 1991 (COER).

Ammunition regulated or prohibited by virtue of the Firearms Act 1968, pyrotechnics and any explosives which it is shown to be intended for the lawful use by the armed forces or policy of any country are exempt.

Explosives transferred outside the MOD for disposal were not considered to be intended for the lawful use of the armed forces. If the disposal is by destruction, regulation 8, "Transfer of Explosives" applied. If the disposal was by means other than destruction, the explosives are being placed on the market and POMSTER fully would apply.

The main requirements of Regulation 8 were:

- Before transfer of any explosive covered by the Regulations can take place, including movements wholly within GB, the consignee must obtain the written approval of the competent authority for the country where the transfer will terminate -HSE in the case of movements terminating in GB. The recipient competent authority document ('transfer document'), or a certified true copy, must accompany the explosives throughout their journey.

- The person responsible for the transfer, normally the consignor or shipping agent, is required to notify the relevant authorities of the Member States through which the movement will take place to obtain their approval. HSE is the relevant authority for Great Britain.
- No person may supply explosives unless they are satisfied that the recipient has obtained the necessary transfer document.

This regulation was revoked when Explosives Regulations 2014 (ER 2014) were enacted that included similar or identical requirements.

3.2.2.7 Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)

The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. They set minimum requirements for the protection of workers from fire and explosion risks related to dangerous substances and potentially explosive atmospheres.

The key requirements in DSEAR are that risks from dangerous substances are assessed and eliminated or reduced.

The Secretary of State for Defence may, in the interests of national security, by a certificate in writing, exempt:

1. any of Her Majesty's Forces
2. any visiting force
3. any member of a visiting force working in or attached to a headquarters
4. any person engaged in work involving dangerous substances, if that person is under the direct supervision of a representative of the Secretary of State for Defence

from all or any of the requirements or prohibitions imposed by these Regulations and any such exemption may be granted subject to conditions and to a limit of time and may be revoked at any time by a certificate in writing, except that, where any such exemption is granted, suitable arrangements shall be made for the assessment of the risk to safety created by the work involving dangerous substances and for adequately controlling the risk to persons to whom the exemption relates. Further information can be found in JSP 375 Leaflet 56.

3.2.2.8 Identification and Traceability of Explosives Regulations 2010 (ITOER)

The Identification and Traceability of Explosives Regulations 2010 (ITOER) require that explosives for civil uses are uniquely identified and can be traced from the production site through to their final use. This is to help prevent misuse and theft and help authorities trace the origin of lost or stolen explosives. The Regulations implement EC Directive 2008/43/EC. This regulation came into force April 2012.

ITOER applies to every explosive except:

- a. pyrotechnics, for example flares or fireworks
- b. ammunition
- c. unpackaged explosives transported and delivered for direct unloading into the blast-hole, for example in pump trucks
- d. explosives produced in-situ for immediate use
- e. explosives for legal use by the military or police

The main duties of the Regulations are:

- a. Product identification – explosives manufactured in or imported into Great Britain shall be uniquely marked with an alphanumerical code and barcode
- b. Record keeping – any person who manufactures, imports, distributes or acquires or keeps any explosives included in the Regulations must keep a record of the explosives: (c) for a period of 10 years and provide the enforcing authority with contact details so that information in their records can be accessed at any time.

Although MOD is broadly exempt from these regulations the matter of disposal or military sales of items when no longer required by MOD may pose some problems. This matter is being addressed via HSE and the ELR process which is still under review.

3.2.3 Explosives Regulations 2014

3.2.3.1 Introduction

Despite the introduction of MSER the UK explosives legislation remained complex. The HSE therefore worked with stakeholders to review the legislation and to consolidate, modernise and simplify the legislative arrangements. The result was the Explosives Regulations 2014 (ER2014) which came into force on 1st October 2014. ER 2014 consolidated and therefore revoked a number of explosives regulations. It has brought together the requirements of health and safety related explosives legislation into a framework based around common topics such as authorisation, safety, security and placing on the market. As a result of the consolidation the Approved Code of Practice to the Manufacture and Storage of Explosives Regulations 2005 (L139) has been withdrawn. Guidance relating to the security of explosives (HSE Circular 1/2005), and guidance on the placing of civil use explosives on the market (L66) was also withdrawn.

3.2.3.2 Changes to the regulatory framework

The main changes to the regulatory framework include:

- Merging registrations into the licensing system
- Allowing local authorities to issue licences up to 5 years, aligning them with equivalent HSE/police-issued licences.
- Extending licensing to address storage of ammonium nitrate blasting intermediate (ANBI).

- Exceptions for keeping higher hazard and desensitised explosives without a licence have been updated.
- Tables of separation distances have been restructured to better allow for sites with more than one store; the tables have also been revised to cover quantities of explosives greater than 2000k.
- A revised list of explosives that can be acquired or acquired and kept without an explosives certificate from the police.
- The repeal of the Fireworks Act 1951, as its remaining provisions have been superseded by the Pyrotechnic (Safety) Regulations 2010.
- The regulations are supported by a suite of overarching and subsector guidance namely:
 - L150 focuses on safety provisions
 - L151 covers security provisions

3.2.3.3 Safety provisions – L150 Safety Guidance

The guidance in L150 is for anyone who has duties under the safety provisions of the Explosives Regulations 2014 (ER2014) (SI 2014/1638). It is particularly relevant to duty holders such as employers, private individuals and other people manufacturing explosives, storing larger quantities of explosives or storing explosives that present higher hazards or greater risks of initiation. The publication provides overarching technical guidance that will help duty holders to comply with the safety provisions in the Regulations. It also identifies detailed topic-based and specialist guidance and provides background information that supports subsector guidance. It also contains material relevant to enforcing authorities such as local authority trading standards officers, the police, fire and rescue services and other emergency services.

The Guidance sets out general principles of safety in explosives operations. For example high standards of safety need to be in place before explosive operations start and they should remain in place, and be effective, for as long as the explosive operations continue. It is generally difficult or impossible to regain control of an event involving explosives once control has been lost. The safety provisions of ER2014 provide the regulatory framework for identifying and implementing these standards of safety and are based on generally recognised principles of safe operation in the sector.

There are ten general principles underpinning the safety provisions of ER2014. These principles should form part of the arrangements and working practices of anyone undertaking explosives operations:

- People undertaking explosives operations should be competent to carry out their particular roles.
- The particular hazards associated with the explosives should be understood.
- The sources of energy that could cause the explosives to initiate should be identified.

- Appropriate safety measures should be part of a planned and proportionate system of work to control all sources of energy that could cause an initiation.
- Particular care should be taken where an activity involves the application of energy to an explosive to ensure that this is controlled.
- So far as reasonably practicable, the quantity of explosives, extent and duration of exposure to the hazard should be minimised.
- The number of people exposed to the hazard should be limited to the minimum necessary for the activity in hand.
- Precautions should be in place to prevent an explosives event from escalating if an initiation does take place.
- Precautions should be in place to protect people if an initiation does occur.
- Robust systems should be in place to make sure that the necessary precautions are in place and remain effective.

Applying these principles should result in arrangements and safe systems of work which ensure that:

- Suitably qualified and experienced people are engaged in all elements of the explosives operations.
- The properties of any explosives being manufactured or stored are known and/ or understood.
- The hazards presented by the explosives under the conditions of their manufacture or storage will have been identified and assessed.
- Reasonably practicable steps are taken to segregate activities involving explosives from activities that do not involve explosives.
- Wherever reasonably practicable, sensitive explosives are desensitised during processing or storage.
- Explosives are not introduced into multi-stage processes until as late as possible.
- The amounts of explosive present in production and packing areas are limited to that needed for the work in hand.
- People are not exposed to explosives hazards unnecessarily.
- People in close proximity to explosives areas are provided with an appropriate level of protection from harm.
- Changes in processes and procedures are not made until checks have been made to see that all the control measures remain appropriate.

3.2.3.4 Regulatory framework

The safety provisions in ER2014 comprise four whole regulations and some elements of a fifth regulation. 41 The four whole regulations are:

1. Regulation 26 requires anyone manufacturing or storing explosives to take appropriate measures:
 - to prevent fire or explosions

- to limit the extent of fire or explosion including measures to prevent the spreading of fires and the communication of explosions from one location to another
 - to protect people from the effects of fire or explosion
2. Regulation 27 requires people storing explosives to maintain separation distances, identifies the circumstances in which separation distances do not need to be applied, and identifies how separation distances are applied to certain sites that are granted a licence by HSE or ONR.
 3. Regulation 28 requires anyone discarding or disposing of explosives, or who is decontaminating explosive-contaminated items, to ensure, so far as reasonably practicable, that they are undertaking those activities safely.
 4. Regulation 29 prohibits the manufacture and storage and import of pyrotechnics containing sulphur and/or phosphorus mixed with chlorates without the approval of HSE.

Regulation 13 relates to the grant of licences but also includes safety provisions. It allows:

- HSE and ONR to prescribe separation distances at most of the sites they license as an alternative to the 'fixed rules' approach required by regulation 27.
- HSE and ONR to prescribe certain activities that will be subject to the provisions of the licence at most of the sites they license to take account of potential interactions between those activities and the manufacture and/or storage of explosives that takes place at that site.
- All licensing authorities to reinforce the requirements of regulation 26 as they relate to the sale of pyrotechnic articles at a site which is licensed for the storage of explosives.

3.2.4 Security Provisions L151 - Guidance

The security guidance publication is for anyone who has duties under the security provisions of the Explosives Regulations 2014 (ER2014). It is particularly relevant to duty holders:

- Acquiring, keeping and transferring relevant explosives
- Manufacturing, storing, transferring and placing on the market civil explosives
- Manufacturing, possessing or transferring plastic explosives
- It provides background information and detailed specialist and technical guidance that will help duty holders to comply with the security provisions in the Regulations.
- It also contains material relevant to enforcing authorities such as local authority trading standards officers, the police and fire and rescue services.

In relation to the security of explosives the following principles should be considered and applied:

- Explosives have the potential to be misused and that misuse can cause both harm to people, the damage or destruction of property and infrastructure, and disruption to wider daily life.
- In addition, inadequate controls can result in unauthorised people having access to places where explosives are manufactured, stored, kept or used which can increase the likelihood of a fire or explosion occurring through inappropriate actions or behaviours.
- Robust security controls need to be in place before explosive operations start and they should remain in place and be effective for as long as the operations continue.
- The security provisions of ER2014 provide the regulatory framework for identifying and implementing these security controls and are based on generally recognised principles of secure operation in the sector.

2.3.4.3 Regulatory framework

The security provisions in ER2014 can be found in three parts of the Regulations.

1. Part 10 comprises three regulations which relate to the prevention of the unauthorised access to, or acquisition of explosives. The three regulations are as follows:
 - Regulation 30 requires anyone who manufactures, stores or keeps explosives to take appropriate measures to prevent unauthorised people having access to either the places where the explosives are manufactured, stored or kept or to the explosives themselves. It also places a prohibition on people entering; – stores; – buildings used for manufacture; and – sites and places with marked boundaries; without the permission of the licensee and provides a framework for the removal of unauthorised people from the site.
 - Regulation 31 provides a framework for the lawful transfer of relevant explosives.
 - Regulation 32 prohibits the employment of prohibited persons in positions where they handle or control relevant explosives. It also prohibits the prohibited person from acquiring, handling or controlling relevant explosives and restricted substances for their own purposes.
2. Part 11 comprises five regulations which relate to the traceability of civil explosives, the records to be kept for both relevant and civil explosives, and the reporting of losses of relevant explosives. The five regulations are as follows:
 - Regulation 33 provides a framework for the unique identification of civil explosives.
 - Regulation 34 provides a framework for the attribution of manufacturing site codes for civil explosives.
 - Regulation 35 requires records to be kept for relevant explosives and identifies the information that those records should contain. It also

identifies those people who are not required to keep records and states that when regulation 36 comes into force, explosives that are both relevant explosives and civil explosives will only need records to be kept under regulation 36.

- Regulation 36 came into force on 5 April 2015 and requires records to be kept for civil explosives. The regulation also identifies what those records should contain and those people who are not required to keep records of civil explosives.
 - Regulation 37 requires duty holders to report losses of relevant explosives. It provides a framework for the information on the loss that should be reported and requires duty holders to have proportionate systems in place to identify that a loss of a relevant explosive has occurred.
 - Regulation 36 requires records to be kept for civil explosives. The regulation also identifies what those records should contain and those people who are not required to keep records of civil explosives.
3. Part 12 comprises one regulation relating to plastic explosives:
- Regulation 38 prohibits the manufacture, transfer and import of plastic explosives unless they are marked with a detection agent.

3.2.4.1 The MOD and EA2014

The application and extent of EA2014 is limited. A number of regulations do not apply to defence activities:

- Regulations 4,5,11,19,21,22,31,32,35 and 37 do not apply to any explosive nuclear device.
 - Regulation 5 does not apply to the acquisition or keeping of explosives by or on behalf of the Crown, in respect of any explosives which is in premises occupied on behalf of the Crown for, or is intended for use for, naval, military or air force purposes or the purposes of the department of the Secretary of State having responsibility for defence or that of the Secretary of State having responsibility for home affairs or the service authorities of visiting forces or any headquarters or organisation designated for the purposes of the International Headquarters and Defence Organisations Act 1964(a).
- Regulations 6, 7, 12 to 14, 16 to 18, 20, 23 and 27 do not apply to the manufacture or storage of explosives, at any site under the control of the Secretary of State having responsibility for defence, or held for the purposes of a visiting force or headquarters, under a scheme approved by that Secretary of State which:
 - a. provides for their safe manufacture and storage
 - b. prescribes:
 - i. separation distances or
 - ii. a combination of separation distances and other safety measures, which are designed to ensure a standard of safety which is equivalent to that ensured by the separation distances, prescribed by regulation 27 and Schedule 5.

- Regulations 6, 7, 12 to 14, 16 to 18, 20, 23 and 29 do not apply to explosives which, for reasons of public safety or protection of property, are undergoing ordnance disposal by:
 - persons under the direction of a member of Her Majesty's Forces or civilian employees of the department of the Secretary of State having responsibility for defence authorised in writing by that Secretary of State to carry out ordnance disposal.
- Regulations 8 and 39 to 42 do not apply in respect of the transfer of civil explosives to, by or on behalf of, or where, following the transfer, the explosives are in the possession of:
 - The Crown in respect of any civil explosives which are intended for use for the purposes of the department of the Secretary of State having responsibility for defence or that of the Secretary of State having responsibility for home affairs.

3.3 ORGANISATIONAL ARRANGEMENTS

3.3.1 MOD and the Law

3.3.1.1 Introduction

The Secretary of State's (SofS) Policy Statement for Health, Safety and Environmental Protection (HS&EP) applies to everyone and all organisations within Defence and who conduct activities on behalf of Defence, including contractors and MOD's partner organisations. It explicitly identifies Top Level Budget Holders (TLBHs) and Chief Executives (CEs) of both Defence Executive Agencies (DEAs) and the Defence Infrastructure Organisation (DIO) as having responsibilities for meeting this policy for Duty Holding, where appropriate, and compliance with the statutory requirements. In doing so, they are required to describe their management arrangements, including the delegations to those managing activities on their behalf and ensure that at every level, both military and civilian, are suitably and sufficiently trained and provided with relevant information and access to resources to ensure compliance with the Policy Statement.

3.3.2 Director General, Defence Safety Authority (DG DSA)

The Policy Statement and the DSA Charter authorises the Director General, Defence Safety Authority (DG DSA) to:

- a. Empower suitably qualified and experienced Crown servants to regulate HS&EP activity across Defence where it enjoys disapplications, exemptions or derogations from statutory requirements, where there is no statutory requirement or where assurance of specific hazardous activities is required.
- b. Provide independent investigation of accidents and be the primary Convening Authority (CA) for safety-related Service Inquires (SIs).
- c. Be the Defence Authority for HS&EP.

3.3.2.1 DSA01.1

DSA01.1 amplifies the Policy Statement and describes:

- a. The HS&EP legislative framework that applies to Defence and how this is addressed by Defence policy
- b. The responsibilities for the management of HS&EP across Defence
- c. The requirements and arrangements for managing HS&EP risk in Defence
- d. The requirements for checking and reporting HS&EP performance
- e. The requirements for ensuring competence and providing information, training and instruction
- f. The arrangements for regulation, assurance and enforcement of HS&EP in Defence activities

3.3.2.2 A failure in HS&EP management

A failure in HS&EP management has the potential to be detrimental to the health and safety of people, the environment, organisational reputation and ultimately the Department's operational capability. DSA01.1 describes the need for suitable and sufficient HS&EP management arrangements to prevent or minimise adverse work-related health and safety effects, impacts on the environment, organisational reputation and operational capability. The treatment and regulation of such risks are addressed by other DSA regulations and guidance. Legislation SofS's Policy Statement reinforces the requirement for Defence to comply with UK HS&EP legislation, (which includes legislation giving effect to the UK's international obligations). However, as a Department of the Crown, Defence has immunity from prosecution and there are provisions that allow total disapplication, specific disapplication, exemption or derogation from legislation:

- a. A non-application of legislation is where an entire set of statutory requirements do not apply to MOD (e.g. Nuclear Installations Act 1965, Air Navigation Order or Control of Major Accidents Hazards).
- b. Disapplications from specific parts of statutory requirements (e.g. Environmental Protection Act 1990, Explosive Regulations 2014).
- c. Provisions within legislation for exemptions to be granted from specific requirements in recognition of a Defence imperative (e.g. the Health and Safety at Work Act etc. 1974 (HSAWA74) permits the SofS to exempt the Department from any or part of the Act by order "to the extent that it appears to him requisite or expedient to do so in the interests of the safety of the State"). Other H&S regulations alternatively specify the exemption in the interests of national security.
- d. Derogations are a lessening of a statutory requirement for justifiable practical or operational reasons (e.g. smoking in single living accommodation recognises the distinction from temporary accommodation such as hotels and hostels).

3.3.3 Defence Policy and Regulations

The HSWA74 requires employers to “prepare and, as often as may be appropriate, revise a written statement of his general policy with respect to the health and safety at work of his employees”. For these purposes, the SofS is regarded as the employer and complies with this duty through a Policy Statement. For convenience and consistency, this Policy Statement identifies the key requirements and high-level responsibilities for both health and safety and environmental protection and applies to all Defence activities and its personnel.

3.3.4 Disapplication, Exemption and Derogation

Where there is a disapplication, exemption or derogation from UK HS&EP legislation or where Defence activities are conducted overseas (outside of the requirement to respond to host nations’ relevant HS&EP expectations and cooperate with their HS&EP authorities), the Policy Statement requires Defence to put in place arrangements that produce outcomes which are, so far as is reasonably practicable, at least as good as those required by UK legislation. Accordingly, a fundamental responsibility of the Defence Safety Authority (DSA) is to regulate activities against Defence Regulations where there are disapplications, exemptions and derogations from statute. Defence Regulators are to consult with stakeholders on the maintenance of Defence Regulations that are appropriate to their domains: These regulations are to be coherent, consistent and proportionate to the risk and where possible goal-based across HS&EP Regulatory domains.

3.3.5 Influencing Emerging Legislation

It is essential that Defence is aware of, and can appropriately influence emerging legislation and consider the potential for consequential constraints on Defence capability. It is this awareness that safeguards those circumstances where disapplications, provisions for exemptions are granted, or, derogations are sought. Therefore, DSA is to ensure that emerging and changing legislation is tracked and influenced in order to protect Defence interests and when necessary seek disapplications, derogations or the provision for exemptions to be granted.

3.3.6 Responsibilities for Health, Safety and Environmental Protection in Defence Activities

3.3.6.1 As an employer

The Secretary of State for Defence is regarded as the employer for the purposes of complying with the requirements of UK HS&EP legislation and is answerable to Parliament for ensuring Defence complies with this duty through a Policy Statement that identifies the key requirements and high-level responsibilities for HS&EP management. The Policy Statement is the Defence

policy for complying with HS&EP requirements and applies to all Defence activities and its personnel.

3.3.6.2 Permanent Under Secretary (PUS) role

The Permanent Under Secretary is the Department's most senior official for HS&EP matters. The Permanent Under Secretary (PUS) is to ensure that effective management arrangements and resources are in place to achieve compliance with the Policy Statement. PUS is to include HS&EP performance in the Department's holding-to-account process.

3.3.6.3 DG DSA responsibilities

The Director General, Defence Safety Authority DG DSA is responsible, through a Charter from SofS, for the following responsibilities:

- a. Empower suitably qualified and experienced Crown servants to regulate HS&EP for Defence activities in the UK where it has disapplications, exemptions or derogations from UK statutory requirements and Defence activities overseas, outside of the requirement to respond to host nations' relevant HS&EP expectations and co-operate with their HS&EP authorities.
- b. To be the primary Convening Authority (CA) for Service Inquiries (SIs) into safety related fatalities, serious injuries and significant loss of major capability. To support him in this function, DG DSA maintains the Defence Accident Investigation Branch (Defence AIB).
- c. As the Defence Authority for HS&EP setting standards and taking assurance of compliance by TLBs and Defence Executive Agencies where Defence has disapplications, exemptions or derogations through the Defence Regulators.
- d. Providing independent advice to the SofS on HS&EP policy in Defence and evidence-based assurance that the policy is being promoted and implemented in the conduct of Defence activities.
- e. Providing the Defence Board with information on HS&EP matters at each meeting and an Annual HS&EP Assurance Report.

3.3.6.4 DSA functions

In support of these responsibilities, the DSA undertakes three main functions:

- a. DSA Headquarters (HQ) oversees the management of the DSA, supports the CA for SIs, formulates MOD HS&EP policy and provides independent assurance to the SofS.
- b. DSA Regulators regulate: Where Defence has disapplications, exemption or derogation from statutory requirements; overseas; where there are no statutory requirements for unique military activities, and, where statutory requirements exist but the high hazard nature of the activity demands a higher level of Defence assurance.
- c. The Defence Accident Investigation Branch (Defence AIB) conducts impartial and expert 'no-blame' safety investigations across Defence in

support of Service Inquires into safety related fatalities, serious injuries and significant loss of major capability.

3.3.6.5 DSA authority

Defence Authority DSA is one of 18 Defence Authorities, which set rules and standards that TLBs must follow to shape delivery of key functions that cut across Defence and are critical to Defence outputs. In accordance with the MOD operating model, “How Defence Works”, Defence Authorities provide these ‘defence directives’ and TLBs’ compliance with Defence Authority directives are assessed as part of the Defence Performance Framework and in an annual assurance report. As the Defence Authority for HS&EP, DG DSA discharges his responsibility specifically through the publication of HS&EP policy requirements and providing an independent Annual Assurance Report.

3.3.6.6 DSA publications

The DSA sets out rules and standards for Defence HS&EP in three broad levels of publications that is consistent with SofS’s Policy Statement:

- Level 1 – Departmental Policy for Defence HS&EP
- Level 2 – Defence Regulations owned by Defence Regulators
- Level 3 – Guidance on complying with Defence Regulations

Level 2 and 3 publications have been developed to replace the plethora of Joint Service Publications including the former JSP482 MOD Explosives Regulations and JSP520 Safety and Environmental Management of OME over the Equipment Acquisition Cycle, two of the main explosives publications in use in the past decade.

3.3.7 Roles of TLB Holders and Chief Executives

The SofS’s policy statement requires TLB Holders (TLBHs) and Chief Executives (CEs) of both Defence Executive Agencies and the Defence Infrastructure Organisation (DIO) to conduct Defence activities in their area of responsibility (AoR) safely, environmentally responsibly and compliant with legislation. In this latter respect, each TLBH/CE discharges the employer’s legal responsibilities, where they apply, on behalf of SofS. These employer’s duties are further delegated by each TLBH/CE to those with direct responsibility for managing Defence activities within their AoRs. Where an individual has such responsibilities, the TLBH/CE is to ensure that they are suitably and sufficiently trained and provided with relevant information and access to resources to ensure compliance with the Policy Statement.

3.3.8 Explosives Regulation in MOD

3.3.8.1 Introduction

Where Defence has disapplications, exemption or derogation from statutory requirements DSA is required to put in place appropriate arrangements that produce outcomes which are, so far as is reasonably practicable, at least as

good as those required by UK legislation. The Explosive Act 2014 as previously described has a number of disapplications for Defence hence DSA regulators are required to produce regulations that achieve appropriate outcomes.

The Defence Ordnance, Munitions and Explosives Regulator (DOSR) is responsible for regulating the majority of explosives and ordnance related activities in MOD. The explosive regulation for which the DOSR is responsible is found in

- DSA 02 - Defence Ordnance, Munitions and Explosives (OME) Regulations
 - Incorporating, Defence Ranges Regulations and Defence Major Accident Control Regulations (MACR)
- Defence Codes of Practice (DCOP) and Guidance Material
 - DSA 03 - OME Part 1 - OME Acquisition
 - DSA 03 - OME Part 2 - In-Service and Operational Safety Management of OME
 - DSA 03 - OME Part 3 - Ranges
 - DSA 03 - OME Part 4 - MACR
 - DSA 03 - OME Part 5 - Lasers

These Regulatory Publications apply to all personnel at all levels in the MOD who have duties and responsibilities for Health, Safety and Environmental Protection (HS&EP) associated with activities involving Ordnance, Munitions and Explosives (OME) (including Lasers), Ranges and Major Accident Control. These Regulations should be read with reference to DSA 01.1 - Defence Policy for Health, Safety and Environmental Protection.

In addition, the Defence Maritime Regulator (DMR) is responsible for the regulation of explosives on ships and submarines.

This chapter will consider the overarching regulation of explosives across the MOD covered by DSA 02 and DSA 03 – OME parts 1 and 3.

3.3.8.2 DSA 02 - Defence Ordnance, Munitions and Explosives (OME) Regulations

3.3.8.3 Introduction

Under UK legislation MOD is disappplied from parts of the Explosives Act 2014. Where disapplications apply the Secretary of State with responsibility for defence has issued a Policy Statement that requires Defence to put in place arrangements that produce outcomes which are, so far as is reasonably

practicable, at least as good as those required by UK legislation. DSA 02 describes in considerable detail what these arrangements are.

3.3.8.4 Applicability

The regulations, issued by the Chief Inspector of Explosives (MOD), endorsed by the OME Safety and Environmental Stakeholder Committee (OSEC), and under the authority of DSA are produced for the guidance and instruction of all personnel, both Service personnel and MOD employed civilians (including supporting contracted staff), who are concerned with the management, storage, maintenance, inspection, processing, transport, handling and disposal of explosives and explosives storage facilities within the Ministry of Defence.

The regulations are based on mandatory provisions, in the form of legislation, and on the recommendations of the Explosives Storage and Transport Committee (ESTC) and NATO AC326, which set MOD standards and safety principles. The conditions provided by these regulations and such necessary ESTC recommendations are to be treated as the mandatory minimum safety regime that must be applied to explosives in the MOD.

Explosives in this context include all substances, and materiel containing substances, which are classified as Class 1 in the United Nations Recommendations on the Transport of Dangerous Goods.

Management of explosives safety within MOD, for the maritime environment, is a two-stage process. The first stage addresses the intrinsic explosive safety of the Ordnance, Munitions and Explosives (OME) following the process defined in DSA 02 and described elsewhere.

This process is MOD wide, for all environments and is undertaken by the OME Project Team. The second stage is the integration of the OME into a maritime platform and is undertaken following the processes defined in DSA 02 – Defence Maritime Regulations which identifies OME as a key hazard requiring independent safety approval and certification. Naval Authority Explosives (NAEXP) is formally authorised by the Defence Maritime Regulator (DMR) as an authority that is independent of the Platform Duty Holder and Operational Duty Holder and is responsible for providing safety regulation in the area of Shipborne Explosives hazards.

3.3.8.5 Applicability overseas and in operational theatres

In overseas theatres, ports, anchorages, airfields etc. it is the Secretary of State's (SofS) policy that the MOD applies all relevant UK/EU/International regulation or standards where reasonably practicable and, in addition, comply with relevant host nations standards. Where there is ambiguous regulation or apparent gaps against UK legislation or standards, we are to implement management arrangements that produce outcomes that are, so far as reasonably practicable, at least as good as those required by UK legislation. Where there is no relevant host nation legislation, our internal standards aim to optimise the balance between risks and benefits. This does not mean avoiding

risks but managing them responsibly, on the basis of consequence and likelihood. Where advice or direction is given by means of these regulations for peacetime, it is also normally to be applied during war or periods of tension, as to do otherwise may be seen as indefensible in court. Disobedience of Regulations or Infringements of DSA 02 Defence OME Regulations and any other associated regulations by any person will result in appropriate disciplinary action in accordance with MOD civilian or service procedures.

3.3.8.6 Nuclear weapons facilities

When Nuclear Weapons containing conventional explosives are stored, processed and handled in MOD Explosives facilities they will be subject to the conditions of this document.

3.3.8.7 Safety aspects - general

Although there are many kinds of items in service that require special precautions to be taken in their handling and storage, those containing explosives (including pyrotechnic or incendiary substances and certain chemical compositions) form a special class. Additional precautions are therefore essential, not only to preserve their serviceability, but also to provide the minimum practicable/acceptable risk, not only for personnel handling them, but also to other persons and property. It must always be borne in mind that the regulations contained in this publication deal with items that are potentially dangerous.

All persons employed in the custody and handling of explosives, whether in peacetime, periods of tension, or war, are to apply both the spirit and the letter of the regulations.

3.3.8.8 Fundamental principles

The fundamental principles underlying these regulations are:

The function of an explosive, pyrotechnic or incendiary substance or article is to explode or ignite violently. The greatest care is therefore to be taken at all times during storage, handling, transportation, processing, inspection, trials and disposal.

Explosives, even those with similar characteristics, differ in sensitiveness (see 20.2.1) to heat, friction, shock and impact. They also differ in stability under varying climatic conditions, and in their rate of deterioration.

Whilst explosives are designed to be stable, this stability may decrease if they are poorly packaged or stored. Furthermore, any physical or chemical degradation in an explosive, such as could arise if explosives have exceeded their design life, almost invariably leads to greater sensitivity rather than less.

3.3.8.9 Limiting the risk from explosives

To limit the risk it is advised that:

- All facilities used for storing and processing explosives must be licensed as suitable for the intended purpose. The HSE performs this role in the civil sector and CIE (MOD) Licences all explosives areas controlled by the MOD. For an explosives licence to be issued, CIE(MOD), through the offices of the respective IEs, must be satisfied that the facility will generate risks to people that are ALARP.
- In addition to ensuring that MOD explosives facilities are safe, CIE (MOD) must be assured that explosives safety management /with MOD business and operational imperatives. It is essential that, for example, storage capacity is adequate for forecast defence needs that encompass future strategic assumptions and not just day to day business. It has therefore been the custom to exploit fully the maximum licensable potential derived from Quantity Distances (QDs). However, while licensing for future needs and Safeguarding to protect against encroachment to Site Potential are a necessity, under the ALARP principle, it is not permissible to grant a working licence for more than the explosives quantity that can be clearly justified for the prevailing conditions. Experience has shown that the risk associated with individual
- PES (see 3.6.2.1) licensed and operated under normal MOD rules is normally within the Tolerable Region. In the case of large, complex sites, the cumulative risks from individual licensed facilities within the site will generate a higher cumulative risk.
- In order to demonstrate ALARP for processing facilities, it is necessary to keep the quantity of explosives present that hazard people to the minimum. Accumulations of explosives waiting processing return to store, or dispatch after processing are to be kept to a minimum.
- Concurrent processing of two or more munitions should be avoided since the activities of one processing team places its neighbouring team at risk and vice versa. Whenever concurrent processing of munitions is to be undertaken by 2 or more teams in the same process room, it is essential that the HoE provides evidence that appropriate protection has been afforded to all teams.
- The number of personnel exposed to explosives risks must always be kept to the minimum and all avoidable exposure must be eliminated. All personnel nonessential to that activity must be given appropriate protection from fire and explosion and closely controlled by local procedures laid down by the Duty Holder. Where people in fixed ES (see 3.6.2.1), who are necessarily mentioned on the PES (see 3.6.2.1) licence to enable closer safety management, are put at risk, and it subsequently becomes practicable to move those personnel and their activity elsewhere, it is not acceptable to substitute other personnel or another activity to take advantage of the latitude recorded on the licence. Any new need must be justified in its own right with the realisation that new facilities and activities may require, by law and HSE guidance, much higher levels of protection from risk. For multi-role facilities, the need to temporarily remove from risk those personnel not involved in the current operation must be considered even if it is not prescribed explicitly on the licence.

- The prime principle of ALARP is to think beyond pure licensing regulations as a permissioning system and to consider whether the activity could more reasonably practicably be performed in a safer manner. If safety can be practicably improved beyond the rules here prescribed, then a clear duty exists to do so that must be discharged. It is thus not sufficient to rely upon rules that take no account of local conditions that might demand or allow a greater level of safety provision. Therefore, for example, it might be permissible within these rules to place explosives at a reduced QD from people thus increasing their level of risk, but if an alternative location exists where the activity can be carried out at a greater separation distance, despite any perceived difficulties and inconvenience, that greater protection to life must be afforded. In this case however, the risks associated with relocating stocks should also be considered.
- Clearly, while on operations, in times of crisis or war, such action may not be practicable because other far reaching risks may be increased by not affording the best operational solution to site activity. Therefore, through general agreement with the MOD, the HSE has acknowledged that the Defence Imperative should be taken into account in determining what is reasonably practicable to ensure the health and safety of employees and others involved with defence operations and that training directly related to operations. Personnel responsible for safety must look beyond their immediate surroundings and situation to improve safety where local conditions and practicability exists. This is to be thought of as a necessary and mandatory continuous lateral thinking exercise.
- What is reasonably practicable will inevitably be a matter for judgement. However, by 'accepting the risk' Duty Holders must satisfy themselves that, in their professional judgement, their decision is supported by thoroughly researched and balanced arguments that can be expected to hold up before searching scrutiny in a Court of Law. The resulting Explosives Licence is therefore to indicate or cross reference, in as much detail as possible, the factors and constraints governing the authorised NEQ limits and the matters that must be addressed, supervised and reviewed for effective safety management.
- However, it is essential for duty holders to note that although there is a general duty to manage risks so that they are ALARP where, in such cases the regulations are limited to "Shall..." or "Shall so far as is practicable", in some cases legislation places a greater duty than "Shall so far as is Reasonably Practicable". EA2014, for example, in relation to the prevention of fire and explosion, the limiting of the spread of fire and explosion and the protecting of people from the effects of fire and explosion places an absolute duty to take appropriate measures.

3.3.9 DSA 03 - OME Part 4 - MACR

The Control of Major Accident Hazards Regulations 2015 (COMAH) are the enforcing regulations within the United Kingdom of the Seveso II Directive which were developed within the EU following the Seveso disaster in

Italy when significant quantities of Dioxin were released into the environment causing serious harm to the environment and local population.

The regulations are applicable to any establishment storing or otherwise handling large quantities of industrial chemicals of a hazardous nature such as explosives or petrochemicals.

The principal aim of the regulations is to reduce the risks of potential major accidents, such as the Flixborough disaster, that are associated with the handling of hazardous substances. The regulations operate on two levels depending on the establishment's status which is divided into two categories, 'Lower Tier' and 'Upper Tier', determined by the size and nature of the inventory.

Lower tier establishments are required to document a Major Accident Prevention Policy which should be signed off by the managing director. A top tier COMAH establishment is required to produce a full safety report which demonstrates that all necessary measures have been taken to minimise risks posed by the site with regard to the environment and local populations. The penalty for unauthorised storage can be severe and companies unsure of whether the COMAH regulations apply should seek advice from trade associations and local health and safety inspectors.

The COMAH Regulations do not apply to:

- An establishment which is under the control of the Secretary of State for the purposes of the Ministry of Defence;
- A headquarters or organisation designated for the purposes of the International Headquarters and Defence Organisations Act 1964 or the service authorities of a visiting force within the meaning of any of the provisions of Part 1 of the Visiting Forces Act 1952.

In order to fulfil the SofS Policy to “put in place arrangements that produce outcomes which are, so far as is reasonably practicable, at least as good as those required by UK legislation”. The MOD publishes and promulgates DSA 03 - OME Part 4 - MACR. These mirror the civil regulations (COMAH).

3.3.10 DSA 03 - OME Part 1 - OME Acquisition

3.3.10.1 Introduction

DSA 03 comprises the DCOP and Guidance notes for OME Acquisition. It explains the requirements needed to demonstrate that the inherent risks from Ordnance, Munitions and Explosives (OME) are either Broadly Acceptable or Tolerable and As Low as Reasonably Practicable (ALARP) for the MOD, third parties and the environment.

It applies to all OME:

- Ordnance e.g., weapons including directed energy, small arms, delivery platforms including barrels, launchers, and fire systems.
- Munitions e.g., missile, shell, mine, demolition store, pyrotechnics, mines, bullets, explosive charges, mortars, air launched weapons, free fall weapons.
- Explosives e.g., propellants, energetic material, igniter, primer, initiatory and pyrotechnics irrespective of whether they evolve gases (e.g. illuminants, smoke, delay, decoy, flare and incendiary compositions).

It is designed to be used by personnel who are responsible for OME employed by or contracted to the MOD.

It contains the policy and direction about the processes involved and the techniques to be applied throughout the acquisition cycle or Manufacture to Target or Disposal Sequence (MTDS).

3.3.10.2 Defence Code of Practice

The DCOP is aimed at the OME Project Team (OME PT) responsible through the complete OME life cycle. It places specific requirements that are mandatory and must be followed by the OME PT. These requirements fall under a number of headings:

Scope

- Defines the meaning of OME
- Details how the risks for OME systems and their components shall be demonstrated at all stages of the acquisition cycle.
- It makes clear that DCOP does not only apply to weapon systems but applies irrespective of the use the OME. It further makes clear that where assessment identifies environments and stimuli that might jeopardise the safety of OME this information must be passed to Duty Holders.
- Where OME comprises a component of a larger system the interfaces with other parts of the system need to be considered. Hence the OME PT is required to define, agree record and control OME system stakeholders as part of the Through Life Management of the system.

Policy

The policy directive makes clear that it is the OME PT and supplier of the system to ensure that all relevant legislation is identified. A compliance assessment against all applicable legislation shall be undertaken of the OME.

Objectives

The OME PT is directed to comply with a number of objectives:

- To manage the OME Acquisition SEMS integrally with other safety and environmental management processes as part of a system of systems.
- To manage OME inherent safety through all stages of the equipment or system lifecycle, in conjunction with identified Duty Holders.

- To define the roles and responsibilities of authorities and personnel, whether the MOD or acting at the direction of the MOD, involved in the management of OME inherent safety.
- To define how their evidence of OME inherent safety will be documented in the Safety and Environmental Case and its validity maintained.
- To identify interfaces with associated authorities and policies.
- To comply with the requirements of these Regulations.
- To comply with DSA objectives specified through DSA Notices, prior to the issue of formal updates to this policy.

Standards

To comply with SofS's policy, the MOD requires evidence within the Safety and Environmental Case that the management and technical standards adopted by the Duty Holder are consistent with best civil and international best-practice as a minimum.

One of the standards to which MOD is committed is that relating to insensitive munitions. The MOD Policy is:

- "The vulnerability of the munitions in the MOD inventory shall be reduced over time to meet the requirements of STANAG 4439.
- All new munitions requirements shall stipulate compliance with the IM criteria. Agreement from relevant FLC/ODH is required for any noncompliance, either in the requirement definition or in the procurement solution, in addition to justification within the Risk Assessment.
- All in-service munitions shall be kept under review to identify opportunities to achieve IM compliance and thereby reduce risk. Prior to replenishing stock (e.g. mid-life updates, repeat buys, etc.), the procurement authority, normally the DE&S OME PT, shall investigate all options for improving IM compliance. Where improving the IM signature is technically achievable but for performance cost or time reasons, and the OME PTL proposes not to pursue improvements, agreement from relevant FLC/ODH is required.

Implementation

Implementation of the DCOP involves consideration of the scope of activity in relation to phases of the acquisition cycle and phases of the life cycle of the OME system such that:

- Safety management activities shall be initiated at the earliest possible stage in the MOD acquisition cycle. Where procurement follows the traditional MOD acquisition cycle, requirements shall be identified for each successive stage, including the specific Implementation and Assurance activities mandated by the OME regulations.
- At the early stages of a project the OME PT shall produce an OME SEMS, setting safety goals and initiating processes in an auditable trail of evidence that demonstrates compliance with individual goals and processes.

- This evolving body of Safety and Environmental Case evidence shall be used as the basis of successive reviews conducted by both the OME PT and the OSRP at key project milestones throughout the acquisition cycle.
- The processes defined by the OME PT shall follow the principles within the DCOP and shall incorporate sufficient flexibility to cope with projects following both a conventional acquisition cycle and alternate acquisition models, for example Off-The-Shelf procurement or Urgent Operational Requirement (UOR).
- All OME shall be assessed against their MTDS. The MOD safety responsibilities extend across the entire MTDS, necessitating PTs to establish a safety management approach that addresses specific safety issues particular to each stage. The Safety Assessment shall also consider the integration of all elements necessary to deliver the defence capability, taking account of associated equipment and platforms, personnel training, maintenance facilities, tactics and procedures.

Safety Requirements shall be established at the earliest stage in the acquisition cycle by the OME PT in close consultation with the capability sponsor.

Each OME PT shall identify and record safety requirements, in consultation with their Capability Sponsor (CS). Safety assessments shall be initiated at the earliest possible stages of the acquisition cycle, addressing the different issues that arise as the Project matures, or requirements alter, throughout the acquisition cycle.

Initial safety requirements shall be developed according to sound design practice or standards such as DefStan 07-85 , with particular emphasis on specifying those safety requirements arising from safety legislation, regulations, standards and the MOD policy. Where production of the Safety and Environmental Case is contracted out, recognition of contractual requirements shall also be given.

For areas of design that are not regulated, appropriate Subject Matter Experts shall be consulted for advice on best-practice and the availability of standards and procedures appropriate to the requirements selected. Adoption of alternative standards to those usually selected shall be justified within the Safety and Environmental Case.

Requirements shall cover the entire system, throughout its acquisition cycle and across the entire MTDS, with due regard for military effectiveness and the system's Safety and Suitability for Service (S³).

All requirements shall be periodically reviewed to consider the effects of emerging capabilities from new equipment, or the application of new / current military thinking, tactics, techniques and procedures on previous assumptions.

The Safety and Environmental Management System is to be established by the OME PT so that:

- The OME PT's OME SEMS shall be established at the initiation of a Project, and shall be managed, maintained, reviewed and updated through-life.
- The OME PT shall establish a Safety and Environmental Panel (SEP) to manage its SEMS through-life.
- All PTs shall satisfy the requirements of the domain-specific safety regulations relevant to the operating environments for that OME by working within a robust integrated SEMS. For Defence OME Regulations-applied systems, the SEMS shall also provide a description of the PT's system for managing inherent OME safety and complying with the requirements of the regulations. This may be in the form of a stand-alone PT OME SEMS or as an Annex to the main document.
- The content of the PT OME SEMS assumes the existence of an overarching PT SEMS that has been produced to the requirements of an alternative functional safety policy. Where no such document exists, the PT shall develop a comprehensive SEMS to meet the requirements of one, or more, of the domain safety policies.

Allocation of OME Review Category

The level of effort and resources applied to the management of OME safety should be proportional to the complexity of the system and level of risk involved. This shall be determined by the OME PT identifying and assigning an OME Review Category to all OME.

The OME Review Category shall be initially assigned at the earliest possible stage in the acquisition cycle and prior to OSRP assessment, but may change as the project develops and further information becomes available.

The OME Review Category shall also determine the level of review to be undertaken by the OSRP. Systems reviews will be proportional to the risk; therefore Low Risk systems will have a lower level of review than that undertaken for High / Medium Risk systems.

Munitions Life Assessment

Munitions Life Assessment (MLA) aims to promote more effective through-life management of munitions and, as a consequence, the optimisation of munitions' lives.

The tools and techniques of MLA shall be applied to all stages of the MOD acquisition cycle and the MLA principles for Initial Service Life Trials, Service Life Amelioration Methods and In-Service Surveillance (ISS) implemented. The SEMS shall also take due cognisance of the management structures for implementing the MOD MLA policy across the MOD.

Conducting Trials

Conducting trials are necessary to generate evidence to support the Safety and Environmental Case arguments.

Where trials are performed at the direction of the MOD, whether on contractor's premises, UK or foreign ranges or in the service operating environment, the OME PTL (or nominated Duty Holder, including the sponsor) shall have a responsibility for ensuring the inherent OME safety of their equipment under trial, within the boundaries of the operating envelope. Duties Holders are to jointly risk assess any operation outside that envelope. Such trials shall require an OSRP Assurance Statement via an OM.

Safety and Environmental Case Development

DefStan00-56 defines a Safety Case as "A structured argument, supported by a body of evidence that provides a compelling, comprehensible and valid case that a system is safe for a given application in a given operating environment." POEMS (see 19.5) defines an Environmental Case as "A body of evidence that is compiled and maintained throughout the lifetime of a project on its environmental aspects and impacts". In recent years Safety Cases and Environment Cases have been combined together, into a Safety and Environmental Case.

The MOD policy stipulates that a robust body of safety and environmental evidence termed a Safety and Environmental Case shall support all equipment operated by or at the direction of the MOD.

The overall safety of weapon systems shall follow the hierarchical approach by assessing the interaction of all systems with the potential to influence the inherent OME safety, including safe operation and suitability for use. The OME PT shall prepare a Safety and Environmental Case for their system or equipment that complements the higher-level systems or platform Safety and Environmental Cases. The aim is to have a seamless flow of safety information between Safety and Environmental Cases at successive levels, be it equipment, system or platform.

The Safety and Environmental Case shall define the system, its boundaries and its operating environment, with all interfaces clearly identified and effectively managed.

OME Safety and Environmental Case Reports (SECRs) shall be produced periodically and at Key Project milestone (Section 7) in the MOD acquisition cycle from Initial Gate onwards.

As the Project matures, subsequent SECRs shall summarise the results of the formal safety and environmental assessment activities conducted by the OME PT. It shall provide compelling evidence that the OME system complies with relevant legislation and that appropriate OME safety risks are either Broadly Acceptable or Tolerable and ALARP, throughout the MTDS when operated within agreed boundaries.

The SEMS shall articulate those posts that have the authority to sign off residual risks, whether it's the Platform Duty Holder and / or the weapon OME PT, as appropriate. Such approval shall indicate their satisfaction with the

progress of the Safety and Environmental Case and their acceptance of the risks and environmental impacts associated with the project.

Existing OME Safety and Environmental Cases shall be reviewed when changes occur to the modification state; operating environment; or the role of the subject equipment, and the existing arguments justifying the safety claims reassessed.

The OME SECR shall include references to relevant clearances and certificates, as applicable, which support introduction into service including:

- ESTC Hazard Classification
- Explosives qualification.
- Range safety assessments
- Laser safety certification
- IM assessment
- Air carriage clearance
- Aircraft Weapons Air Carriage and Release (Aircraft Self Damage [ASD], Thermal Effects on Airborne Conventional Armament Stores and Equipment [TEACASE] and Aircraft Weapons Ballistic Committee [AWBC])
- Logistic Parachute Delivery Clearance, commonly known as Air Drop Code
- Defence Munitions Approval to Process (ATP) and Approval to Store and Handle Explosives (ASHE)

Risk management

OME PTs shall adopt a risk-based safety management approach to system design and through-life management. They shall demonstrate in their Safety and Environmental Case and SEMS details of their system, its manner of operation, and the operating environments to which it will be subjected. They shall begin implementation of processes that shall identify hazards and provide an assessment of that OME's response to a wide range of credible stimuli at the earliest possible stages of the project. In turn, they shall assess levels of risk presented by the OME and consider reduction of those risks using suitable methods to control consequence and / or probability, and seeking appropriate advice from OME Safety Advisors and Subject Matter Experts. They shall consider the balance between operational benefits and options for mitigation, by avoiding the imposition of inappropriate controls and justify their decisions accordingly.

OME Safety Submission

DSA requires that all OME systems are assured for compliance against these regulations. Assurance of inherent OME safety shall be through the independent review of documentary evidence undertaken by an OSRP

The OME PTL shall present OME Safety Submissions for OSRP review at key project milestones throughout the MOD acquisition cycle. These shall include:

- Initial Gate
- Main Gate
- Entry to Service
- In-Service changes
- Withdrawal from Service

In addition to these main milestones, the OSRP Secretariat shall be notified at any stage of the MOD acquisition cycle where changes affect assumptions about the inherent safety of the system.

The OME SECR shall provide sufficient detail to satisfy the OSRP that relevant legislation and standards are complied with, that residual risks are either Broadly Acceptable or Tolerable and ALARP statements are comprehensive, credible, robust and proportionate.

Where an OME Safety Advisor and / or ISA is appointed by the PT, all relevant conclusions drawn from advice and / or audit reports shall be included in the OME SECR to provide support to safety arguments and declarations.

The issue status of all OSRP Assurance Statement shall be recorded and monitored for currency.

Appointment of an OME Safety Advisor

Unless the OME PTL can demonstrate that sufficient OME safety competence exists within their PT to fully discharge the responsibilities defined in this DCOP, they shall obtain external specialist advice from a source that can be demonstrated as independent.

Management of Safety Information

As the Safety and Environmental Case includes a 'body of evidence', identifying, obtaining and managing the evidence it is of the utmost importance. The OME PT shall put arrangements in place to manage the identification, obtaining, updating, configuration control and review of safety related documents and information; ensuring that urgent safety related information is made visible to all relevant Duty Holders / Users without delay.

Transferring the Safety and Environmental Case

Where an OME system is to be transferred to another management authority, it shall be the joint responsibility of the existing acquisition and operating authorities to ensure that the Safety and Environmental Case is complete and up to date. The handover and acceptance criteria shall be systematic and documented.

3.4 CLASSIFICATION OF EXPLOSIVES

3.4.1 Background to Classification

Explosives are dangerous goods. It has been agreed by the United Nations (UN) that dangerous goods should be classified so that those handling them can understand the dangers which they pose. This facilitates their transportation across national boundaries. The UN has published a set of model regulations⁽¹⁾. These are used to inform each nation's own legislation to ensure there is a consistent approach to the handling of dangerous goods.

Within Europe, more specifically, the United Nations Economic Commission for Europe (UNECE), 48 Countries (Contracting Parties) have agreed the arrangements for the transportation of dangerous goods by road⁽²⁾ also known as ADR. In accordance with ADR explosives must have been assigned a classification by the Competent Authority of the Contracting Party before they are transported by road and this is regulated in the UK by The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations 2011.

3.4.2 The Process of Classification

'Classification' is a technical process that identifies and considers the hazards posed by explosive substances and articles as packaged for transport.

The Competent Authority of a Contracting Party to ADR must assign the classification of explosive materials before they can be transported by road within Great Britain. The process involves assessing an explosive to determine whether or not there is a danger of fire/explosion that would jeopardise safe transport in terms of:

- thermal stability i.e. the response to heat and flame
- sensitiveness (see 20.2.1) towards mechanical stimuli i.e. the response to impact and friction
- response to dropping an unpackaged article, packaged article or packaged substance from a height of 12 metres.

The final stage of the process is to assign the explosive to – or exclude from – Class 1 of the UN classification scheme for the transportation of dangerous goods by assessing its behaviour in terms of:

- mass explosion of a single package
- propagation potential towards other packages or from a non-packaged article to another
- mass explosion, dangerous projections, radiant heat, violent burning or other dangerous effect when packages are involved in a fire
- hazardous effects outside the package arising from accidental ignition or initiation of contents.

An explosive assigned to Class 1 is given an appropriate UN Serial Number, hazard division and compatibility group, depending on its composition, type, and hazard.

A Competent Authority is a body designated or recognised to carry out duties under transport of dangerous goods regulations. In Great Britain:

- HSE is the Competent Authority for the classification of non-military explosives.
- Military explosives, i.e. explosives under the control of and/or in connection with the execution of contracts for the Secretary of State for Defence are classified by the Defence Ordnance Safety Regulator (DOSR) of the Ministry of Defence.
- The arrangements for the classification of military explosives are set out in DSA 03.OME Part 2 (JSP 482).

Once the Competent Authority has agreed the classification, it issues a Competent Authority Document (CAD). An industry guide provides further details⁽³⁾.

3.4.3 The Role of HSE

As Competent Authority, HSE:

- assigns classification of non-military explosives where a CAD does not exist
- recognises the classification of explosives whose classification has been assigned by the Competent Authority of a country that is not a Contracting Party to ADR
- issues a CAD, which records the classification granted, and any appropriate conditions

HSE lists all GB-classified explosives on the LOCEF database, which can be found on the Explosives Web Community internet site⁽⁴⁾. Registration is required to access the site and access is free.

3.4.4 Classification of Military Explosives

3.4.4.1 The Role of the Defence Ordnance Safety Regulator (DOSR)

DOSR is the UK Competent National Authority for the classification of military explosives. DOSR-TL is delegated as the Ministry of Defence Classification Authority. Classifications awarded by the HSE and the DOSR are normally, but not necessarily, acceptable to each other.

The only exception to this policy is for Serviceable ACA's which have been previously classified for transportation of explosives. The furniture of these containers may be modified to enable on Unit transportation of prepared for use natures e.g. Armed Fire Bottles, Countermeasure Flares etc. These transit containers are to be painted RED and be suitably marked with the contents and

Hazard Division. A transit container may be used for on Unit storage whilst awaiting fitment or disarming.

With the exception of the storage of explosives retained for Research and Development or Evaluation purposes and Bird Control Explosives, all explosives must be classified by the DOSR before they can be stored or transported by the MOD. The DOSR-TL, after review, issues the classifications on behalf of DOSR. These classifications are taken into use immediately.

All explosives stored for Research and Development or Evaluation at Fort Halstead or Porton Down do not require formal classification by DOSR. These explosives must be assessed by appropriately authorised competent persons and allocated a suitable Hazard Division and Compatibility Group prior to storage. For any subsequent movement on, e.g. transport on the public road, the explosives must be classified by DOSR, using either the Temporary or Provisional process. DOSR Classifications are detailed in the Defence Ordnance, Munitions and Explosives (DOME) database. The awarding of a classification does not imply the item is safe to store and transport. The classification is only applicable to items that are assessed as safe to store and transport by a competent person.

It is important to understand that a DOSR classification is not the only requirement to permit storage or transport. Other legal and procedural requirements to enable safe storage and transport are detailed within DSA 02 Defence OME regulations and DSA 02.OME Part 1 (e.g. UN Package Certification and Safety Case Reports). The DOSR classification also guides the correct response by emergency services in the event of an accident.

3.4.4.2 Method of Obtaining a Classification

The DOSR is the only authority in the UK for assessing and classifying military explosives, including those imported for British and Visiting Forces, and foreign munitions for either transshipment to or within theatre, or for information gathering purposes. Military Explosives having HSE or Foreign Competent Authority Certification require classification by the DOSR. It is illegal to transport Military Explosives by road or rail within the UK without DOSR classification.

It is the responsibility of the appropriate MOD Branch or PT sponsoring the Staff Requirement or Main Supply Contract to initiate action to provide the DOSR with all the necessary information to classify the item(s). They should also provide funds for any tests that the DOSR consider necessary for classification.

3.4.4.3 Assigning a Classification

Explosives may be assigned a classification by one of the following methods:

- on the basis of UN test results and information supplied
- by analogy with a similar explosive previously classified by HSE or DOSR
- technical argument through documentary evidence

- by recognising the classification assigned by the Competent Authority of a country that is not a Contracting Party to ADR
- for fireworks that are manufactured in Great Britain or a country that does not have a Competent Authority – UN default classification scheme

The DOSR process of classification of military explosives as packaged (when stowed and transported in such a condition) consists of the allocation of the appropriate:

- HD, as a result of tests or by analogy
- CG
- UN Number and UN Proper Shipping Name selected from the Dangerous Goods List, ('The Orange Book')

The Test Scheme used by DOSR and other competent authorities is that detailed in Part 1 of the UN Manual of Tests and Criteria. The sections concerning military explosives are repeated in NATO AASTP 3 - Manual of NATO Principles for the Hazard Classification of Military Explosives. The UN Test Scheme relates to explosives as presented for transportation, but MOD has extended its use to cover storage. The UN Manual or NATO AASTP must be referred to for details of the Test Scheme and the sentencing criteria, as outlined below at Figure 3-1.

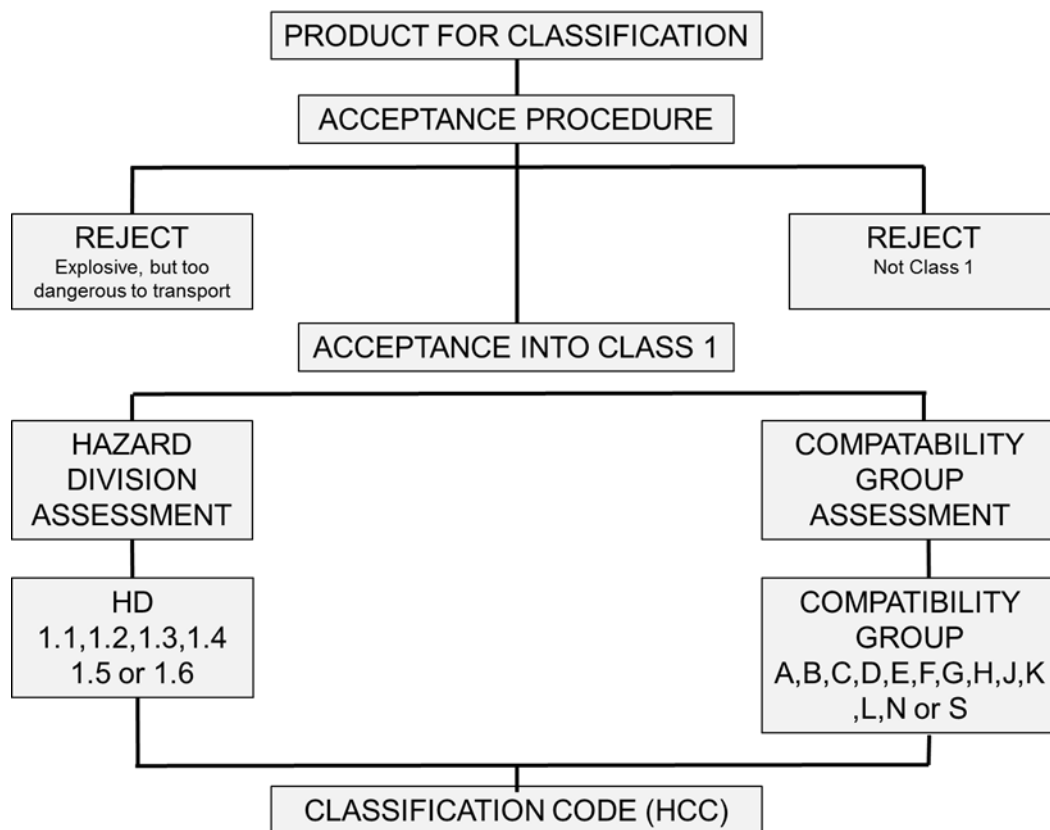


Figure 3-1 Overall Scheme of Procedure for Classifying Substances or Articles in UN Class 1**3.4.4.4 Purpose of the Scheme**

The purpose of the scheme is to assign the classification code which is essential for transportation and, in the case of MOD, for storage. Evidence of the behaviour of explosives in their transportation and storage environment is essential to assign a classification code. Where evidence does not exist then practical tests should be carried out. The UN testing scheme is described in detail at Appendix A of this Chapter. The first group of tests, series 1-4 are to decide if the substance should be accepted into class one whilst the second group, series 5-7, is to determine the hazard division. In the absence of clear evidence then the most onerous classification should be applied. Hence if there is no clear evidence that an item is in HD1.3 then it must be assumed that it is HD1.1.

3.4.4.5 Responsibility for Testing

It is the responsibility of the party requiring classification to provide test results for series 1-4 and 5-7 to the Classification Authority as required. The test results should come from a recognised test authority.

3.4.4.6 Packaging

Care needs to be taken to ensure that classification is determined for each condition in which the explosives are stored and transported. The test results from classification tests may vary depending on whether the explosives are packaged or not and the nature of the packaging. Planning the classification test programme will require close liaison with the Classification Authority to ensure that appropriate classification is assigned depending on the nature of packaging during the explosives life cycle.

3.4.4.7 Types of Classification

There are six types of MOD classification:

1. **Permanent Classifications.** These are intended to cover all in-service military explosives in their service packages, in unit loads, or unpackaged articles in handling devices when stored or transported in such conditions. These classifications are identified by a four figure DOSR Serial Number prefixed by the letter 'P', e.g. P3254.
2. **Temporary Classifications.** These are intended for allocation to military explosives in the development or final disposal stage, remain extant for a specified period up to a maximum of 10 years, and are automatically cancelled at the end of this period. Temporary Classifications may also be used for Foreign Munitions which are only expected to be stored or transported by MOD resources for a limited period. These classifications are identified by a four figure DOSR Serial Number prefixed by the letter 'T', e.g. T2361.

3. **Excluded From Class 1 Classification.** These are intended for articles that satisfy certain conditions and are identified by a four figure DOSR Serial Number prefixed by the letter 'N', e.g. N0025
4. **Provisional Classifications.** These are allocated for the short term storage and one-off transport of military explosives, as defined, during research and development and disposal, normally between MOD sites, but can also be to/from sites under contract to MOD provided the journey begins / ends at a MOD site. Provisional classifications are extant initially for three months. The identifying number for these is determined by the applicant.
5. **EOD Disposal Classifications.** These are awarded to facilitate a need to transport and store EOD arisings prior to final disposal they should be classified in accordance with DSA 03.OME Part 2.
6. **Research and Development (R&D) and Evaluation Classifications.** These are allocated at Fort Halstead or Porton Down only to allow the STORAGE of military explosives undergoing R&D or evaluation (see para 1.1.6). This hazard assessment must be recorded in a register (in a format agreed by DOSR) and retained for audit purposes. This classification CANNOT be used to transport explosives off site.

3.4.4.8 Procedure for Obtaining Classifications

The procedures for obtaining different classifications are set out in DSA 03.OME Part 2. Broadly, permanent, temporary and items excluded from Class 1 must be classified by DOSR whilst provisional, EOD arisings and research explosives can be classified by a competent person with delegated authority from DOSR.

3.4.4.9 Classification of Explosives Belonging to Visiting Forces

Explosives of visiting forces must be classified and marked in accordance with UK legislation. Classifications assigned by foreign authorities must be endorsed by DOSR. The procedure for obtaining endorsement requires information to be supplied in advance to DOSR before any movement takes place.

3.4.5 Other Classification Requirements

3.4.5.1 Classification under the Classification, Labelling and Packaging Regulation

European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures⁽⁵⁾ came into force on 20 January 2009 in all EU Member States, including the UK. It is known by its abbreviated form, 'the CLP Regulation' or just plain 'CLP'. The CLP Regulation adopts the United Nations' Globally Harmonised System on the classification and labelling of chemicals (GHS) across all European Union countries, including the UK.

Explosive substances and articles must also be classified under CLP and requires manufacturers and suppliers to provide their customers with

information about the hazards associated with their products and to package them safely.

3.4.5.2 Classification under Registration, Evaluation, Authorisation & Restriction of Chemicals (REACH)

REACH⁽⁶⁾ is a European Union regulation concerning the Registration, Evaluation, and Authorisation & Restriction of Chemicals. It requires safety data sheets (SDSs) to be provided. REACH is a European system for regulating chemicals imported into the EU in quantities greater than 1 tonne. The detailed CLP and REACH requirements are separate to the explosives classification process.

3.5 EXPLOSIVES LICENSING ARRANGEMENTS

3.5.1 Licensing Principles

Since the introduction of the 1875 Explosives Act it has been a legal requirement in the UK for all sites required to store, handle or process explosives to be licensed. A license is a document that allows the holder to store and/or manufacture explosives. The holder of the license is the person who controls the activities covered by that license such as storage or manufacture and who complies with the conditions of the license.

The license is issued by either, Local Authorities, Police, Health and Safety Executive (HSE) or Office of Nuclear Regulation (ONR) depending on:

- Whether the activity is manufacture or storage
- Whether an explosives certificate from the police is needed to acquire and keep the explosives
- The quantity of explosives
- Whether the separation distances can be met.

In the case of military explosives and MOD facilities the Secretary of State for Defence is authorised to operate his own scheme for Separation Distances (Quantity Distances) and Explosives Licensing.

There may be occasions where, for one reason or another, MOD estate is not licensed by the MOD but by HSE, the Police or Local Authority, and vice-versa. The underpinning intent is to issue the explosives licence to the person carrying out the activity; therefore that person will be accountable for controlling the activity, on a day to day basis; consequently if a person does not have the requisite authority to control the people and activities then they should not be the explosives licensee.

Where a facility is licensed by MOD the relevant MOD Inspector of Explosives will license in accordance with the following principles:

- Explosives buildings, facilities and associated traverse if required, must be constructed to an approved design.

- Where Electrical installations will form part of the building infrastructure then they must conform to the required standard, but they can be to an approval from TA Electrical Safety.
- With certain exceptions, a Lightning Protection System must be installed. Legacy systems are acceptable providing they continue to meet the design and performance criteria applicable at the time of installation, unless legislation or a safety concern requires retrospective action.
- All new explosives buildings are to be commissioned in accordance with ESTC Standard 6 (Requirements for the commissioning, inspection, testing and maintenance of works for explosives facilities in the Ministry of Defence).
- All explosives facilities must be subject to acceptance by the relevant TLB/TFA security service. Any security requirements must be complied with, or where observations allow a HoE to accept a security risk, there must be evidence of such acceptance. All explosives facilities must be subject to acceptance by DFRMO, where DFRMO is the Fire Enforcing Authority. Any requirements of DFRMO must be complied with, or where observations allow a HoE to accept a fire risk, there must be evidence of such acceptance.
- Where DFRMO is not the Fire Enforcing Authority (such as with CCF located in schools) then the TLB/TFA IE is to inform the relevant fire enforcing authority, in writing, to comply with the Regulatory Reform (Fire Safety) Order 2005 Section 42(1)(a). Any requirements made by the relevant fire enforcing authority must be complied with).
- An effective Safety Management System (SMS), appropriate to the explosives activities for which the explosives licences are required, is to be in place.
- There is to be a suitable organisation with the appropriate competences, under the command of the explosives licensee, to operate the SMS and manage the duties required by MoD regulations.

The appropriate Quantity Distances (QDs) should be met. Licences are to be issued on the basis of appropriate protection to people; the underlying principle is that people are to be afforded protection from a fire or explosion and this may be by distance or distance and other safety measures.

Validity of the explosives licence, once issued, is dependent upon continued maintenance of explosives facilities in accordance with ESTC Standard 6; there being no comments restricting or prohibiting the presence of explosives by the security or fire services; no infringements of the QDs; and the continued effective management of the explosives facilities and activities.

Consequences from an unplanned fire or explosion in a PES (see 3.6.2.1), to people within an ES (see 3.6.2.1) external to the PES, can normally be assumed to be at least tolerable if all the Explosives Licences for all the PES on site meet all the normal requirements of the Quantity Distances. Where there is full compliance with DSA 03.OME Part 2 then a Standard Explosives Licence may be issued by the TLB/TFA IE.

Where the requirements of Structural Standards, Electrical Infrastructure, LPS, Fire, Security or Quantity Distances cannot be met, this may not in itself necessarily preclude the issue of an Explosives Licence. Situations may also occur which the prescribed standards do not address. In these cases then a Technical Assessment (TA) or Consequence Analysis (CA) should be made to determine whether the intent of the legislation or regulations is being met and form part of the evidence within a Safety Case (SC).

3.5.2 Technical Assessment and Consequence Analysis

3.5.2.1 Unable to Meet Standard Conditions

There may be various reasons why the standard conditions cannot be met. These may include construction to previous standards; alternative arrangements are already in place; or explosives to be held are less than the minimum assumed by QD tables' minimum separation distances.

3.5.2.2 Choice of Technical Assessment or Consequence Analysis

The TLB/TFA have the option to arrange for a Technical Assessment or a Consequence Analysis (TA or CA) to be conducted by a competent person; this may be someone from within their own chain of command or an external person if the TLB/TFA does not have the competence.

3.5.2.3 The Basic Principle of the TA or CA

The Basic Principle of the TA or CA is to compare the standards that would have been achieved if full compliance with the regulations was met with that that is being achieved in practice. If the TA or CA can demonstrate that the intention of the regulations has been met then this will allow for the authorisation of the explosives licence by the TLB/TFA IE.

3.5.2.4 Failure to Meet Intent of Regulations

If the TA or CA demonstrates that the intent of the regulations has not been met then the licence should not to be issued. If the TLB/TFA still requires a licence then it must comply with the Non Standard Licence procedures.

3.5.2.5 Conditions Imposed on TA or CA

All explosives licences issued on the basis of a TA or CA should refer to the TA or CA and any conditions imposed by the TA or CA should be licence conditions; otherwise the TA or CA assumptions may be invalidated.

3.5.2.6 Infrastructure related TA

Infrastructure related TA will normally relate to either statutory standards or MoD mandated standards. In either case, where the current standard is not being met in practice then the appropriate Technical Advisor should be requested to assess the actual arrangements against the statutory or

mandatory requirements. Particular attention must be paid to any appropriate Approved Codes of Practice (ACoP) or industry best practice.

3.5.2.7 Intent of the Statutory or Mandatory Requirement is Being Met

Where the assessment demonstrates that the intent of the statutory or mandatory requirement is being met, and MoD is in a position to defend itself, then the explosives licence can be issued by the TLB/TFA IE.

3.5.2.8 Continued use of Infrastructure

Infrastructure that has been installed under previous standards, and where there is no breach of safety standards, may continue to be used providing that the performance continues to meet the standards at the time of installation. The exception to this is where legislation, or other safety concerns, may require retrospective action.

3.5.2.9 Explosion Effects CA

Explosion Effects CA must consider the hazards produced in the event of a fire or explosion. These may include:

- Blast
- Primary fragmentation such as from the munitions casing
- Secondary fragmentation such as from the munitions packaging or other munitions
- Debris from the structure or other non-explosives articles present
- Thermal effects from blast or fire
- Toxic effects of gases produced during fire

3.5.2.9.1 Output from the CA

The CA must identify:

- The hazards and level of hazard generated in the event of a fire or explosion
- Any secondary hazards that may be present such as fuel installations etc.
- All people exposed to the hazard and the degree of protection afforded to them
- Whilst the priority is the protection of people, consideration must be given to assets where such assets are critical; their loss may have a strategic impact and be unacceptable.
- The potential consequences to the people and assets exposed to the explosives hazard
- Any other mitigation measures in place

3.5.2.9.2 Comparison of Potential Effects with Full Requirements

The CA must provide a comparison between the potential effects to people and assets exposed to the hazard vs the potential consequences if the full

requirements of the QDs had been met. In order to achieve this it is probable that the effects will need to be modelled. An ESTC approved modelling tool must be used where this is necessary.

3.5.2.9.3 People for Suffering no Greater Harm

Where the CA demonstrates that people exposed to the hazard will not suffer greater harm than that would be expected if full compliance with the QD's/Structural requirements had been met then a Standard Licence can be authorised by the TLB/TFA IE.

The term general public applies to all people, MoD employees, contractors and members of the public who are not involved in the explosives activities for which the licence is required.

3.5.3 Non Standard Licences

3.5.3.1 Issuing a non-standard licence

In principle there should be no Non-Standard explosives licences. However, it may be that the TLB/TFA still requires an explosives licence to support their activity. Depending on the level of residual risk it will be for CIE (MOD) or PUS to determine whether defence will underwrite the risk and therefore allow the issue of an explosives licence.

Where the TLB/TFA believes that in order to meet the Defence Imperative the activity is required, irrespective of the residual risk, and then they must make an application to CIE (MOD), as detailed below. The application must be submitted with sufficient time for adequate scrutiny and possible referral to PUS.

The CA detailed above may require the need to undertake a Quantitative Risk Assessment (QRA) as part of the SC.

The SC may provide a variety of potential scenarios and consequences. The CA will provide an output expressed in terms of Conditional Probability of Fatality based upon the explosion happening; Annual Risk of Fatality for an individual at exposed sites (Individual Risk); and of the surrounding population as a whole (Societal Risk).

A SC must be supported with clear evidence as to the Defence Imperative; what options have been considered; reasons for rejecting options and selection of the preferred option; and the consequences of not being granted an explosives licence.

Where an option exists that meets the standard licence conditions then there will need to be a very compelling argument to support why it has not been taken where:

- The general public are at no greater risk of harm than if they were at the full QD appropriate for the circumstances (PTRD, IBD OR VBD)
- Potential consequences only affect explosives workers and explosives area support workers

- Where the risks, Individual and Societal lie between the Broadly Acceptable and the Intolerable, the Safety Case submitted to CIE(MOD) must be endorsed by an appropriate 1* from the TLB/TFA requiring the activity. The 1* is to have the authority to accept the risks on behalf of the TLB, and confirm that all options have been considered; with reasons as to the appropriateness of the selected option.

Then the TLB/TFA IE may authorise the licence if it has CIE (MoD) endorsement where:

- The general public are at greater risk of harm than if they were at the full QD appropriate for the circumstances
- Where the risks, Individual or Societal, are above the intolerable limit the Safety Case submitted to CIE(MOD) must be endorsed by an appropriate 2* from the TLB/TFA requiring the activity. The 2* is to confirm that all options have been considered; with reasons as to the appropriateness of the selected option. Chap 9 Jan 2013

Then such applications for a licence are to be submitted to CIE (MoD) for comment and then submitted through the TLB/TFA chain of command to PUS for approval.

It is to be noted that any single major industrial incident that may result in 50 or more fatalities overall or 6 members of the general public should be viewed with grave concern. Society is unlikely to tolerate such consequences.

3.5.4 Quantitative Risk Assessment

3.5.4.1 Introduction

Quantitative Risk Assessment (QRA) was introduced into the work of the Explosives Storage and Transport Committee (ESTC) in the early 1990s. A Risk Assessment Study Team (RAST) was later established in the ESTC Support Group to develop the technique, and produced a range of reports in so doing. Using the resulting modelling programmes, a number of studies have now been conducted on a range of MOD explosives areas, and the process has been largely validated. As a result the RAST has been renamed Risk Assessment Team (RAT) and has representatives from each of the Services.

Explosives safety regulations employ Quantity/Distance (QD) rules, based on the likely effect of an accidental explosion. A QRA procedure is used to assist management decisions where there is concern that the QD rules cannot be fully met. QRA estimates the probability of initiations at potential explosion sites in addition to the probability of fatality given that initiation has occurred, and thereby assesses the overall risk to exposed persons. Individual risk is defined as the probability that a single person who is continuously exposed to the stated hazard will suffer a fatal accident during one year. An indication of risks to groups of people whose members may be continually changing (known as societal risk) is produced in the form of a graph of the frequency of accidents that generate N or more fatalities.

Once the results from the QRA are known a judgement can be made as to whether the risks generated are acceptable or tolerable.

The content and form of the QRA are provided in Annex B.

3.6 SEPARATION DISTANCES / QUANTITY- DISTANCES

3.6.1 Introduction

3.6.1.1 Hazards Generated by Initiation

When explosives initiate the hazards generated by the initiation may include air blast, fragments, ground shock, debris and heat which will radiate out from the point of initiation. The closer one is to the point of initiation the more these hazards will be felt. It follows that to protect people or facilities the greater the distance from an explosion the safer one would be. Separating people by distance from explosives has therefore been the principal tool used to achieve their safety and forms a key component in UK civil legislation, MOD regulation, in explosives licensing and in explosives safety management nationally and internationally.

3.6.1.2 Hopkinson-Cranz Scaling Law

The underlying principal is derived from the relationship between the quantity of explosives initiating, the distance from the explosion and the hazard generated by the explosion. The quantity of explosive is related to the hazard by the Hopkinson-Cranz Scaling Law (Equation (3-1).

$$D = Z * Q^{1/3} \quad (3-1)$$

Where: D is the distance in metres; Q is the quantity of explosive; Z is the distance coefficient.

A series of distance coefficients have been agreed internationally by the explosives safety community as representing the distances at which an acceptable level of risk is achieved. They give rise to the Quantity – Distance (QD) rules and tables widely used for explosives licensing and ammunition storage.

3.6.2 Application of Quantity Distances

3.6.2.1 Definition of terms

Before considering the use of these rules and tables there are some terms that require definition:

- A Potential Explosives Site (PES) is any stock of explosives, however or wherever stored (building, stack, vehicle, railway wagon, berth, transit shed etc.), the explosion of which will affect an Exposed Site.

- An Exposed Site (ES) is any facility, service or civilian, exposed to and thus hazarded by the effects of an explosion or fire at a PES. These facilities include:
 - Any stock of explosives, however or wherever stored
 - Process Buildings and explosives workshops
 - Inhabited buildings and places of assembly
 - Public traffic routes, including roads, footpaths, railways, canals and civil aircraft facilities, etc.
 - Other Hazardous Installations, e.g. electrical sub-stations
- Net Explosive Quantity (NEQ). On the basis of assessment of the effects of such an explosives event (e.g. blast and fragment radii), and predictions as to which specified levels of risk obtain in terms of injury or damage, the MOD Explosives Storage and Transport Committee (ESTC) has developed tables of Net Explosive Quantity (NEQ) and associated recommended distances. These tables are known as Quantity Distance (QD) Tables and, together with other ESTC criteria for their use, form the foundation for MOD explosives licensing of Potential Explosion Sites (PES). The QD are based on trials and other data, but are susceptible to uncertainty owing to the variability of the nature of explosions and the incompleteness of the trials data. QD are subject to continuing refinement, as further data becomes available.
- The distances quoted in the QD Tables for HD 1.1 are applicable to quantities of TNT. Where explosives having a significantly more powerful or less powerful effect than TNT are being considered, a 'TNT equivalent' may be used to determine the appropriate QD. TNT equivalence can vary significantly depending on the parameters used to measure the equivalence. CIE (MOD) staff will advise on the appropriate equivalence to be used in any specific situation.

3.6.2.2 Expected Effects to Personnel and Facilities at Different QDs

The expected effects on people and facilities are described detail DSA 03.OME Part 2 and are reproduced at Annex C. The effects will depend on the hazard division or hazard type of the explosives in question.

For an explosion of HD1.1explosives the injury effects would be at:

- $QD\ 8.0Q^{1/3}$ (Process Building Distance) Serious injuries or possible fatalities are likely from debris, firebrands, fragments, or building collapse. There is only a small chance of serious injury occurring due to direct blast effects.
- $QD\ 14.8Q^{1/3}$ (Public Traffic Route Distance):
- $QD\ 22.2Q^{1/3}$ (Inhabited Building Distance). Injuries are unlikely as a direct result of blast effects, but could occur due to glazing fragments and flying/falling debris.
- $QD\ 44.4Q^{1/3}$ (Vulnerable Building Distance). Injuries are unlikely as a direct result of blast effects. Injuries that do occur will be caused principally by falling glass.

For an explosion of HD1.2 Explosives the injury effects would be:

- The total fragment/debris hazard at IBD would not be expected to exceed one potentially lethal fragment ($>80 \text{ j}$) per 56 m^2 of ground area at the surface. It should be noted that the hazard is generated over a significant time period, generally in excess of one hour after the initial explosive event, and is not generated instantaneously as in the case of HD 1.1.
- For an explosion of HD1.3 Explosives the injury effects would be based on a thermal dose criterion of 62.8 kJ/m^2 . It is anticipated that occupants of traditional UK types of inhabited buildings would not suffer injury unless standing in front of a window. Such personnel, and any personnel in the open, are likely to experience reddening of any exposed skin areas.

3.6.2.2.1 Building Damage Levels At Exposed Sites

The damage levels likely to occur to an ES (see 3.6.2.1) of conventional construction from an explosion of HD 1.1 at a PES (see 3.6.2.1) for different QDs are as follows:

- $\text{QD } 2.4\text{Q}^{1/3}$ Buildings not designed to resist the blast loading will almost certainly suffer complete demolition.
- $\text{QD } 8.0\text{Q}^{1/3}$ (PBD) Buildings not designed to resist the blast loading will probably suffer severe damage. Direct initiation of stored explosives is unlikely, but communication of the explosion as a result of fire could occur.
- $\text{QD } 22.2\text{Q}^{1/3}$ (IBD) Buildings not designed to resist the blast loading should suffer only minor damage, mainly to glazing, lightweight cladding, etc.
- $\text{QD } 44.4\text{Q}^{1/3}$ (Vulnerable Building Distance (VBD)) Buildings not designed to resist the blast loading are likely to suffer only superficial damage to large panes of glass and other lightweight cladding.

3.6.2.3 Separation Distances

The Explosives Act of 2014 does not use the QD terminology but instead uses the term “Separation Distance” and requires that “every person who stores explosives at a site must ensure that the relevant separation distance prescribed in Schedule 5 of the Act is maintained between a store and a building or other place to which that Schedule applies”. The Schedule specifies the different sorts of location which could be at risk in the event of an explosion. These are grouped into Classes of protected locations which in MOD parlance are regarded as exposed sites. A full description of the classes is provided in Schedule 5. Tables within Schedule 5 show the distances that these protected locations must be from a range of potential explosives sites containing different quantities of explosives as shown in Figure 3-1.

Table 1: Hazard Type 1 explosive in a brick-built mounded store								
<i>1</i> <i>Quantity of</i> <i>explosives</i> <i>(kg)</i>	<i>2</i> <i>Class A</i> <i>distance</i> <i>(m)</i>	<i>3</i> <i>Class B</i> <i>distance</i> <i>(m)</i>	<i>4</i> <i>Class C</i> <i>distance</i> <i>(m)</i>	<i>5</i> <i>Class D</i> <i>distance</i> <i>(m)</i>	<i>6</i> <i>Class E</i> <i>distance</i> <i>(m)</i>	<i>7</i> <i>Class F</i> <i>distance</i> <i>(m)</i>	<i>8</i> <i>Class G</i> <i>distance</i> <i>(m)</i>	<i>9</i> <i>Class H</i> <i>distance</i> <i>(m)</i>
0.1-25	33	50	100	100	100	50	9	18
25-30	33	50	100	100	100	50	9	18
30-40	34	51	103	103	103	51	9	18
40-50	35	53	106	106	106	53	9	18
50-60	37	55	110	110	110	55	10	22
60-70	37	56	111	114	114	57	10	22
70-80	38	57	113	118	118	59	11	22
80-90	38	58	115	121	121	61	11	22
90-100	39	59	118	125	125	63	11	22
100-150	43	64	128	142	142	71	13	27
150-200	46	70	139	156	156	78	14	27
200-250	50	75	150	169	169	85	16	30
250-300	54	80	161	170	170	85	16	30
300-350	57	86	172	172	172	86	18	33
350-400	61	91	183	183	183	92	18	33
400-450	64	97	193	193	193	97	19	36
450-500	68	102	204	204	204	102	19	36

Figure 3-1 Example of a Quantity-Distance table

It can be seen that for 55 kg of explosives in this brick built store a vulnerable building, dwelling or vulnerable building should be at least 204 metres away to remain safe. Less vulnerable specialist explosives buildings such as those in classes G and H can be located significantly closer to the potential explosives site.

3.6.2.4 Site Design and Building Construction

The QD and Separation Distance approach is essential in the design and construction of explosives facilities. It determines the construction of buildings that may be either or both PES and ESs. Their detailed construction will determine the level of protection they afford to people and any explosives present in the building and will also determine the nature of the hazard that they represent as a potential explosives site. DSA 03.OME Part 2 contains details of the construction of buildings associated with military explosives. Schedule 5 of the explosives act 2014 also illustrates how separation distances vary depending on the nature of the building containing the explosives and sort of explosives that they contain.

3.6.2.5 Other Uses of Quantity Distances

Quantity Distances have wider application to above ground explosives sites:

- Above Ground Storage for Marshalling Yards, Transit and Staging Facilities
- Military Explosives in Naval or Military Ports

- Storage and Loading/Unloading of Aircraft Explosives Held Forward on Airfields
- Underground Storage
- Mutually Hazardous and Other Non-Explosives Buildings and Facilities in Relation to Potential Explosion Sites
- Criteria for Disposal Grounds Co-located with Explosives Areas.

3.7 SAFEGUARDING

3.7.1 Introduction

3.7.1.1 Explosives Safeguarding

Explosives facilities are a potential hazard to persons and to property. Accordingly, in order to minimise these hazards should an explosion occur, it is necessary to site such facilities at prescribed Quantity Distances from buildings, roads, railways or places frequented by persons both within and without an enclosed explosives facility. These QDs frequently extend beyond the site boundary. To ensure that MOD explosives, and other essential defence installations, are not compromised by civil encroachment of private or public development within the prescribed quantity distances, maps limiting such development are lodged by Defence Infrastructure Organisation (DIO), via the Office of the Deputy Prime Minister (ODPM) and Department of Transport, Local Government and the Regions (DTLR), in England, the Scottish Executive in Scotland, and the Welsh Assembly in Wales, with the Local Planning Authority (LPA). This process is known as Explosives Safeguarding.

3.7.1.2 Explosive Safeguarding Maps

Under the arrangements described below, the IE's are responsible for the production of the Explosive Safeguarding Maps (ESMs).

3.7.1.2.1 Types of ESM

There are two types of ESM:

1. REGISTERED – Where part of the SG area falls outside the MOD boundary and the ESM is registered by DIO with the LPA.
2. UNREGISTERED - Where the SG area lies entirely within the MOD boundary, thereby only blighting MOD property so does not require registering with DIO or the LPA.

3.7.1.3 Safeguarding Direction Orders

From these ESMs DE (safeguarding) produce the Safeguarding Direction Orders (SDOs) which are issued, complete with the statutory direction to consult, to the LPAs which are responsible for development on land which adjoins those MOD sites. This is necessary to safeguard certain essential installations, of which explosives facilities form just a part (indeed, SDOs for

military airfields are in fact mostly concerned with the Safeguarding of the operational flying criteria). The initiation of changes to those elements of the map which deal with the prevention of civil encroachment to licensed explosives facilities are, in the MOD, the responsibility of the appropriate IE. DE issues the final editions of the Safeguarding Direction Order Maps and is directly and centrally responsible for the administration of Safeguarding on behalf of the MOD.

3.7.2 Safeguarding in Practice

3.7.2.1 Safeguarding legislation

The Town and Country Planning Act allows the MOD to safeguard areas by means of individual Directions which require planning authorities to notify DIO of planning applications for development within certain defined areas as shown on the Explosives Safeguarding Direction Order Maps(SDO). Statutory Safeguarding does not in itself impose restrictions on development. It does not go beyond placing on a LPA a statutory obligation to consult and to take into account any representations made by the MOD. The main features of the Safeguarding legislation are:

- Consultation with MOD by the LPA before planning consent is given
- Consultation requirements are illustrated on the SDO.

3.7.2.2 DO becoming valid

When MOD wishes to have a site safeguarded it informs DIO who issue a map in the form of a Direction Order (DO) to the relevant National Authorities. The DO becomes valid when National Authorities issue the DO to the relevant Local Planning Authority (LPA). The LPA are required to consult MOD, through DIO, before the LPA decides to approve development in the restricted areas denoted on the map.

3.7.2.3 DIO approval of development

When development is proposed within the restricted area MOD will be consulted and the proposal may be dealt with by DIO. Some cases will be referred to the relevant Inspector of Explosives and to other specialist advisors who will advise DIO. DIO then agrees to the development in full, in part or objects to the development. The decision is subject to appeal and may involve a public inquiry at which point MOD will need to present a robust case in support of its objection.

3.7.2.4 Safeguarding contractor sites

Safeguarding also applies to sites that are a strategic MOD asset operated by a Contractor under HSE explosives licensing where MOD capability would be affected if encroachment were allowed. The HSE licences granted are to be considered "Strategic" Licences and are solely for the purpose of establishing a MOD explosives safeguarded area. For sites where the HSE licence the facility

a “HSE safeguarding map” is required to be lodged with the LA. Consideration should be given to the area covered by this map and where possible the MOD safeguarding map should be made to fit this area.

3.7.2.5 Other safeguarding requirements

It is not only explosives that could present a risk to personnel around an MOD facility. Gun and rocket firing could present a significant source of risk. However such Directional Weapons Safety zones do not attract the same statutory protection as safeguarding. Nevertheless it could be a significant consideration in the development of areas within and around MOD installations. Maps that illustrate the danger areas are required to be produced at relevant sites and approved by the HOE and endorsed by the relevant IE inspector.

3.7.3 The Importance of Safeguarding

3.7.3.1 Failures of Safeguarding

The Safeguarding of explosive facilities is crucial to the continued operational effectiveness of a site and although the statutory system of consultation ensures that the majority of intended developments come to the notice of the MOD, the mechanism is not fool proof. The reasons for this are essentially threefold:

- Local authorities may occasionally, through error, omit to acquaint the MOD about local planning applications.
- The LPA overview maps cannot be amended quickly in order to reflect any changes made to the Safeguarded areas brought about by major changes in Explosives Licences through extensions to explosives facilities.
- Landowners may execute development without first seeking planning permission from the LPA.

3.7.3.2 Head of Establishment role in safeguarding

HoEs are to ensure that the procedures, which are intended to maintain the integrity of explosives facilities and to prevent encroachments of the Safeguarded Areas, are complied with in full. In particular, the monitoring process detailed is to include a regular physical inspection of the Safeguarded zones to check, in so far as is reasonably practical, that no encroachments have occurred.

3.8 REFERENCES

- [1] UN Recommendations on the Transport of Dangerous Goods - Model Regulations Twentieth revised edition, United Nations (2017).
- [2] European Agreement concerning the International Carriage of Dangerous Goods by Road, United Nations (2017).

- [3] Industry guide and Code of Practice on the carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (as amended) (CDG).
- [4] Health and Safety Executive Web Communities, Explosives Group. Available at: [Explosives Web Community](#) (Accessed December 2017).
- [5] European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP Regulation) January 2009. Available at: [CLP](#) (Accessed December 2017).
- [6] Registration, Evaluation, Authorisation & restriction of Chemicals (REACH) Regulation. Available at [REACH](#) (Accessed December 2017).

Appendix A A Brief Description of the Purpose and Types of Tests Called for in the UN Classification Test Scheme

A.1 Test and criteria for acceptance into class 1

The tests for acceptance in UN Class 1 are grouped into four series of tests (further tests relate to the determination of the correct Hazard Division (HD)).

The numbering of these tests, and the tests to determine the correct HD, relates to the sequence of assessing results rather than the order in which the tests are conducted. Nevertheless it is important for the safety of experiments that certain preliminary tests using small quantities be conducted first, before proceeding to experiment with larger quantities. The result of such preliminary tests may also be used in the classification procedure.

The tests and sentencing criteria are fully detailed in the UN Manual of Tests and Criteria, to which reference should always be made. A brief description of the tests and their purpose is given below.

A.1.1 Acceptance tests

Test Series 1: These tests are applied to substances and designed to answer the question “Is it an explosive substance?” and these consist of three types of tests, as follows:

1. Type 1a. A shock test with a defined booster and confinement to determine the ability of the substance to propagate a detonation. JSP 482 Edition 4 Classification of Military Explosives For Storage and Transport Chap 4 Annex B Jan 2013 Page 2
2. Type 1b. A test to determine the effect of heating under confinement.
3. Type 1c. A test to determine the effect of ignition under confinement.

Test Series 2: These tests are applied to substances and designed to answer the question “Is the substance too insensitive for acceptance in Class 1?” Test Series 2 trials are essentially the same as those for Test Series 1. Series 2 tests and Series 1 tests have different pass/fail criteria, and consist of three types of tests as follows:

1. Type 2a. A shock test with defined initiation system and confinement to determine the sensitivity to shock.
2. Type 2b. A test to determine the effect of heating under confinement.
3. Type 2c. A test to determine the effect of ignition under confinement.

Test Series 3: These tests are applied to substances and designed to answer the question “Is the substance too hazardous for transport (in the form in which it is tested)?” This Test Series consists of four types of tests as follows:

1. Type 3a. Tests to determine the sensitiveness (see 20.2.1) to impact.

2. Type 3b. Tests to determine the sensitiveness to friction (including impacted friction).
3. Type 3c. Tests to determine the thermal stability.
4. Type 3d. Tests to determine the response to flame (i.e., the ease of deflagration to detonation transition in small quantities when unconfined).

Test Series 4: These tests are applied to packaged and unpackaged ammunition and to packaged/unpackaged explosives and designed to answer the question “Is the article, packaged article or packaged substance too hazardous for transport?” This Test Series consists of two types of tests as follows:

1. Type 4a. Tests to determine the thermal stability of packaged substances, packaged articles and unpackaged articles.
2. Type 4b. Tests to determine the effect of dropping the packaged substances, packaged articles or unpackaged articles from up to 12 metres. There is a special test for liquids.

A.2 Tests and criteria for assessing hazard divisions

After making sure that the substance or article is in Class 1, a further series of tests related to the determination of the correct HD (Tests Series 5, 6 and 7) is undertaken as appropriate. A brief description of the tests and their purpose is given below.

A.2.1 Tests to determine the Hazard Division

Test Series 5: These tests are applied to substances and designed to answer the question “Is it a very insensitive explosive substance with a mass explosion hazard?” Any candidate of HD 1.5 must pass all the following types of test:

1. Type 5a. Shock tests that determine the sensitivity to detonation by a standard detonator
2. Type 5b. Thermal tests that determine the tendency of transition from deflagration to detonation. .
3. Type 5c. Tests to determine if the substance, when in large quantities, explodes when subjected to a large fire. Classification of Military Explosives JSP 482 Edition 4 For Storage and Transport Jan 2013 Chap 4 Annex B Page 3
4. Type 5d. Tests to determine if the substance ignites when subjected to an incendiary spark (i.e., it is the intention to exclude easily ignitable substances, such as black powder, from HD 1.5).

Test Series 6: These tests are to determine the correct HD (from 1 to 4) to be applied to packaged and unpackaged ammunition and to packaged/unpackaged explosives. Test 6a and Test 6b are normally carried out at least three times unless explosion of the entire contents occurs earlier. Test 6c is normally performed once only. However, if the wood or other fuel used for the fire is all consumed leaving a significant quantity of unconsumed explosives

substance in the remains or in the vicinity of the hearth, consideration should be given to performing the test again using more fuel or a different method to increase the intensity and/or duration of the fire. Test 6d is normally carried out three times, in different package orientations, unless a decisive (negative) result is observed earlier. If the results of the recommended number of tests do not enable the Hazard Division to be determined, the number of tests is increased. The four types of test are as follows:

Type 6a (Single Package Test). Test on a single package for the purpose of determining:

- Whether initiation or ignition in the package causes burning or explosion and whether burning or explosion is propagated in the package,
- In what way the surroundings could be endangered by these effects.

Type 6b (Stack Test). Test on a stack of packages of ammunition or explosives, or unpackaged ammunition/explosives for the purpose of determining:

- Whether burning or explosion in the stack is propagated from one package to another, or from one unpackaged ammunition article to another,
- In what way the surroundings could be endangered in this event.

Type 6c (External fire (Bonfire) Stack Test). Test on a stack of packages of ammunition or explosives, or of unpackaged ammunition or explosives for the purpose of determining:

- How the packages or unpackaged ammunition/explosives in the stack behave when involved in an external fire simulating a realistic accident,
- Whether and in what way the surroundings are endangered by blast waves, heat radiation and/or fragment projection.

Type 6d (Unconfined package test). Test on an unconfined package of explosive articles to which special provision 347 of Chapter 3.3 of the Modal Regulations applies, to determine if there are hazardous effects outside the package arising from the accidental ignition or initiation of the contents.

Test Series 7: These tests are applied to articles to answer the question “Is it an extremely insensitive article?” Any candidate, including explosive substance(s), for HD 1.6 (articles, explosives, extremely insensitive (EEI)) must pass all applicable Test Series 7 tests:

- Type 7a. Shock test to determine the sensitivity of the explosive substance to detonation by a standard detonator.
- Type 7b. Shock test with a defined booster and confinement to determine the sensitivity of the explosive substance to shock. JSP 482 Edition 4 Classification of Military Explosives For Storage and Transport Chap 4 Annex B Jan 2013 Page 4
- Type 7c. Test to determine the sensitivity of the explosive substance to deteriorate under the effect of an impact.

- Type 7d. Test to determine the degree of reaction of the explosive substance to impact or penetration resulting from a given energy source.
- Type 7e. Test to determine the reaction of the explosive substance to an external fire when the material is confined.
- Type 7f. Test to determine the reaction of the explosive substance in an environment in which the temperature is gradually increased to 365 °C.
- Type 7g. Test to determine the reaction to an external fire of an article that is in the condition as presented for transport.
- Type 7h. Test to determine the reaction of an article in an environment in which the temperature is gradually increased to 365 °C.
- Type 7j. Test to determine the reaction of an article to impact or penetration resulting from a given energy source.
- Type 7k. Test to determine if an article will detonate a similar item adjacent to it that is in the condition as presented for transport.

A substance intended for use as the explosive filling in an article of HD 1.6 should be tested in accordance with Test Series 3 and Test Series 7. Test Series 7 substance tests should be conducted on the substance in the form (i.e., composition, granulation, density, etc.) in which it is to be used in the article.

An article being considered for inclusion in HD 1.6 should not undergo Test Series 7 until after its explosives filling has undergone Test Type 7a to Test Type 7k to determine whether it is an extremely insensitive detonating substance (EIDS).

To determine whether the article with an EIDS filling is in HD 1.6, Test Type 7g to Type 7k need to be completed. These tests are applied to articles in the condition and form in which they are to be stored and transported, except that non-explosive components may be omitted or simulated if the competent National Authority is satisfied that this does not invalidate the results of the test.

Appendix B QRA Reports

B.1 Content and form of a QRA report:

1 Site Description

The purpose and outline arrangement of the site is described.

2 Management Standards

Management and technical standards are subject to regular technical inspections, often involving also an Explosives Auditor from Directorate of Safety, Environment and Fire Policy (DSEF Pol), to which ESTC reports. Any audit made by the Health and Safety Executive (HSE) is also noted.

3 Description of Method

Assessments may be made at a basic level (Level 1) or a higher level. Level 1 follows a standard mechanism; higher levels introduce more specialised methods where unusual problems have to be examined. The Level 1 assessment method is based on an estimate for the frequency of initiation per Potential Explosion Site (PES) per year, taking a standard storage category for each store. In the case of a Process Building (PB), an additional frequency contribution is added. Further contributions to this basic frequency are made to include the probability of external hazards (aircraft crash, flood, lightning, and nearby hazardous installations). Finally, the probability of ignition by communication from neighbouring buildings is included. The total frequency of initiation is then combined with fatality predictions from a suite of consequence models (for blast, weapon fragments, building debris and thermal radiation) to produce probabilities of fatality. These are expressed in terms of individual and societal risk. The computations are performed using a programme (RISKWING) developed by AEA Technology. QRAs estimate the maximum risk generated by explosives areas, based on a range of assumptions. They also address the maximum quantities of explosives permitted by the Explosives Licence for each PES. A second assessment may be made based on the actual holdings on a particular day.

4 Exposed Sites

With the agreement of the local site management, a number of exposed sites (ES) are chosen for the assessment to represent the locations at highest risk, usually those recorded in the explosive limit licences. ES are usually both on the site and external to it. Details are entered into annexes. Also shown, for each ES, are the number of workers, residents and those exposed to transient risks, and the fraction of time they are likely to spend exposed, indoors and outdoors.

5 Potential Explosion Sites

Examples of PES are explosive store houses (ESH), process buildings (PB), hardened aircraft shelter (HAS), forward weapon store (FWS), road and rail

transfer points, road staging and rail marshalling areas, etc. Annexes show each PES by its number, type and length of building, NEQ and HD of the explosive for which it is licensed, the date of the licence, and the map co-ordinates.

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Confirmation is sought that storage rules are closely set out in the licences and operating procedures of the site under survey.

6 Site Co-ordinates

The site co-ordinates used in a RISKWING study are normally taken from Ordnance Survey maps, though they may be superimposed. They are taken into the ES and PES tables in the various annexes. The areas containing certain ES are divided into fine grids to give more accurate inter-building distances and facilitate the modelling.

7 Basic Initiation Frequency

Basic initiation frequencies are derived from the Level 1 method and entered for each PES in the PES annex. No account is taken of PES licensed only for HD 1.4, because of the very limited effects outside the building which are likely to follow from any accident. In buildings containing more than one HD, the highest is used for the assessment, the initiation frequencies being based on the greatest possible figure for munitions that might be held. Thus the worst credible event is assessed, even though in practice the management of storage always tends to reduce the frequency noticeably. The PBs, HAS, FWS, road and rail transfer points, road staging and rail marshalling areas, etc. are shown in the same way.

8 External Hazards - Contributions to Initiation Frequency

The following contributions are considered for addition to the basic initiation frequency, in line with an External Hazards Guidebook. The frequency contribution for each PES is entered in the PES annexes:

- Lightning. All PES where a lightning protection system (LPS) installed to BS 6651 is not fitted.
- Flooding. Any history of significant flooding at the site, or of stores being affected by it though water, sensitive stores will normally be fully protected by their packaging.
- Aircraft Crash. The probability of crash, by civil airline aircraft, light aircraft and small transports, military fixed wing aircraft (especially where the site is in a designated High Crash Concentration Zones (HCCZ)) and helicopters. Special factors, such as hot refuelling of helicopters on the site, are considered. Aircraft crash is normally the only external hazard to have a significant effect.
- Nearby Hazardous Installations. On a site, there may be storage tanks for heating oil and fuel for vehicles and machinery, and liquid petroleum

gas tanks. There may also be demolition and burning areas. Such installations are not normally regarded as constituting a significant hazard.

9 Additional Contributions to Initiation Frequency

The following are considered:

- Site Transport and Transfer Operations. The modelling programme makes standard allowances for frequency contributions arising from site transport and transfer operations. These apply at road and rail loading and transfer points, and need to be modified only if there are extraordinary conditions on the site.
- Malicious Destruction. The modelling programme also makes a standard allowance for frequency contributions arising from malicious destruction. This is also entered in the tables.
- Communication. A calculation is made of the probability of the communication of an initiation event between PES, each one in turn being regarded as donor and receptor. The input for the programme is based on the QD rules in Chapter 10.

10 Consequence Models

Once the total initiation frequency is known for each PES, based on all the above influences, the next step in the QRA process is to determine the fatality probability at each ES, given an event from each PES. This is done using the RISKWING programme. The RISKWING software has separate consequence models for assessing lethality from blast, weapon fragments, building debris and thermal radiation. Lethality can be determined for people in the open or inside domestic housing. For HD 1.1 and HD 1.2 stores, all consequences less thermal radiation are combined. For HD 1.3, thermal radiation is the only consequence model considered. The models are as follows:

- Blast. The relationship between quantity of explosives, separation distances and lethality is taken from two RAST reports. The lethality from blast applies only to HD 1.1 and HD 1.2 events. The lethality probability falls below 10^{-9} (effectively zero) at a scaled distance (SD) of 6.8 for people outdoors and 5.5 for people indoors.
- Building Debris. The model for building debris has been derived for traversed PES of brick walled construction with a reinforced concrete roof. The method provides only a coarse estimate of fatality probabilities, but it can be taken as a maximum value. Special account has to be taken of debris from igloos, especially the front wall.
- Weapon Fragments. Fragment lethality is estimated for each PES licensed for HD 1.1 and HD 1.2. A selection of weapon type is made from the following, reflecting the worst long range consequence predicted for the contents of the PES:
 - a. 155 mm L15 HE Shell
 - b. 1000 lb Bomb
 - c. 81 mm Mortar HE Bomb

- d. 30 mm ADEN HE Round
- e. Sea Dart SAM
- f. Mk 24 Torpedo

For HD 1.2, the blast and debris effects are assessed on a notional NEQ of 50 kg rather than the licensed NEQ. This follows the assumption that HD 1.2 would detonate at intervals, in a series of initiations, rather than in mass. The 50 kg figure used allows for 10 consecutive explosions of 5 kg each, which it is assumed would give time for anyone in the immediate area to move to safety.

- Thermal Radiation. Where PES are licensed primarily for HD 1.3, an estimate has been made of the effects of thermal radiation, for which a procedure has been devised. These effects are clearly in a much lower order than blast and projection effects.

11 Results

B1.11.1 Assessment addresses the risks arising from the storage, handling and processing of explosives, particularly:

- The risks to workers operating at various points around the site, though not within the explosives areas, and taking into account the working hours during which they are actually exposed to risk.
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- The risks to those workers regarded as 'residents' because of their permanent occupation of exposed sites, and also to the general public residing in houses around the sites.
- The risks to the transient general public on nearby railways, major roads and, in some cases, public rights of way.

12 Individual Risk

Responsibility for ensuring the Health and Safety of Service personnel, MOD civilian staff and members of the general public lies firmly with the line management who generate the hazard and the risks there from. The generator of the risk has to show that the risk not only is tolerable, but also has been reduced to a level which is ALARP. Under a procedure devised by ESTC and described in Chapter 9, the respective IEs are given guidance on how they may manage explosive storage and handling situations, including those which do not appear to meet ESTC recommendations for QDs as reflected in this publication. ESTC suggests that an IE could determine the range of risks of fatality which are generated by the high proportion of his explosives facilities which meet existing QD rules. Then, by assessing risks associated with a non-compliant situation, the IE could decide whether the problem generated a risk significantly greater than the normal range. If not, he may decide to issue a licence for the operation to proceed. He will remind the risk generator of his responsibility to ensure that the risks are ALARP. The IE may of course make his approval conditional on management constraints; regular review, time limits and so forth.

Even if risks are significantly higher than normal, he may conclude that they are ALARP and can be defended as tolerable within the guidelines laid down by the HSE. Chapter 9 states that he may proceed with issuing licences provided that CIE (MOD) is informed through ESTC, and that the situation is subject to regular review. Further guidance is offered for dealing with higher risks and those which affect the general public.

MOD does not have formally accepted criteria for tolerable risk, and each particular estimated risk has to be discussed in terms of criteria used by other bodies in similar situations. For example, HSE has published guidance on how to assess acceptable risk associated with the operation of nuclear power stations and the transport of dangerous substances. The approach followed in QRAs is recommended by HSE and involves the use of two threshold criteria. Above the upper threshold risk is considered intolerable and immediate steps must be taken to reduce or eliminate it. Below the lower threshold risks are accepted as tolerable and no further effort need be made to reduce them. In the intermediate region, the risk has to be demonstrated as ALARP. The IE is at liberty to identify conditions which enable him to defend the choice of different threshold values if he considers this both necessary and practicable.

QRA site assessments performed for each of the Services and results from across the MOD have shown that the risks generated by explosives storage facilities which meet ESTC QD recommendations can be defended as 'tolerable' using guidance issued by the Health and Safety Executive. Values used by HSE in their recommendations on the transport of dangerous goods are:

- 1 in 1000 per year - maximum tolerable risk of fatality for any identifiable group of workers
- 1 in 10 000 per year - maximum tolerable risk of fatality for the general public
- 1 in 1 000 000 per year - individual risk negligible for both workers and the general public

The estimated maximum values of individual fatality risks per year are shown, from all PES, for people at each exposed site. Comparison with the above figures will indicate whether the risks can be defended as tolerable. It should be noted that management action will normally reduce these risks further by, for example, restricting the routine movement of explosives to the smallest number of storehouses, or by restricting the storage of white phosphorous natures to specific ESH.

13 Societal Risk

Societal risk addresses the number of fatalities to be expected from an accident. This is done because of the perception that society in general tends to have a greater aversion to a single accident causing multiple casualties than to a number of separate accidents causing an equivalent number of deaths. Criteria for this have not been developed to the same extent as individual risk. HSE has estimated that the annual chance of an aircraft crash somewhere in

the UK killing more than 500 people is 1 in 1000 per year, and they have stated that a major societal risk in UK with a similar large number of casualties should be tolerable at a probability of 1 in 5000 per year. The calculation takes each PES in turn and determines the probability of an accident there having a lethal result at each ES. This probability is then summed for all the ES and multiplied by the population.

The QRA programme produces a graph indicating the estimated accident frequencies where between 0.1 and 1000 fatalities may be expected. The diagonal lines on the graphs indicate the seriousness of the risk and threshold values adopted by the HSE. Above the upper line, the risk must be regarded as intolerable, and below the bottom line broadly acceptable. Between the two lines, the risk can be regarded as tolerable but must be kept ALARP.

14 Assumptions

The risk estimates generated in a QRA are normally based on a number of assumptions:

1. For the permitted licence, all storehouses are full to the maximum NEQ allowed, with the worst case natures (highest frequency and most severe hazard division).
2. There are no materials stored in contravention of compatibility mixing rules.
3. Any processing operations are performed only in the permitted buildings.
4. Workers in buildings are protected only to a level expected in normal domestic housing.
5. Workers are generally at risk for a maximum of eight hours per working day (0.24 fractional exposure). The number of days in the year on which each specific exposed site is occupied varies considerably, however, and is taken into account.
6. The communication frequencies for the most vulnerable igloo and ESH may be applied to other similar PES.
7. The consequence models, though simplistic in several areas, represent maximum values and a worst case prediction. It follows that estimates of risk can be considered to be upper limits for a site operated as described and which meets MOD safety standards.

15 Conclusions

A QRA report can often conclude that the maximum risk of fatality to workers and residents from the storehouses, PBs and transport facilities, etc., on the site, can be defended as tolerable under the current Explosive Licences. This is normally so where the site is licensed under full QD rules, but tolerability of risk may also be established in circumstances where strict compliance with QD causes difficulties. Where the risk cannot be defended as tolerable, the deficiency will be identified. Care should be taken, in any event, to ensure that risks can be shown to be as low as is reasonably practicable.

16 Recommendations

Recommendations are made where required, especially when remedial action can be taken to address means of reducing risk to tolerable and ALARP.

Appendix C The Expected Injuries to Personnel at Specific QDs from Explosions.

The Effects at different QDs are:

C.1 QD 44.4Q^{1/3}

Expected Effects – The expected effects are:

1. Unstrengthened normal structures are likely to suffer only superficial damage.
2. Certain types of vulnerable structures (particularly Type 4 structures – see Chapter 6 para 8.1.4(4)) may collapse and cause injuries or death by crushing and falling debris.
3. When large panes of glass or other non-load bearing frangible materials, e.g. external cladding panels, are exposed so as to face a PES, 50 % or more of these may be detached from the structure or broken by the blast.
4. Injuries and fatalities are very unlikely as a direct result of blast effects. Injuries that do occur will be caused principally by the impact on passers-by of falling, broken or detached panel or window materials. The risk of injury will often be reduced by minimising personnel exposure by, for example, placing gardens around the foot of buildings.

Personnel and Facilities Acceptable - This is the normal distance required for buildings of vulnerable construction and large facilities. Examples of such buildings are:

1. Large Facilities of Special Construction or Importance. Examples are:
 - a. Large factories
 - b. Multi-storey office or apartment buildings
 - c. Public buildings and edifices of major value
 - d. Large educational facilities
 - e. Hospitals
 - f. Major transport centres e.g. railway stations, airports, etc
 - g. Major public utilities, e.g. water, gas and electric work
2. Facilities of Vulnerable Construction Used for Mass Meetings. Examples are:
 - a. Assembly halls and fairs
 - b. Exhibition areas
 - c. Sports stadia
3. Built-up areas which are both large and intensely developed

C.2 QD 22.2Q^{1/3}

General - The equivalent QD in respect of earth-covered buildings considered to be UK standard igloos are:

1. From the side: 19.0Q^{1/3}
2. From the rear: 15.5Q^{1/3}

Expected Effects - The expected effects are:

1. Unstrengthened buildings will suffer minor damage, particularly to parts such as windows, door frames and chimneys. Partial collapse may occur in buildings where structural integrity relies either on critical elements or the continuity of the structure.
2. Injuries and fatalities are very unlikely as a direct result of the blast effects. Injuries that do occur will be caused principally by glass breakage and flying/falling debris.

Personnel and Facilities Acceptable - This distance is known as the Inhabited Building Distance and is the minimum distance at which inhabited buildings not directly concerned with the functions of the explosives facility should be sited.

This QD is acceptable for the following types of ES:

1. Untraversed stacks of explosives
2. Structures in the administration area of the facility with a considerable number of occupants (see Chapter 10, Section 7), e.g. office buildings, non-explosives workshops, mess halls, changing areas with refreshment areas or showers.
3. Structures in the administration area of the facility which are important for the functioning of the installation, e.g., manned fire stations, manned heating plants, MT areas, unprotected water, gas and power supplies.
4. Inhabited buildings whether single buildings, communities or areas of scattered habitations.
5. Structures and facilities in which people assemble other than those at para 8.1.2, above.
6. Facilities serving the needs and safety of the general public such as water, gas and power supplies, radar installations and communications centres.
7. Important railways and public roads, e.g., main railway lines, motorways and major roads and navigable waterways.

C.3 QD $14.8Q^{1/3}$

General - The equivalent QD in respect of earth-covered buildings considered to be UK standard igloos are:

1. From the side: $14.0Q^{1/3}$
2. From the rear: $11.0 Q^{1/3}$

Expected Effects – The expected effects are:

1. Unstrengthened buildings will suffer average damage costing in the range of 10 % of total replacement cost to repair.
2. Personnel under cover are afforded a high degree of protection from death or serious injury. Such injuries as do occur will be mainly caused by glass breakage and building debris.
3. Personnel in the open are not likely to be seriously injured by blast but some injuries are likely to be caused by fragments and debris depending

on the structure of the PES, the NEQ involved and fragmentation characteristics.

Personnel and Facilities Acceptable - This distance is known as the Public Traffic Route Distance and is the minimum distance at which routes used by significant numbers of people for purposes unconnected with the explosives facility must be sited.

This degree of protection is acceptable for the following:

1. Structures and facilities within an administration area concerned with the explosives facility with a limited number of occupants
2. Structures and facilities in which people assemble temporarily and which can be cleared quickly, e.g. sports fields, parking places, Small Arms ranges.
3. Railways, roads and navigable waterways of minor medium importance.

C.4 QD 9.6 Q^{1/3}

Expected Effects – The expected effects are:

1. Buildings that are unstrengthened can be expected to suffer damage to main structural members that will require repair. Repairs may cost more than 20 % of the replacement cost of the building. Strengthening of buildings to prevent damage and secondary hazards is feasible and not prohibitively expensive.
2. Cars may suffer some damage to metal portions of the roof and body by blast.
3. Windows may be broken; however, the glass should not cause serious injury to the occupants.
4. Aircraft will suffer some damage to appendages and sheet metal skin.
5. Cargo type ships will suffer minor damage from blast to deck houses and electronic gear.
6. Personnel may suffer temporary hearing loss, however, permanent ear damage is not likely. There are likely to be some injuries caused by fragments, debris, or translation of the individual(s) involved.

Personnel and Facilities Acceptable - This must be the least distance at which unprotected duty personnel (e.g. troops, military and civilian maintenance and security personnel and crews of ships) should be permitted when their duties are not closely and specifically related to the PES. This degree of protection is acceptable for the following:

1. Open air recreation/sporting facilities used only by military personnel where structures, or dependants and the general public, are not involved.
2. Training areas for unprotected military personnel.
3. All military aircraft when the PES is not for the immediate service of the aircraft.

C.5 QD 8.0QP1/3

General - The equivalent QD in respect of earth-covered buildings considered to be UK standard igloos are:

1. From the rear: $6.0Q^{1/3}$

Expected Effects – The expected effects are:

1. Buildings which are unstrengthened can be expected to suffer damage which is likely to cost above 30 % of the total replacement cost to repair.
2. Serious injuries to personnel, which may result in death, are likely to occur due to fragments, debris, firebrands or other objects.
3. There is some possibility of delayed communication of the explosion as a result of fires or equipment failure at the ES. Direct propagation of the explosion is not likely.
4. Cargo ships will suffer damage to decks and superstructure. In particular, doors and bulkheads on the weather deck are likely to be buckled by the overpressure.
5. Aircraft are expected to sustain considerable structural damage.

Personnel and Facilities Acceptable - This distance is the minimum permissible distance between a PES and a Process Building. This degree of protection is acceptable for the following personnel and facilities:

1. Process Buildings in which the number of personnel present is kept to a minimum essential for the task.
2. Packing and shipping/transit buildings in the Explosives Area.
3. Minor transmission and communication lines.

C.6 QD 3.6Q^{1/3}

Expected Effects – The expected effects are:

1. Unstrengthened buildings will suffer structural damage approaching total demolition.
2. Severe injuries or death to occupants of the ES are to be expected from direct blast, building collapse, or translation.
3. Aircraft will be damaged, by both blast and fragments, to the extent that they will be beyond economical repair. If aircraft are loaded with explosives, delayed explosions are likely to result from subsequent fires.
4. A high degree of protection against direct propagation of an explosion is to be expected, provided direct attack by high velocity fragments is prevented, e.g. by a receptor traverse. Explosions may subsequently occur in adjacent PES from fire spread by lobbed debris or blast damage to an ES.

Personnel and Facilities Acceptable - This degree of protection is acceptable for the following personnel and facilities:

1. Temporary holding areas for vehicles containing explosives for Service production or maintenance facilities provided traverses are interposed both between the vehicle locations and other PES.

2. Unmanned auxiliary power facilities, transformers and other utilities that serve a PES and which are not vital and will not create a secondary hazard.

C.7 QD 2.4Q^{1/3}

Expected Effects – Unstrengthened buildings will suffer complete demolition.

Personnel and Facilities Acceptable - This degree of protection is acceptable for the following personnel and facilities:

1. Personnel performing storage and shipping functions in explosives areas may operate for short periods at adjacent PES. In large explosives areas however, management controls must be in place to reduce the length of time that unrelated operations are exposed to one another at distances less than 9.6. Q^{1/3}