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STANDARDS SETTING BODY FOR

EXPLOSIVES, MUNITIONS AND SEARCH OCCUPATIONS

OCCUPATIONAL MAP

EXPLOSIVE SUBSTANCES & ARTICLES (ESA) OCCUPATIONS

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INTRODUCTION

BACKGROUND

This report was commissioned by the Standards Setting body (SSB) for Explosives, Munitions & Search Occupations (EMSO) at the request of the Head of Profession (HoP) for Ordnance, Munitions & Explosives (OME[1]) Safety on behalf of the Ministry of Defence (MoD) civilians. The HoP, in his role as Director, Defence Ordnance Safety Group (DOSG) is also required to provide assurance of competence of all MoD OME staff (civilian and military) to the functional board, the Defence Ordnance Safety Board (DOSB). DOSB's purpose is to provide top level direction of ordnance, munition and explosives safety policy and to ensure the continual effectiveness of the MOD OME Safety Management System. The scope of its responsibilities covers safety policy, standards, and the safety and assurance of ESA. Overall system/platform safety is covered by the appropriate Functional Safety Board for that domain.

In particular, the issues facing the MoD are:

- a need to assure competence as one means of avoiding accidents by providing an objective method of assessment of training inputs;
- recruitment difficulties: ESA is a shrinking specialism within the MoD and a high level of commitment is required of applicants who will need to fulfil their training programme;
- a need to put in place objective criteria by which contracts placed with commercial companies can be assessed and managed;
- a desire to provide formal accreditation for individuals' competence
- the imperative of enhancing and maintaining safety standards.

In order to carry out further development work that could provide accreditation through National Occupational Standards (NOSs), the research needs to cover the full span of industries where explosives work is carried out. Where it has been possible to do so, the Standard Industrial Classification Code (SIC) classification system has been used to identify numbers of people employed. However, this system is not fully comprehensive and omits certain activities such as munitions testing and evaluation. The relevant industries that have been identified by SIC are:

- coal mine (deep or drift)
- gas extraction (natural gas)
- oil extraction service activities

[1] Also known in the commercial environment and referred to in this report as Explosive Substances and Articles (ESA)

- quarrying
- explosives manufacture/firework manufacture
- explosives wholesalers
- demolition contracting/blasting & associated rock removal
- mine sinking
- fireworks (commissioning agent)
- motion picture production on film or videotape
- television programme production
- live theatre presentation.

OBJECTIVES

This report aims to support the HoP for OME safety in:

- providing recognized competence standards for the benefit of the UK workforce and MoD civilian and military personnel;
- ensuring that professional training and development is available, and wherever possible, provides individuals with recognized qualifications;
- providing a functional competence framework for the UK MoD OME community;
- setting appropriate standards of performance for all levels of competence.

As the first step in the process to develop standards and qualifications, this report aims to scope the industries concerned in terms of:

- the numbers employed in each industry as a whole
- the numbers of people employed in ESA occupations
- identification of the relevant roles
- characterization of the significance of the industries concerned
- issue, trends and factors affecting education, training, skills and qualifications of those involved in explosives handling work
- the existing education and training arrangements in each industry
- the benefits and constraints offered by the introduction of N/SVQs.

In terms of research and development activities within the industries concerned, this study relates only to the receipt and safe handling of ESA materials, natures, assemblies and components prior to, and during, R&D, and aspects of the planning and conduct of the same. It does not relate to “blue skies” research.

In terms of military munitions-related activities, the study relates to the storage, transportation, distribution and maintenance of ESA, but does not attempt to scope the users of such items.

HAZARD CLASSES

The report covers all types of military ordnance and munitions, all categories of explosives as classified by the United Nations (UN), and non-lethal civilian applications of explosives. For each substance or article in each category, classification is required from HSE for civil explosives, and from the ESTC for military explosives of the Defence Ordnance Safety Group. A brief summarized version of the UN international System of Classification Hazard Divisions is listed below.

1.1 A mass explosion hazard ie hazards of blast, high velocity projections and other projections of relatively low velocity resulting in severe structural damage.

1.2 Projection hazards but not a mass explosion hazard, resulting in items burning and exploding progressively, and fragments, firebrands and unexploded items may be projected. Blast effects are limited to the immediate vicinity.

1.3 A fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. Some items may produce a mass fire hazard and others may burn sporadically. Firebrands and burning containers may be projected.

1.4 No significant hazards presented but rather, primarily a moderate fire hazard. The effects are confined to the package.

1.5 Very insensitive substances for which there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

1.6 Extremely insensitive articles that do not have a mass explosion hazard, demonstrating a negligible probability of accidental initiation or propagation. The risk is limited to the explosion of a single article.

STAKEHOLDERS

This study has been carried out by the SSB for EMSO in conjunction with the DOSG and other key stakeholders including governmental and non-governmental organizations and commercial companies.

Cranfield University at the Royal Military College of Science (RMCS) Shrivenham has recently been successful in winning European funding through a Leonardo da Vinci project. This project aims to develop European-wide standards of competence for the munitions community. Cranfield University at RMCS therefore forms a major stakeholder in this project, and information has been exchanged between the two projects for the benefit of the ESA community as a whole.

In addition to the Leonardo da Vinci project described above, the current level of international interest in establishing standards of competence in

munition occupation matters is indicated by the standards setting initiative for de-mining activities being led by the European Committee for Standardization (CEN).

The Confederation of British Industry Explosives Industry Group (CBI EIG) has been consulted and endorses this work.

Consultation with IExpE and the BPA to be written.

STRUCTURE, ISSUES AND TRENDS AFFECTING THE SECTOR

Explosives accidents have claimed the lives of more than a thousand people around the world since the turn of the Millennium. Many of the accidents have been caused not by failure of design, but by human failure. Much of this can be attributed to the lack of competencies, skills and adequate training of the people concerned.

These accidents have happened in many areas: the explosion of an ammunition dump; an explosive incident aboard a Russian submarine; misuses of fireworks; and an explosion in France involving ammonium nitrate in an industrial facility. These accidents, therefore, have significant consequences in terms of human tragedy, strategic defence capability, economic and political disruption.

Effective explosives safety depends upon people making the right decisions at the right time – ie performing their jobs competently.

Changes in legislation affects all sub-sectors of the industry, and specific aspect of these are discussed by sub-sector as appropriate below. However, the Manufacture and Storage of Explosive Regulations (MSER) will apply to all sub-sectors. This includes the public sector and military which, although exempt from such legislation, has undertaken to ensure that its own procedures will be no less demanding.

Industries using explosives are strictly regulated and all must comply with the following legislative requirements:

1 licence to acquire explosives (ie same day use) (available from the Police)

2 licence to acquire and store explosives on site (available from the Police)

3 licence to acquire, store and keep explosives (requiring an appointed "competent person")

4 for explosives stored under item 3, a licence is also needed from the Trading Standards and Fire Authority which carries out annual inspections

5 Placing on the Market and Supervision of Transfer of explosive Regulations (POMSTER) – a 3-year certificate granted by the Health and Safety Executive (HSE) specifying the types of explosives that may be received from suppliers

6 1991 Explosives Regulations.

Open-cast mines and quarries require a licence from the HSE to cover ammonium nitrate and fuel oils (ANFO) use. In addition, there have been further specific controls introduced as a result of the events on 9 September 2001 relating to the quantities of ammonium nitrates (ie

explosive components) stored in warehouses and docks which now require a Detonation Resistance Test Certificate.

THE SUB-SECTORS

MOD

The MoD has an exemplary record in explosives safety. It is exempt from the main civil explosives Acts of 1875 and 1923, but has put in place a régime which is at least as rigorous – and for some aspects such as building construction, is more rigorous - than the civil legislation.

Twenty years ago, explosives ordnance for the UK armed forces was developed in MoD research laboratories, and the explosives were synthesized and manufactured in MoD production facilities. Nowadays, manufacturing and production are firmly in the private sector and more recently, much of the explosives and ordnance research community has made a similar transition. Nuclear weapons are produced in privatized facilities. There is limited movement of staff between these different organizations and it is difficult for the MoD to recruit or develop explosives specialists with broad experience.

The general contraction of the explosives business in the UK has had a major impact on the numbers of skilled specialists. In addition, many of the UK specialists were recruited during a growth period in defence science and technology in the 1970s and are now approaching retirement. A lack of recruitment in the late 1970s and 1980s has left a demographic trough and consequently, there are insufficient skilled explosives specialists to replace those who will be leaving government service in the next few years. In addition, in the last decade, there has been a worldwide reduction in theoretical and university-based research on explosives which provided another source of recruits.

Apart from the armed forces, the two main business areas of the MoD concerned with ESA are:

- Defence Procurement Agency (DPA) which includes the DOSG;
- Defence Logistics Organization (DLO) which includes the Munitions Business Area comprising the Munitions Corporate Business Unit (MCBU) (the policy setting lead), Integrated Project Teams (IPTs) and the Defence Storage & Distribution Agency (DSDA) of which the Director Explosive Operations is a key stakeholder.

DEFENCE PROCUREMENT AGENCY (DPA)

The Defence Procurement Agency's (DPA's) primary role is to:

- generate modern equipment for battle-winning forces
- provide professional services throughout MoD
- encourage defence technology and science to sustain key skills in the supply chain
- understand and work with key suppliers to improve performance.

The DPA's primary task is to acquire new equipment for the armed forces, balancing customers' requirements and the capabilities available from suppliers. This requires a clear understanding of what customers (ie the armed forces) want, and a realistic appreciation of the supplier base. Almost all projects have an international dimension, whether through formal co-operation, direct procurement, supply chain aspects, shared research and technology or the harmonization of requirements. The DPA works with partners in other governments, bilaterally and through a variety of international fora. Objectives include the adoption of best acquisition practice, opening defence markets and fostering key relationships through initiatives such as the European Letter of Intent Framework Agreement and the US/UK Declaration of Principles.

Projects are managed through Integrated Project Teams (IPTs) (see the MoD section on *Roles* for descriptions of these teams' composition and responsibilities). IPTs' work involves identifying the best value for money to meet the requirement, delivering solutions on a through-life basis, negotiating contracts and ensuring an MoD contribution to their successful execution. IPTs' projects may have a lifespan of decades, or may be smaller, more rapidly fielded items that can make a critical difference to the warfighter in a short time. Some 700 projects may be under way at any one time. Risk management is critical to the improvement of project management. New processes, tools, technology and maturity models are in use to measure risk and through life management approaches to achieve optimum value for money.

Effective exploitation of research and technology is essential to the delivery of advanced equipment. The DPA therefore collaborates with the defence research community and others to ensure that the MoD's research programme focuses on the early identification, maturation and deployment of technology. As health and safety is central to the work of the DPA, it is seeking a more coherent approach to acquisition safety management across the DPA to ensure that cost effective safety arrangements are in place.

The DPA's performance depends upon suppliers delivering on their contracted undertakings. The DPA is developing a better understanding of the abilities, capacity and prospects of key suppliers to identify in advance strategic issues that may impact on projects and which

complements the professional commercial services that the DPA also provides to the MoD at large.

DEFENCE ORDNANCE SAFETY GROUP (DOSG)

Formed in 2000 to create a pan-MoD focus for policy, strategy, policy implementation, performance measurement and support relating to explosive and ordnance safety, DOSG is a support group within the DPA. DOSG has a core group of scientists, engineers, administrators and military officers who are specialists in all aspects of ordnance and munitions safety.

DOSG provides:

- impartial appraisal of the safety, and advice on the suitability and serviceability for service in UK armed forces of weapons and those parts of weapon systems and stores in which explosives are used;
- assessments for qualification of explosive compositions for military use;
- advice on matters affecting the safe use of weapons and other hazardous stores during military training;
- the MoD focal point for NATO and international standardization, for testing, assessment and acceptance criteria relating to the above matters, and their safe use in training and on ranges
- assurance to the Secretary of State that the management of safety for MoD OME is effective.

The Director of the DOSG has a number of personally delegated roles from the 2nd Permanent Under Secretary of State of the MoD including:

- Chief Inspector of Explosives (MoD)
- Competent Authority for Major Accident Control Regulations (MoD)
- Chairmanship of the:
  - Explosives Storage and Transport Committee
  - Defence Land Ranges Safety Committee
  - Military Laser Safety Committee
  - Head of Profession for OME Safety.

DOSG also hosts the DPA Acquisition, Environment and Safety Office (AESO) to provide a corporate focus on the management of safety and environmental issues within the DPA.

DOSG comprises a mixture of military and civilian personnel and draws on wide experience from both environments. Many DOSG personnel are recognized as national and international experts in the fields of ordnance and explosives. These experts can offer advice to IPTs on *Safety and Suitability for Service* (S3) covering:

- design safety assessment
- safety, suitability and survivability trials
- NATO interoperability

- storage and transport
- whole life assessment
- service life extension and surveillance programmes.

Advice can cover a considerable range of weapons as diverse as anti submarine weapons, heavy armour direct tank fire, mortars, pyrotechnics, nuclear missiles and warheads and submarine launched weapons.

DOSG's specialist capabilities involve:

- qualification, characterization and classification of energetic materials
- ordnance risk assessments
- electrical safety assessments
- munitions through life assessments
- statistics and modelling.

As the centre of excellence, DOSG's significance lies in managing and implementing the regulatory régime within the MoD. As a centre of expertise, it provides advice on the design, manufacture, and use of weapons systems. A key issue for DOSG is the need to improve understanding of munitions and therefore, the process and technology underlying its design in order to advise on safety implications to ensure current and future safe and cost-effective use of equipment in service.

Changes in relevant legislation greatly affect the work of DOSG which therefore engages with the developers of such legislation – for example, legislation relating to the storage and safe transport of explosives - in order to influence its design so that the MoD can conform. However, due to compatibility issues in operational arenas, this is not always possible.

DEFENCE LOGISTICS ORGANIZATION (DLO)

An agency of the MoD, the DLO's role is to decide, provide for and deliver effective and integrated logistic support and information services to the front line and across the MoD at best value.

Logistic capability is fundamental to generating and maintaining fighting power, and the changing nature of operations reinforces the need for robust and sustainable logistic solutions, networked for the timely delivery of rapid effect to the battle space and to support military capability in peace as well as during conflict.

Key considerations for the DLO are:

- sustaining the front line at the required operational tempo while reducing costs and delivering greater value
- the need to generate greater efficiencies in support areas to fund investment that contributes to more effective and capable front line forces

- reducing whole-life costs and delivering optimized and integrated whole-life support
- achieving the best balance between performing activities in-house and transferring to industry those functions that they are better able to carry out
- ensuring equipment availability, reliability and safety within a support chain that is flexible and meets new and changing operational contexts
- collaborating with others internally and with industry suppliers to improve performance and reduce costs.

The DLO recognizes its need to become an “intelligent decider” – an organization that manages performance effectively across a coherent range of service delivery arrangements that deliver operational benefits. This requires the DLO to optimize industrial capacity to shape relationships and deliver improved availability, capability and sustainability as well as harnessing the benefits of technological developments to improve the speed and quality of communications at lower costs. It is anticipated that this shift from the traditional model to that of intelligent decider will need to be achieved through contractual arrangements that better incentivize industry’s performance. This approach to logistic support will be embedded through existing processes and mechanisms and will be applied to current legacy arrangements. In this way, it is intended that support arrangements will be considered early within the acquisition cycle.

MUNITIONS BUSINESS AREA (MBA)

This comprises the Munitions Corporate Business Unit as the policy and co-ordinating led, with membership of the three DLO support pillars for sea, land and air: Ships Missile Systems IPT (SMS IPT), Torpedoes IPT, Guided Weapons Support Systems IPT (GWSS IPT), Defence General Munitions IPT (DGM IPT), Air Launched Munitions IPT (ALM IPT), and the Defence Storage and Distribution Agency (DSDA) who are responsible for the storage, processing and distribution of munitions materiel. The Munitions Management Board (MMB) is the executive body for the MBA.

The MCBU and the DGM IPT together form the Defence Munitions Group (DMG) which has a number of specific tasks to complete in support of its purpose including:

- policy and guidance to the DLO Munitions Business Area
- a focus for munitions operational capability
- managing the Defence General Munitions IPT (DGM IPT) operational munition stockpile, ensuring that the levels are maintained at those specified
- undertaking the supply of DGM natures for programmed activity in accordance with agreed customer service agreements

- providing the DLO with a munitions focal point in support of operations
- acting as the delegated lead within DLO for explosives safety
- implementing the recommendations of recent reviews including
  - investigating the potential for further industry involvement in the management and through-life support of munitions
  - rationalizing the munitions stockpile
  - developing and implementing a revised policy for “lifing” munitions
- managing the demilitarisation aspects of the DLO’s contract with QinetiQ.

Through the Munitions Management Board, the MCBU manages munitions safety policy and rationalization and convergence issues across the DPA and the DLO.

One key OME activity for which the MCBU has responsibility (via the Inspector of explosives (DLO) post) is licensing (on behalf of the Chief Inspector of Explosives (CIE) (MoD) the DLO’s UK-wide explosives facilities (some 1077 individual licences in total). This also involves safeguarding the sites (ie ensuring that it is free from encroachments that would compromise explosives licences). The Inspector of Explosives (DLO) also commissions from DOSG Quantitative Risk Assessments and Technical Assessments to support the licences; represents the DLO on the Environmental Safety Management Steering Group; and ensures that the implications for the DLO of all relevant safety legislation is addressed.

Other ESA-related functions for which the DMG is responsible include rationalizing information databases on the storage and issue of munitions; maintaining databases on those munitions that are banned or constrained for use; and maintaining the Tri-service database on incidents and defects. Supporting these activities are those relating to identifying and spreading best practice in ESA work.

Historically, munitions work in the MoD was a fragmented area, and the creation of the DLO in 1999 brought together each separate Service’s different logistics teams. As the horizontal integrater, the MCBU provides further cross-fertilization between what were largely autonomous groups and brings together the different DLO agencies to bring coherence and convergence in their activities.

The munitions life cycle may be described by the acronym *CADMID*, standing for:

Concept **A**ssessment **D**emonstration **M**anufacture **I**n-service **D**isposal.

As the specifier of requirements, the Director Equipment Capability (DEC) is concerned with the *Concept* stage. As the procurement body, the DPA’s area of interest is mainly from *Assessment* to *Manufacture*, whilst the DLO’s primary area of involvement is from *Manufacture*

through to *Disposal* although it retains a significant interest in cost issues prior to this.

Each Integrated Project Team (IPT) “owns” all in service munitions, and is responsible for the day to day management of stockpiles (inventory management, surveillance, proofing, disposal or “re-lifing”), and for the intrinsic safety of munitions. However, one of the key issues for the MBA as a whole is to control and reduce where possible the “whole life” costs of munitions ie from the point of concept through to disposal.

The current system of “lifing” munitions is considered somewhat broad brush in that the lifespan of muntions is determined regardless of the environments in which it is to be used. Factors such as vibration, shock, heat, humidity, and other climatic conditions can vastly affect the stability - and therefore, the life and intrinsic safety – of a munition. When an unused munition reaches the end of its life, it is recalled for disposal from wherever its location is around the world. Potentially massive savings could therefore be made if the effective and safe life of the munition were determined more accurately according to more specific environmental data as described above. The MCBU is responsible for promoting methods for the collection of empirical data that will address the issue of whole life assessment. The increased involvement of manufacturers in this process is seen as a key and element in increasing efficiency and providing economic improvements.

A key factor affecting the ESA community’s ability to deliver is the lack of suitably experienced civilian recruits and the lack of appropriate training provision for civilian personnel. A combination of an ageing workforce, budget cuts and courses dropped and a lack of a co-ordinated direction has resulted in insufficient numbers of job applicants of an appropriate quality and skills fade on the part of those already employed. Whilst military personnel have access to courses and qualifications delivered by Cranfield University at RMCS, there is very little off the job provision for civilians other than a 2-day awareness course and an 8-day intermediate course.

DEFENCE STORAGE & DISTRIBUTION AGENCY (DSDA)

DSDA’s mission is to provide an effective and efficient materiel distribution, processing and storage service within the supply chain to sustain the fighting power of UK armed forces worldwide. The Explosives Operations Directorate works to fulfil this aim within its remit of dealing with all manner of explosives – whether complex weapons systems such as guided missiles or conventional munitions such as bomb and ammunition. DSDA comprises a Head Office and 13 major installations across the UK as well as other smaller units. Abroad, it has installations in Germany, and provides advice and support to customers in Gibraltar, Saudi Arabia and trials sites in the Bahamas. In total, it stores 0.3244 million cubic metres of explosives.

DSDA fulfils several different roles in working to serve its customers – mainly IPTs - which are best summarized below.

1 For the majority of complex weapons systems, IPTs task DSDA to store, transport and maintain ESA.

2 For complex weapons systems currently coming into service, OME manufacturers sub-contract the arrangements for DSDA to *Assemble, Integrate and Test* (AI&T) the weapons and configure the explosive element using MoD facilities. This arrangement has yielded substantial cost savings.

3 For conventional munitions, the manufacturer delivers to DSDA under the direction of the IPT. DSDA then stores, transports and maintains the OME.

DSDA's services are set out in Customer Supplier Agreements (CSAs) which specify the level of service in terms of quality, cost and performance standards to be met.

To ensure the safe custody of ESA, a fundamental service delivered by DSDA is the safe storage, handling, transport and preventive maintenance programme. The lifespan of a munition is identified when it comes into service and therefore, when it must be expended or disposed of or inspected to ensure its continuing stability and therefore, safety. DSDA carries out surveillance checks and proofing on ESA as directed by the appropriate IPT Duty of Care Holder. In the case of some complex weapons, the munitions are subjected to refurbishment routines, replacing and carrying out functions tests of components, and performing an overall electrical intrusive test on the warheaded munitions. Torpedoes are reconfigured to exercise rounds by removing the warhead and fitting an instrumented head. After recovery, these torpedoes undergo deep refurbishment routines for re-conversion to war-shot torpedoes. Since torpedoes are designed for single use, this represents a significant engineering task in terms of time and cost, involving around 500 separate components.

DSDA suffers from the same issues that affect other ESA-related parts of the MoD namely, the loss of technical ESA skills caused by Departmental reorganizations and cutbacks made which erode the strategic focus that would allow appropriate levels of future support. The ageing workforce exacerbates concerns about skills loss and skills fade. Current skills training relies to a large extent on on-the-job training which risks teaching poor safety practice from one generation to another. In addition, since ESA expertise has been lost, so too has the depth of knowledge and appreciation of explosives risk been lost. It is felt that further work needs to be done to teach ESA personnel about the rationale of ESA procedures and the risks and potential consequences of not following them.

A clear understanding of the nature of the Explosives Licence is crucial for roles in warehouse management and generic training courses are seen as lacking the necessary depth. Training is carried out to in-house standards with no national or Departmental standards. This, linked to

insular thinking has, over the years, compounded a general skills fade and ESA awareness. There is also a lack of career structure to support and nurture future managers.

The concerns raised about the lack of depth of explosives risk appreciation applies also to DSDA's customers – the IPTs, thus affecting DSDA's ability to store, process and deliver ESA safely. It is felt that the significance of the surveillance and maintenance systems, the quality of information and the need for complete compliance with safety procedures are not fully appreciated by IPTs who may themselves be target customers of ESA training in order to understand fully the degree and nature of their accountability as the Duty of Care holders.

ROYAL NAVY

HMS Collingwood is the Royal Navy's lead school for ESA training in the Fleet. A satellite school at HMS Raleigh caters for explosive safety on board submarines. Explosive Ordnance Disposal (EOD) is taught at the tri-service Defence Explosive Ordnance Disposal School (DEODS).

Operational availability of the Fleet is the primary consideration. An accident or incident involving explosives would clearly affect this availability. Consequently, the safety requirements of ships' magazines and explosives form one of the Royal Navy's "Key Hazards", and are rigidly policed both ashore and afloat.

In order to maintain the Fleet's operational capability, there is a strong need for extensive training with respect to legislation and its implications, particularly storage and transportation of explosives are concerned. At present, the Fleet is governed by Book of Reference (BR) 862 naval Explosive Regulations, whilst explosive safety ashore is regulated by the Joint Service Publication (JSP) 482. The training schools focus on teaching to these regulations, offering practical, hands-on training where necessary. The imminent introduction of MSER legislation may require amendments to these references with the associated re-training and/or re-briefing taking place as required. Furthermore, recommendations made by the International Commission for Non Ionizing Radiation Protection Board (ICNIRPB) to the European parliament, which – if adopted – may also impact on the Royal Navy. ICNRPB reports on personnel exposure limits of NIR. Induced electric currents or the "antenna effect" produced by ships' systems can pose both a personnel hazard and explosive risk to certain specified susceptible weapons. Should European legislation increase the minimum safe distance for personnel and similar recommendations follow for Electro Explosive Devices (EEDs) to new limits higher than those currently recommended by UK national authorities, then operational capability may be affected by having to inhibit transmissions whilst explosives movements take place.

ARMY

Effective delivery of ESA functions enables the Army's operational and strategic capability by managing the supply chain. The Army is deployed worldwide in operational "hotspots" and is also involved in defence diplomacy, supporting local governments at strategic and political level. ESA-related operations conducted in support of foreign governments' requests might range from peace-keeping duties to the destruction of unstable stockpiles of weapons, or seconding technical specialists to provide technical, supply or safety advice on ammunition.

To understand the fundamental importance of ESA functions, the Army's distribution chain first needs to be understood. Active operational areas are described as either first, second or third line. Supplies of all natures including OME arrive at the Air (or Sea) Port of Disembarkation (A/SPOD). From the A/SPOD, supplies are moved up to the second line Divisional Supply Area (DSA) to be held till called off for use by the first line – ie the front line of the battlefield. Alternatively, depending upon the urgency with which it is needed, ammunition may be delivered from the third line direct to the first line. A similar permanent structure exists in peacetime which is used for training exercises. Much of the routine peacetime transportation of ammunition from the manufacturer to the third line supply depots is now largely civilianised. For active operations, Transport and Supply Regiments are responsible for moving ammunition to the first line.

Within the Field Army, every Regiment is required to have a specialist Ammunition Storeman in post, and every sub-unit (ie up to and including a company/squadron) is required to have in post an Authorized Representative. This role's responsibilities relating to the storage and movement of ammunition are described in more detail under the *Roles* section.

Control of the Army's specialist ammunition resource is vested in the Principal Ammunition Technical Officer Branch (PATO) whose ESA role is to ensure the delivery of explosives safety, operational ammunition planning and technical expertise. The operational branch of PATO concerned with ESA functions is Ammunition Operations and Plans (Ammo Ops & Plans). Broadly, the branch's main ESA responsibilities include operational ammunition planning and subsequent management in peace and war; accountability for and delivery of the Army's explosives and ammunition inspection programme; providing technical advice and policy for peace and operational ammunition supply management, sustainability explosive safety and site licensing; and managing the manning of specialist personnel in operational, exercise and training commitments in support of the MoD, FCO, Home Office and Security Service.

The Army shares the similar pressures posed by changes in legislation such as that described above (see *Royal Navy*).

ROYAL AIR FORCE

As for the other armed forces, the significance of ESA work is to enable strategic and operational capability through the rapid delivery of weapon systems. This is an essential component of modern warfare without which air superiority would not be gained to give safe skies for land and fleet operations.

Again, as for the other armed forces, the RAF has been subject to stringent defence budgets but more personnel are deployed in operational areas (eg the Gulf, the Falklands) now than during the Cold War. Like the other armed service, the RAF is shrinking as more non-operational functions are privatised.

Due to the inherent hazards of working with explosives, the RAF armaments sector is highly trained and regulated. The same requirements for training in legislation apply as those for the Royal Navy, and indeed, the same potential difficulties arising from the ICIRPB apply as RAF stations' radar and other transmitters present susceptibility risks.

The Inspector Explosives (RAF) holds responsibility for the safety of operational explosive systems (buildings, licensing, storage, maintenance of weapons and related components and ancillaries etc). Armament expertise is also required in the Air Launch Munitions and other relevant Integrated Project Teams (IPT) (see the *Roles* section for a description of the remit of an IPT), and through the Armaments structure down to unit level (ie locally) where aircraft maintenance is carried out. Each armourer is regularly trained, assessed and authorized to meet the RAF's stringent safety requirements. This represents a very heavy training investment for loading teams which comprise the individual carrying out the loading/maintenance, the supervisor, an independent inspector and a further external inspector. In terms of ESA-related systems and components, this covers the loading and maintenance of weapons, launchers, sets and carriers with explosive ejector release units.

As technology advances, there is a greater need to foster IT skills for technicians needing to access and use databases. Increasingly, manufacturers and contractors are carrying out maintenance work and this has reduced the need for personnel to acquire a deep knowledge of the functioning of weapons within their remit.

DEFENCE RESEARCH

Defence research is a crucial back-up to the UK's strategic weapons and defence systems. Within this broad area relevant to this report are functions involving explosives, namely:

- forensic casework
- explosives counter terrorism
- assessment of safety of munitions
- advice on military and terrorist threats
- disposal of explosive ordnance (planned and improvised)

- developing tools and technologies
- assessment of tools and technologies used by others
- characterization of energetic materials.

There are a number of organizations within the defence research community whose responsibilities are broadly as follows:

Internal security	DSTL
Strategic systems	DSTL, AWE
Generic OME technology, research	Commercial private suppliers, QinetiQ, universities
Education & some research	Cranfield and Cambridge

The MoD is currently restructuring its business in new technologies and it is encouraging defence research establishments to bid to become national capability centres (ie centres of excellence) in a particular area or areas of specialization.

The defence research market is competitive, but due to shortages of funding, collaboration between the public, private and quasi-private sectors is essential. This collaborative approach has been fostered by MoD procurement policy which – by encouraging competition - also encourages consortia bids. However, IPR issues can, and often do hinder such collaborative working.

As in the defence manufacturing sector, closures and reductions in operations in primary companies have led to smaller research organizations delivering work that would in bygone days have been carried out in-house by the larger firms.

The defence research/manufacturing sector is becoming a global marketplace and there is a trend toward the UK buying ammunition made abroad. In these circumstances, it is difficult for the UK acquisition community to apply UK design and quality standards. This trend is expected to continue. It is claimed that some is of inconsistent quality, and therefore, both less capable and less safe to use. The question therefore arises: does the UK – as a customer – understand what it is buying and what are the implications of this? Indeed, the procurement imperative to buy cheapest risks more contracts being placed abroad which in turn risks losing UK capability.

Changes in regulation affect the sector, particularly so where previously, establishments held Crown immunity, but which lost this on changing to GOCO status. For example, the Atomic Weapons Establishment (AWE) is subject to regulation by the Nuclear Installations Inspectorate of the HSE, the Explosives Inspectorate of the HSE and the Environment Agency – all of which may challenge production methods. In future, the Nuclear Weapons Regulator of the MoD be able to challenge the design

of nuclear weapons, thus adding a further layer to the regulatory requirement.

The Health and Safety (HSE) has altered its approach to the inspection of premises containing hazardous materials. Whereas previously, HSE inspectors would carry out an inspection and report their findings, the current emphasis is to expect organizations to demonstrate their local explosives safety arrangements by the production of a safety case which embraces relevant legislation; the HSE then monitors compliance with the safety case. Recent legislation (the Control of Major Accidents and Hazards 1998 and the Environmental Act) has also tightened up requirements. HSE's approach and legislation have increased the resources and overheads needed by companies to meet the requirements.

Whether MoD regulations or HSE legislation applies can be complex depending upon the nature of the site's licence, the work being carried out and the customer for whom the work is carried out. However, staff still need to ensure that they identify the correct requirements and comply with them at all times.

Imminent changes in legislation will affect the defence research sub-sectors, namely, the EU Waste Incineration Directive which in future will encompass explosive ordnance disposal. Existing facilities will need to comply by 2006 and new facilities must comply immediately. The UK's Food and Environment Protection Act will also impact on research work through the requirement to register items put in the sea. This will not greatly affect organizations where the potential impact for pollution is minimal, but is another piece of legislation that will require ESA producers/users to ensure that staff are adequately trained to understand it.

Career progression is comparatively limited in defence research and there are no defined career routes. The roles are specialized, and explosives handling and analysis are rare skills for which specialized training is needed but for which little is available. This applies at all levels from very junior laboratory technicians to PhD-qualified researchers who are all trained on-the-job. Given the long term nature of defence activities, there is a strong case for developing and nurturing the skills and competencies that will be required over the next 20 years within the Department.

Since the split of the Defence Research Evaluation Agency (DERA) in April 2002, DSTL has taken responsibility for three broad areas of research: the creation of systems that include assessment of performance, technical risks and effectiveness of the systems. This also involves advice on the effective use of systems and achieving best value in acquiring the systems; expertise in defence-specific technologies; and the creation of deep expertise in core science that is not readily available commercially.

QinetiQ – originally part of DERA, and now part-privatized – is responsible for a broad range of activities namely:

- research and development of explosives and explosive devices
- testing, evaluation and proofing of explosives and munitions
- safety and suitability for service assessment of munitions
- limited manufacturing of specialist pyrotechnic and fuse devices
- disposal of munitions.

As the MoD's competitive policy has led to the placing of more R&D contracts with a wider range of research organizations, it has proved hard to sustain the required competency levels in the public sector as retention of R&D scientists becomes more difficult. This has led to concerns about the future of blue skies research into such areas as future propulsion systems. Further, the imperative now is to seek ways of extending the life of munitions and warheads (up to 20 – 30 years, in some cases), thus achieving savings on design, R&D, and manufacturing processes as well as reductions in risks through transportation and dismantling purposes. However, skills and expertise which are not maintained will erode. Through extending the life of munitions, there will be an increased requirement for those involved in storage, deployment, surveillance and re-engineering or retirement, but an erosion of skills and capability in the early stages of feasibility, design, development and safety testing. This erosion of capability is of great concern in the defence research sector whose succession planning requirements de facto are of a long-term nature. Similarly, whilst seeking to maximize specialist expertise by creating centres of excellence in particular systems, this approach also risks further erosion of capability in other areas.

Reductions of indigenous development and manufacturing of explosives materials has led to some large scale materials qualification capabilities to erode through lack of use and provision of funding for maintenance; likewise, expertise I the use of these facilities and interpretation of the results obtained has also declined.

On the other hand, testing and evaluation is seen as more secure due to the need to maintain strategic capability by assuring operational equipment through the testing programme. QinetiQ has won a long-term MoD contract to carry out live test checks on all military weapons and munitions – both complete and sub-assemblies of all systems and ammunition using explosives. The nature of the tests depends upon the conditions in which they are expected to be used, and might involve being dropped, cooked off, subjected to sympathetic detonation, shock or to changes in climate etc. Those items that are successfully tested are then certified as safe for use within the given conditions.

The high-valued testing contract includes ESA-related equipment as varied as ship systems, submarines, sonobuoys, aircraft ejector seats, parachute systems, weapons systems, and explosive reactive armoured tanks. QinetiQ also delivers capability for training on large items of

ordnance (ie 500Kg) on behalf of UK Services Explosive Ordnance Disposal (eg DEODS).

The sector's main significance lies in ensuring the UK's current strategic defence capability – both nuclear and conventional. In addition, DSTL carries out research into new explosives which are developed and tested by QinetiQ. The decisions as to whether or not to manufacture – thereby influencing performance capability – adds further strategic value.

DEFENCE MANUFACTURING

Historically, the munitions manufacturing industry has been dominated by a few major defence contractor companies. Over recent decades, government investment in defence spending has declined, and together with rising costs, this has led to the defence contractors closing whole departments that were involved in support, but non-core activities (eg the Precision Products Group (PPG) in MBDA). This has enabled smaller companies in the defence industry to increase their involvement from, say, component and minor sub-assembly design and manufacture to more major assembly design and manufacture under contract to the prime contractors as well as commercial companies. In addition due to increasing commercial pressures, the smaller companies now typically outsource some functions that were previously carried out in-house (such as inert prototype and inert production hardware manufacture and other small scale or non-core business activities). As opportunities allow, companies are designing and manufacturing complete – rather than partial – sub-assemblies the sales value of which can represent an increase of several hundred percent.

Due to the history of closures within the industry, the often secret nature of the work, and competing products, collaboration is neither universal nor comprehensive across the industry and there is little activity by way of joint ventures between smaller companies. Such collaboration is more likely to exist between the major contractors and their sub-contractors. However, this trend is beginning to change with joint ventures being discussed between smaller companies with a view to exploring the potential for synergy.

In the defence manufacturing industry, there is a spectrum of activity ranging from those companies that manufacture products to those that supply engineering solutions. The balance between production staff and development and design engineers also varies depending upon where they fit in this spectrum of activity.

The production process in smaller companies is intermittent based on batch sizes typically of a few hundred. This is because sub-assemblies can be produced quicker than complete assemblies such as missiles, and also because of the requirements of destructive proof testing which is used to demonstrate to the customer the continuing quality level that is required. Sampling and sentencing for destructive proof testing is usually carried out in accordance with BS 6001. This naturally places a considerable emphasis on the company's production planning capability.

COAL MINING

The UK coal mining industry is worth £1000 million a year. The UK produced 41 million tonnes of coal in 2001 and coal is the raw energy for 34% of the electricity generated in the UK. As electricity companies have commitments to provide energy that they cannot meet, the security of the energy supply is becoming a national issue. The government has agreed an investment policy which will provide a proportion of the funding needed for individual mines that are demonstrated as economically viable. Whilst government has promised £56m, a further £300m must be found by the industry. Foreign coal is heavily subsidized, and UK companies must compete for the domestic market. In 2003, the UK burned 50m tonnes of coal of which around 30m tonnes was imported. A clear national energy policy is seen by the industry as essential for the health of the UK coal industry.

Due to low labour costs, coal produced across the world is cheap, and until recently, shipping costs were also low. Since 11 September 2001 and the significant increases by the Chinese of their import markets, shipping costs have risen sharply for reasons of both security and demand. These increased import costs have worked in favour of the UK domestic coal industry although local producers are unable to meet the full demand. UK coal production contracts are agreed on a 5-year basis in advance with domestic companies. Global issues such as those described above and any changes to the price of foreign coal directly affect the UK domestic supply and companies may be forced to buy coal to meet their contractual obligations. Whilst a minimum of a 2-3 year contract would be needed to provide the economic stability to produce an acceptable return on investment, this situation inevitably renders the UK coal and electricity markets fragile.

Coal is the most abundant fuel in the world, but the use of coal has lead to concerns being voiced over the environmental impact of coal and coal combustion. Emissions of SO2 and NO from the burning of coal in the UK have fallen dramatically as coal has been replaced by gas, and the new challenge to the coal industry comes from the associated CO2 emissions and the role that coal plays in the greenhouse gas issues. The demonstration of clean coal technologies will enable coal to be burnt in an environmentally acceptable way.

Whilst the UK is currently self-sufficient for its power, our gas reserves are running out, and the UK will be a net importer of gas at some point in this decade according to government forecasts. Eurogas, the association for the European gas industry has reported that in 1999, Europe produced only 66% of its own needs. Nearly 20% of Europe's gas needs were supplied by Russia and 14% by Algeria.

Over recent years, the market for coal has reduced dramatically. As a consequence, the UK coal industry has faced massive restructuring which culminated in the announcement by British Coal in 1992 of a programme of 31 colliery closures. There are now only 4 privately owned

deep mines in the UK and a further 4 or 5 open-cast mines. No mine-sinking activity is carried out nor is any anticipated.

The shrinking of the mining industry has had devastating effects on communities in the affected areas, but also the reduction of business in the mining and quarrying industries has impacted on explosives manufacturers.

Open-cast mines are classified as those with seams close to the surface. Coal is extracted, the seam covered over gain and the final area is landscaped. Deep mines refer to those that are not exposed to sunlight for access to which shafts are needed. A 25-year programme of aftercare is administered to both kinds of mine.

Open-cast mines are typically blasted once a day to fragment sufficient rock to be extracted in one day. This blasting is usually carried out by contractors. The Quarries Regulations 1999 applies to open-cast mines, and requires a suitable management structure including the appointment of an Explosives Supervisor who is trained in blast design. The Quarry Regulations 1999 set out the specifics in terms of competence requirements for Explosives Supervisors and Shotfirers through the Shotfirers qualification awarded by EPIC. For Quarry Managers and operators, the requirement is less specific provided that personnel are “competent”. Qualifications gained prior to 1999 are still valid, but as the syllabus has changed significantly, pre-1999 graduates will be required to re-qualify. The revised qualifications now address environmental effects and legislation.

Command Supervisors (formerly known as Deputies) in deep mines need to meet the legislative requirements set out by the Mining Qualifications Board (MQB) – a section of the Mines Inspectorate of the HSE. The MQB specifies the qualification and approves the syllabus. Since little shotfiring is carried out in deep mines which are now very localized small scale excavations, there is insufficient opportunity to qualify all those working underground. In addition, modern machinery is so powerful that there is less demand for the use of explosives to extract rock. The industry anticipates that ultimately, there will be no need at all for shotfiring underground.

QUARRYING

The quarrying industry is dominated by a few large companies such as Tarmac, Lafarge and Hansons, and smaller contractors that own their own quarry. Most large quarrying companies have their own qualified personnel to carry out blasting and drilling operations but others – notably the smaller companies bring in sub-contractors to blast and drill under contract. UK quarrying is mainly undertaken in a belt stretching down from the central belt of Scotland through Yorkshire, Derbyshire into Gloucestershire and then into Somerset and Cornwall. The open cast coal mining industry operates on a similar basis to the quarrying industry as does the clay pit industry. Coal mining exists mainly in northern

England, South Wales and some in central Scotland. The clay pits are in South West England.

The quarrying industry is directly affected by the amount of large scale public developments such as significant road-building programmes and tunnelling, and is now shrinking.

The industry has been under financial pressure due to the Aggregate Tax – a tax on each tonne of material extracted from quarries which multiplies by the time it reaches end users. Because of the significant increase in cost, road-builders are buying fewer materials and using alternatives, mainly by recycling stone which is not subject to the Aggregate Tax. In consequence, whilst there has been a decrease in quarrying activity, there has also been an increase in mobile processing plants to recycle materials.

A further development has decreased the requirement for road building materials. Nowadays, chemicals are used to stabilize clay road bases instead of stone. This has minimized the use of stone and therefore, has impacted on the bulk suppliers who have typically responded to the loss of business by reducing average working days from 12 hours to 9 – 10 hours per day.

The requirements in the quarrying industry for the competence of Explosives Supervisors and Shotfirers are set out in the Quarry Regulations 1999 and are described in the chapter above relating to coal mines.

OIL AND GAS EXTRACTION

The UK offshore oil and gas sector ("Upstream") provides three quarters of the UK's primary energy, providing employment for 380,000 people. The DTI notes that "the direct impact of oil production has helped the UK trade balance considerably. The net contribution of trade in oil has been positive since 1980. The contribution fell from around £6.5 billion in 2000 to some £5.6 billion in 2002. Since the start of major developments in 1965, operators and licensees have generated gross operating surpluses totalling some £306 billion. They have reinvested around £115 billion in the UK oil industry. Revalued to 2002 prices, this represents an investment of some £210 billion." (source: www.og.dti.gov.uk/information) in 2002, 2,652 thousand tonnes of crude oil were produced in the UK, and in 2003, 786.2 million barrels of oil were produced.

Upstream is facing significant challenges as the province matures. In future, its ability to compete will depend upon rapid and continual improvements in performance. This in turn will depend on greater collaboration to ensure that this performance can be delivered with the resources available. The UK still has substantial recoverable reserves of oil and gas potentially exceeding the amount already produced. However, many existing large producing fields are well into decline and discoveries are becoming fewer and smaller or have associated technical challenges.

The UK is a high cost province. As other areas around the world are opening up to international oil investment, the UK needs to compete even harder for investment funds. The current average cost of finding and producing a barrel of oil in the North Sea is at least $13. This compares with $9 a barrel in the Gulf of Mexico and $4 in Malaysia.

There are three companies globally supplying extraction services using explosives to oil and gas companies and a number of micro-businesses offering limited services within their area of expertise based in the North Sea offshore sector. Global companies' services include exploration, extraction and processing ready for sale. Halliburton is a major player in this arena with a significant share of the global market. In addition, the Jet Research Center (a separately owned division of Halliburton) manufactures specialist explosives for use in the oil industry in the USA. These explosives are shipped to the UK and used in the North Sea to perforate wells both as part of Halliburton's own operations as well as being sold to customers for use in theirs. The Jet Research Center delivers additional services to customers in the shape of pipe recovery (using explosives to cut and retrieve pipes that have become stuck in situ); rig and platform recovery on which explosives might be used to cut large steel structures below sea after the superstructure has been dismantled; and sub-sea explosive ordnance disposal. The need for munition clearance activities is identified by marine surveys and is carried out before a rig is positioned at its location or before a pipeline is laid.

The use of explosives in the oil and gas sector is highly competitive and very technical area. There is a strong need to collaborate closely with customers to ensure the most appropriate selection of explosive from a wide range of possible products. The choice would depend upon a number of factors including the type of geology, depth of use, and whether gas or oil is to be extracted. Other pressures on the industry are the need to gain and keep a competitive edge in a highly resource-intensive field and to be right first time as the financial – and potentially human - consequences of making good after mistakes are considerable.

A fiercely competitive market, the companies have needed to diversify into other areas related to its core business in order to create new markets particularly where lower taxation and higher prospects of good returns on investment may be expected.

Maintaining the skills base is a major issue in the sector as the average age of the workforce has risen from early 20s to the late 40s. The North Sea market has matured, and the ageing workforce reflects both public recognition of this fact and the fact that less work exists now than three decades ago. Above average reward schemes largely account for the low turnover so that retention is not a significant issue although this may present career blockages for those seeking promotion.

As with other industries using explosives, the sector is subject to significant amount of health and safety legislation. Assembling perforating guns for use in wells is deemed to be a manufacturing activity, and is therefore subject to the HSE's licensing and inspection

regimes and the forthcoming MSER legislation relating to the manufacture and storage of explosives.

EXPLOSIVES MANUFACTURE

Explosives manufacturing includes the assembly, construction and blending of components that produce explosives. Due to the decreases in the mining and quarrying industries, explosives manufacturers have also been affected and companies such as Exchem have diversified into related areas such as speciality chemical manufacturing, quarry blasting contracting, the manufacture of mining adhesives, explosive ordnance disposal (EOD), explosives training and consultancy, storage, transport and even farming – which optimises the large amount of land which by law must surround sites where hazardous materials exist. These services are seen as "value-added" as they deliver more to the client. For example, in the past, explosives were sold to quarries, but now, the service offered to customers is rock removal.

The shrinking markets in the quarrying and mining industries have also affected explosives manufacturers in that the reductions in business have resulted in Joint Ventures (JVs) between separate companies.

The biggest driver to civil business is the safety requirement. This affects the whole industry's operations in a number of ways. Developments in technology have altered the supply of explosives to quarries through the introduction of mobile blending vehicles, thus rendering the transport process safer. Separate elements – which are themselves safe – are brought to the site and then blended to form explosives. Factory planning needs to take into account the need for remoteness – which in turn affects the distribution chain, and the requirement for a maximum number of people in a magazine needs to be taken into account when planning manpower needs and operations.

A reasonably recent development in military explosives manufacturing is the introduction of Plastic Bonded Explosives (PBX) which are used to make Insensitive Munitions (IM). It is MoD policy to employ IMs which have the same effect as conventional munitions but are safer to store and transport. There is therefore a trend toward using IMs where they are appropriate to the application and cost-effective (the production costs are significantly more expensive than conventional explosives). Royal Ordnance is the only UK manufacturer of IHEs (Insensitive High Explosives) and due to the increasing uptake of IMs, it is in the process of closing down its conventional manufacturing and filling facilities. The manufacture of PBX requires a different process from that of conventional explosives.

DISPOSAL

Munition clearance encompasses explosive ordnance device disposal (EOD); conventional munition disposal (CMD); improvised explosive device disposal (IEDD); weapons of mass destruction disposal (WMDD) (also known as chemical, biological, radiological and nuclear weapons disposal (CBRNWD); explosive ordnance clearance (EOC); range and

training area clearance; battle area clearance (BAC); humanitarian demining (HDM); demilitarisation of abandoned and stockpiled munitions, clearance diving and systematic search. Although a critical aspect of the munition clearance process, the latter discipline has broad utility and provides a stand-alone capability.

The primary focus of CMD activities is Explosive Ordnance (EO). Explosive ordnance is the primary tool of conflict and is designed to kill or deter people, cause delays and deny routes and objectives to opposing armed forces and civilian populations. But the majority of munition clearance also has as an objective the protection of life, property, the economy and the environment. The global military arsenal of conventional weapons – current and obsolete – is vast. All explosive ordnance is capable of presenting those tasked with CMD with potential explosive hazards and these may be encountered in peace, tension/crisis and war in a range of environments. The threats may result from ordnance that has been fired and failed to explode, abandoned explosive ordnance whose provenance is unknown or from deliberately placed explosive ordnance such as anti-personnel mines.

IEDs are the tools of terrorist and criminal groups around the world and are the primary focus of IEDD activities. Such groups maintain wide-ranging links with each other that enable single groups to benefit from tactical or technical advances made by other groups. Effective countermeasures often result in terrorist groups escalating the technical threat using ever more complex technology and sophisticated tactics. Many types of IED are common to several groups and there is increasing evidence of shared knowledge worldwide either on a bilateral basis or through widely available papers and the internet.

Disposal by commercial companies is seen as a growing market. This is partly due to the confiscation of fireworks which must be disposed of; the Scottish offshore industry needing to dispose of shaped charges which no longer meet European standards and for reasons of good housekeeping; and an increasing tendency in military contracts to include demilitarisation clauses.

Within the private sector companies operating in the munition clearance arena, there are concerns as to the lack of training – both in quantity and in quality. The competence of job applicants and existing practitioners cannot be assured due to the lack of any nationally or internationally recognized qualification (although military qualifications are recognized by Non-Government Organizations.) The risks to life and limb to the practitioners themselves and bystanders – is therefore considerable. Furthermore, incompetent munition search and clearance operations can degrade military effectiveness (war winning) and inhibit post conflict reconstruction by resulting in unnecessary loss of life, injury, and economic and environmental damage. It is also felt that where training is available, it is likely to be comparatively role-specific. Any munition clearance operative who moves between employers or to new geographical sites may be under-trained and therefore, at risk. A globally

recognized competence-based qualification is seen as a means of assuring competence and therefore, reducing risks to safety.

FIREARMS PROOFING

Although not exempt from the Health and Safety at Work Act, the Crown is exempt from a requirement for weapons to be proved when these have been manufactured by government and used by HM Forces. However, since all manufacturing is now in private hands, all weapons are required to be proved. In practice, there is little manufacturing in the UK which has led to a decline in business for the Proof Houses.

The Proof Houses employ around 16 people across two sites, and, there is low staff turnover, and whilst a popular choice for job applicants, few are suitable.

Proofing is the compulsory and statutory testing of all new commercial shotguns or other small arms before sale to ensure, so far as is practicable, its safety in the hands of the user. Reproofing is the similar testing of a small arms model which has previously been proved. Both involved the firing through the barrel of a considerably heavier load than is customary in the shooting field, thereby setting up pressure and stress on the barrel and action much in excess of the pressure generated by standards load cartridges. Such pressure is intended to disclose weaknesses in guns.

Commercial small arms proving (maximum 2in bore) is carried out by the Worshipful Company of Gunmakers at their two Proof Houses (one in London, the other in Birmingham). The Livery Company was established in 1637. There is a Committee of 8 people; a Court of 18; and a Livery of 270.

All commercial arms (new, antique and imported) are subject to proofing. Attachments to arms (eg sound modifiers) and ammunition are also proofed. Some large bore weapons (ie more than 2in) are also proofed such as cannons used by re-enactment societies and film production companies in order to obtain public liability insurance. The standards and regulations covering small arms proving are laid out in the Gunbarrel Proof Act of 1868 and the Rules of Proof (last edition 1989) which is currently being re-drafted, and which specified how guns and ammunitions are tested. The Gunbarrel Proof Act 1978 enables reciprocal recognition of proof marks by international signatories.

Large military arms and munition proofing (ie over 30mm/2in bore) is carried out by QinetiQ at Shoeburyness. MoD Pendine (QinetiQ) proofs, tests and evaluates military munitions up to 30mm bore and is NATO's Small Arms Proof House. The principles of stressing to ensure the weapon and ammunition are fit for purpose apply equally to large bores. This includes subjecting shells to extreme conditions to ensure their fitness for purpose in the different environments in which they might be used. A release certificate specifying the conditions in which the piece is safe to use may then be issued.

Maintenance is part of the proofing requirements as failed ammunition could be unstable, unpredictable and unsafe, it must be re-proofed as it reaches the end of its lifespan to re-qualify as safe and fit for purpose. For military ammunition (and all its components), the lifespan is determined at the outset by DOSG and a re-proof profile is determined ie the date by which the item must be re-proofed and the method for doing so. This is listed in the initial certificate of serviceability. The proofing programme covers different elements of re-proofing. For example, it might cover a full cycle of testing or it might involve specific types of environmental testing as well as firing. The rigour of the testing regime is usually proportionate to the cost of the item being tested.

MOTOR INDUSTRY

Every modern car is fitted with sensors that actuate explosive airbags on impact. Since the airbags are swift to respond to the signal, seatbelts must be fitted with pre-tensioners to ensure their simultaneous co-ordination. Two occupations are involved in activities associated with explosive elements of car manufacturing: Motor Vehicle Technicians and Vehicle Body Repairers.

Due to the presence of explosives, the industry is subject to the HSE's explosives legislation in the same way as other industries. The main issue for the industry is the need to keep the workforce's skills up to date with rapidly advancing technology such as those needed to fit, remove and replace airbags.

DEMOLITION

The demolition market is currently buoyant due to the confidence in the economic climate, with demolition work preceding building programmes. Safety is the biggest driver of the industry as historically, demolition is the cause of the second largest number of deaths in the building industry. However, the use of explosives is regarded as ten times safer than traditional methods of dismantling, and is therefore becoming a more acceptable method of demolition. Comparative risk assessment is a way of life in demolition – literally, comparing the advantages and disadvantages of each different method of carrying out a demolition task. On a purely economic basis, the use of explosives would be the most beneficial.

Estimated as an annual market of approximately £20m, the UK explosives demolition market accounts for roughly 10% of the whole UK demolition market and is growing for reasons of safety and economic efficiency.

In general, the industry does not experience recruitment problems as there is a steady stream of applicants with relevant experience leaving the armed forces. However, these recruits require training in the commercial aspects of demolition. Also, as they are recruited often in their early – mid 40s, their remaining working life is limited. It is

anticipated that – due to demographic reasons – there will be an acute shortage of explosives engineers and concerns have been expressed as to the need for training to begin now as part of the succession planning process.

TRANSPORT AND STORAGE

The commercial movement of ESA is a relatively small niche market. Full details are not available for security reasons, but it is estimated that some 30K – 40K tonnes of commercial explosives are moved into and out of the UK annually. The split between defence business and commercial business is estimated as approximately 50/50. It should be noted that this does not include commercial contracts for allied power defence and the MoD's own large ESA movement commitments. There has been a significant reduction globally in the need for explosives to be used in mining as chemicals can now be blended on site, thus obviating the need to transport explosives to the site. This trend is expected to increase. There is also expected to be a downturn in the defence market for the movement of explosives as weapons become more accurate and technology advances, so decreasing the need for large amounts of ammunition although it will remain significant. Conversely, as weapons become smaller and more portable, an increase in risks relating to terrorism is expected.

Unsurprisingly, given the high insurance costs, the typical cost of moving an explosives container is around five or six times the cost of moving a normal container load. Despite the potential for profit, few carriers will take the risk of operating in this area. The explosives movement sub-sector is heavily regulated, and the constraints imposed by regulatory controls have led to the creation of a sub-network of specialist carriers by land, sea and air within the general national and international freight movement markets. Five specialist companies operate in the UK, varying a bit in their particular specialities but in general offering a full package of chartering ships, lorries, trains and planes. Services can, if required by the customer, include checking the customer's packing and labelling, arranging transport to airports, holding cargoes in magazines, arranging customs export clearance and import clearance at the cargo's point of export and its destination, trucking arrangements, security, and obtaining import, export and transit licences. Historically, customers dealt with a number of different operators for each part of the movement chain but modern operators have unified services into one logistics chain, offering both increased efficiency and reductions in risks to both health and safety and in security as well as reducing the risk of commercial loss. An important aspect of moving explosives is that, if anything goes wrong, consequential costs rapidly mount exponentially and disproportionately.

Strategically, the explosives movement sub-sector is significant as it enables the conduct of military operations, and hinders their execution in the case of problems. For example, when the Royal Fleet Auxiliary *Fort Stixene* loaded with ammunition exploded in Bombay harbour in 14 April

1944, it caused so much damage that the British campaign against the Japanese was delayed by 3 months.

The category of explosive as classified by the UN determines the transport requirements. For example, category 1.1 explosives (potential instant mass detonation of the whole load) cannot be transported by passenger ferry or by tunnel. Many shipping lines will not take such loads even if they are allowed to so by the terms of the port explosive licences as the commercial risks from delays, inspections and regulatory requirements are disproportionate to revenues. The correct labelling of the categories of explosives is therefore critical as this determines the treatment of the consignment by successive carriers and facility operators throughout its movement.

When explosives are moved domestically or internationally, they must be certified as safe for “transport as packed” by national Competent Authorities. In the UK, the two Competent Authorities are the HSE Explosives Inspectorate and the MoD. However, a small consignment of detonators would be categorized as hazard division 1.1 but can be downgraded to hazard division 1.4 by packing them in a 1m3 box of Kapok or similar material.

There exist reciprocal agreements to accept other countries’ designations as safe for transport but no absolute requirement to accept them. In practice, most countries’ designations are accepted but some – from specific countries – are checked in detail before import licences are granted.

All explosives (and other dangerous goods) are allocated a 4-digit UN number from which the carrier determines the requirements for storage and movement. Consignors are responsible for correct labelling. As with the correct classification of explosive type, correct labelling is critical as the majority of transport problems are caused by incorrect labelling. Incorrect labelling results in incorrect and unsafe handling by successive carriers, docks and airport, who think they are handling a consignment with hazard characteristics in accordance with the labelling but are in fact handling explosive with quite different hazard characteristics.

Once the load has been allocated its UN number, the carrier must follow various codes depending upon the method of transport to be used.

For transport by sea, carriers follow the United Nations International Maritime Dangerous Goods Code. Inter alia, this suggests what training must be given to ships’ crews; how the cargo must be stowed, packed and separated from other hazardous goods.

For road transport, the current UK legislation covering the movement of dangerous materials is the Carriage of Explosives by Road Regulations 1996 as amended and the Carriage of Dangerous Goods by Road (Driver training) Regulations 1996. These are to be replaced in May 2004 by the Agrément pour le Transport des Marchandises Dangereuses par Routes (known in the UK as “ADR”) and the Carriage of Dangerous

Goods and Use of Transportable Pressure Equipment Regulations which enshrine ADR into UK law. Whilst the UK signs up to the main principles of ADR, there remain some historical differences in the detail eg traditional acceptable UK weight limits exceed those of other EC nations. Also, as ADR legislation specifies the vehicle requirements for different types of explosive category and the limits on combinations of different categories, this has investment implications for management in deciding how many and which types of vehicle should be bought or leased, or whether sub-contracting arrangements should be made.

By rail, carriers follow the Regulations Concerning the International Carriage of Dangerous Goods by Rail. For transport by air, carriers follow the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air. For explosives to be transported under either of these regulations, the carrier selects and applies the treatment appropriate to the designated UN classification.

Both the amount of regulation and the rate of change are factors identified by the industry as causing additional burdens on their operations, but also, what are seen as contradictory requirements. A dichotomy is perceived between the need for safety and the need for security. For example, whilst the safest place to keep a lorry load of TNT would be in the middle of an open space, the securest place would be confined in secure premises – which would not be the safest. In the light of recent military offensives and global terrorism, the industry perceives the trend for current pressures as moving from the greatest need for safety to the greatest need for security.

FIREWORKS

Few fireworks manufacturers remain in the UK due to the huge import market from China. This, coupled with high UK labour costs has driven the UK fireworks manufacturing market into decline. For those that remain, fireworks are manufactured, tested and packed in warehouses, but the transport function for distribution to retailers is contracted out.

The supply of fireworks is a major support to the retail industry, and makes a substantial contribution to 30,000 retail outlets. The consumer market is worth around £60m per annum and professional displays are valued at around £20m p.a. Approximately 30 companies import fireworks from China and supply the retail trade. The fireworks market is seasonal and relies heavily on temporary and part time staff. Retailers of fireworks are required to obtain a local authority licence issued under the Explosives Act if they store up to 1800Kg of fireworks. Fireworks are usually sold in small shops which do not generally belong to any particular industry or trade group.

Trends in the fireworks industry have changed little in the last century and are not subject to changes in taste or technological advance as in other industries.

Changes in legislation dealing with fireworks is imminent, taking effect by December 2003, through the Fireworks Regulations 2003 and the Manufacturing and Storage of Explosives Regulations (MSER) which will replace the 1875 Explosives Act. MSER legislation will affect all industries using explosives. From the fireworks industry perspective, the enabling legislation of the Fireworks Act 2003 will make it illegal to possess fireworks under the age of 18 and to possess fireworks not intended for general public use (previously, it was illegal to supply fireworks but not to possess them). In addition, there will be a fireworks curfew between 11pm and 7am. The new legislation will also cover a formal training requirement for those involved with professional displays; the time of use; and the enforcement of the current voluntary agreement of the 3-week selling period prior to 5 November. There will also be tighter controls on imports as there is currently a substantial problem with illegal imports in the way that they are stored and sold. Decibel limits will also be introduced.

The MSER legislation will increase the amount of consumer fireworks stored at retail outlets; allow an increase in the amount of consumer firework on display at retail outlets and update the way that fireworks are stored at retail outlets.

The biggest issue for the industry is the nuisance factor and the constant noise produced by fireworks has created adverse publicity for the industry. However, the single biggest issue is the misuse of fireworks post-sale, and the industry is attempting to educate retailers who are regulated by local authorities in the storage and sale of fireworks.

In the UK, it is illegal to set off fireworks in a public space (note: the area surrounding public displays are in fact roped off, therefore creating a “private” space). This differs from other EU countries which permit letting off fireworks in public (streets, parks, open spaces etc), and the UK is far more heavily regulated than elsewhere in the EU. Attempts to introduce harmonized EU-wide legislation are seen as potentially harmful to the UK which is already in advance of other member states.

In many industries, the packing function has been automated to varying degrees – either partially or wholly. However, in the event of an incident, it would be difficult to stop the propagation of reaction, and therefore, fireworks packing is carried out on a small batch basis rather than continuous production. The packing area is cleared after each batch before starting the process again. Fireworks packing is therefore subject to less automation than other industries. This poses a further problem. The imminent EU Pyrotechnic Directive will require more rigorous standards of testing and labelling which will mean making QA checks on samples from each batch made. In Kimbolton’s case, where large fireworks are made for professional use, a 25% test of the 7Kg batch represents 1 firework in 4 being used for QA purposes. The commercial implications of this are significant.

A risk assessment is made in each production shed for each process. There is now a requirement for each risk assessment to be written which

has increased the amount of time spent on carrying out risk assessments. However, as people do not in general read them, there remains a constant communication requirement to ensure all staff remain alert to the common dangers caused by impact, friction, static, temperature and humidity – all of which are frequent topics for in-house training.

There are as many as 5,000 professional fireworks display operators in the UK although many of these do not practise more than once a year. Since 1996, government has been increasing regulation in this area, and the DTI has designated certain items as to be used only by "professionals". The currently accepted definition of "professional" is someone who has 365 day per year insurance; has access to proper storage arrangements (as defined by HSE); and is "competent" – although there is at present no agreed definition of what this is. Effectively, this change of emphasis has shifted fireworks displays from a leisure pursuit into the world of work. Display operators are responsible for carrying out site risk assessments and ensuring that any changes at the site are accommodated in the display plan. For example, the new or changed location of marquees and car parks could present new risks and the planned debris patterns and trajectory angles may need to be re-calculated.

PERFORMING ARTS SPECIAL EFFECTS

In 2003, the worldwide film industry was worth £42.3billion and is growing by 6.3% per year. It has been forecasted that in 2007, consumers will spend £54billion watching films in the cinema and on video. The value of indigenous UK production has fluctuated between £165m and £200m since 1996, well above the £30 - £40m level of the early 1990s.

Although one of the smallest occupational group within the performing arts industry, Special Effects is one of the most prestigious. British Special Effects technicians are often said to be unrivalled, with increasing numbers of US films being made in the UK as a result.

There is fierce competition both among UK companies and between UK and overseas businesses, in particular, those in Eastern Europe and the US. However, competition is generally viewed as a positive thing – a motivation for constant improvement and excellence.

Employers recognize that the creativity of their people is paramount. However, investing in skills development is a significant and sometimes prohibitive operating cost.

Special Effects is both a small and specialist area, and entry is difficult despite the increasing number of special effects being used in films and television programmes. Media and graphics courses are available, but new entrants still have to shadow those working above them for some time before they have the experience to progress, particularly in more dangerous and technical areas such as pyrotechnics.

Many special effects companies have been in existence for an average of around 12 – 15 years, and most employ between 10 and 25 permanent staff.

The key business drivers to the Special Effects industry are:

- the increase in the global visual effects market
- shortages of talent
- lack of easy access to the global employment market
- fiscal policy in the UK to sustain inward investment
- pressure on budgets, competition with cheaper markets
- difficulty in finding better quality but cheaper technology.

The UK film industry is in direct competition with the American market, and the Special Effects sector loses its personnel to the American market due to their attractive salaries.

Freelancers are assessed on a job-by-job basis.

The industry is heavily regulated, and there have been no plans to develop N/SVQs to date.

NUMBERS EMPLOYED WITHIN THE SECTOR

TOTAL INDUSTRY SIZE

Despite its name, the DTI Small Business Service (SBS) is able to provide data on the numbers employed in different industries regardless of the size of the organization. These data derive from VAT returns. However, whilst the Standard Industrial Classification (SIC) codes are identifiable for relevant industries down to a 4-digit level of detail, the SBS's data are only available down to a 3-digit level of detail. This means that industries or sectors are included which may not necessarily be relevant to ESA occupations. For example, SIC code 101 includes the manufacture of solid fuel in addition to deep and open cast coal working. It also includes civil engineering projects that may or may not use explosives (eg the Channel Tunnel). Similarly, SIC code 246 includes the manufacture of glues, gelatines and essential oils in addition to explosives and fireworks manufacture. However, they do provide useful indicators.

The SIC codes relevant to ESA occupations are:

10.10 Coal mine (deep or drift)

11.10 Gas extraction (natural gas)

11.20 Oil extraction service activities

14.11 Quarrying of stone

14.12 Quarrying of limestone, gypsum & chalk

14.13 Quarrying of slate

14.21 Quarrying of sand & clay

24.61 Explosives manufacture/firework manufacture

29.60 Firearms manufacturers (hunting, sporting or protective use)

34.10 Motor vehicle manufacture

45.11 Demolition contracting/blasting & associated rock removal

45.25 Mine sinking

51.12 Fireworks (commissioning agent)

51.55 Explosives wholesalers

92.11 Motion picture production on film or videotape

92.20 Television programme production

92.31 Live theatre presentations.

The table that follows shows the total numbers employed in civilian organizations. These figures include roles not associated with ESA occupations) at the greatest level of detail possible from the SBS ie 3 digits.

Note that the numbers have been rounded to avoid disclosure. A symbol * replaces data that are deemed to be disclosive.

SUMMARY OF AVAILABLE DATA OF CIVILIAN NUMBERS OF EMPLOYEES (000S) BY SIC CODE

Employer size	101	111	112	141	142	246	296	341	451	452	511	515	921	922	923	Total
Micro	0	0	0	2	1	1	0	2	5	196	23	40	9	5	30	314
Small	*	*	*	2	2	4	0	2	6	140	13	67	7	5	13	261
Medium	*	*	3	*	*	9	*	4	*	96	*	49	*	7	13	181
Large	*	*	*	*	*	18	*	90	*	198	*	87	*	53	14	460
All	11	11	14	6	19	31	15	98	18	630	52	242	38	70	71	1326

NUMBERS EMPLOYED IN ESA OCCUPATIONS IN COMMERCIAL APPLICATIONS

DEFENCE MANUFACTURING

It is estimated that the defence manufacturing industry employs approximately 21,000 people, of which 4000 are engaged on ESA work.

COAL MINING

The Coal Authority gives the figures of those employed in September 2003 in the UK coal industry as:

Open cast:	2350
Underground:	6209
Total:	8559.

Of these, it is estimated that around 50 people working in open cast mines use explosives, and around 25 people in deep mines ie 75 in toto.

QUARRYING

EPIC – the National Training Organization for the extractive and mineral processing industries quotes 30,000 people as employed in work relating to quarry products. The latest date for which figures are available of people qualified to use explosives (ie Blast Design certificates, Explosives Supervisors and Shotfirers) is 2000. At this date, the numbers were 750. Although this figure will have been exceeded, it is not possible to say by how much.

OIL AND GAS EXTRACTION

It is estimated that there are approximately 35,000 people as a whole working in the offshore oil and gas sector ie on-shore support and platforms. Of these, it is estimated that there are 200 at most who use explosives.

EXPLOSIVES MANUFACTURE

It is estimated that the explosives manufacturing industry employs approximately 600 people of which around 200 are employed on ESA activities.

FIREARMSPROOFING

There are 16 people employed in roles that involve explosives handling in the two UK Proof Houses dealing with small arms proving.

The proving of large weapons is carried out by QinetiQ. The numbers involved are listed separately under the MoD heading.

MOTOR INDUSTRY

There are 226,627 Motor Vehicle Technicians and 28,535 Vehicle Body Repairers involved in fitting airbags and pre-tensioners in the motor vehicle manufacturing industry ie 255,162 in total (source: Motor Industry Training Council).

DISPOSAL

The figures below were listed in the Munition Clearance Occupational Map. As these have been included elsewhere, they have not been included in the totals, but are shown here for completeness' sake.

ORGANIZATION	Nos. employed	Nos. potential candidates
33 Engineer Regiment (EOD)	650	520
Royal Logistic Corps	700	600
Royal Navy (FDS and MCMVs)	281	269
Royal Air Force Armament Support Unit	168	168
DEODS	63	46
NSC (military branch)	70	30
NSC (police branch)	18	11
DSTL	1180	542
QinetiQ Shoeburyness contractors	55	35
Police Service	1000	800
Contractors (estimate)	c.200	c.100
Territorial Army	446	360
TOTAL	4707	3481

DEMOLITION

There are 3 specialist demolition companies employing around 150 people in total. Of these, approximately 80 people use explosives.

TRANSPORT AND STORAGE

The logistics industry as a whole employs some 1.7 million people in 63,000 companies. Skills for Logistics estimates that there are 455,000 people involved in warehousing occupations (of which 68,000 are employed in a management function). The Health and Safety Executive estimates that of these, around 500 are engaged in the warehousing of ordnance, munitions or explosives.

The industry covering the manufacture of transport equipment (ie all motor-related vehicles) is estimated at 4,309,472 at spring 2004 (source: Automotive Skills). At September 2003, there were 110,000 drivers qualified with a Vocational Training Certificates for driving dangerous goods. It is estimated that approximately one third of these ie 36,666 would be qualified in Class 1 (ie explosives). There are approximately 4,500 qualified Dangerous Goods Safety Advisers (DGSAs) most of whom would be qualified to cover Class 1.

FIREWORKS

There are no published numbers of those people directly involved in fireworks handling occupations (manufacturing, retailing or displays). It is estimated that there are around 1000 staff employed in manufacturing and importing companies (ie excluding retailers). Of these, it is estimated that about half are sales and administrative staff, and the remaining 500 are involved in packing, warehousing, manufacturing and testing occupations.

PERFORMING ARTS SPECIAL EFFECTS

Skillset, the Sector Skills Council for the audio visual industries estimates that there are around 34,000 people in the industry as a whole. BECTU estimates that there are some 654 people employed in Special Effects, of whom 127 are freelances. Within Special Effects, it is estimated that 150 people are employed in pyrotechnics.

TOTAL ESA ESTIMATES IN COMMERCIAL APPLICATIONS

Sector	**Sub-sector numbers**	**ESA Numbers**
Defence manufacturing	21,000	4000
Coal mining	8559	75
Quarrying	30,000	750
Oil & gas extraction	35,000	200
Explosive manufacture	600	200
Firearms proofing	16	16
Motor industry	4,309,472	255,162
Disposal	4707	4707
Demolition	150	80
Transport & storage	565,000	367,168
Fireworks	1000	500
Special effects	654	150
Total	**4,976,158**	**633,008**

ARMED FORCES AND MOD EMPLOYEES IN ESA OCCUPATIONS

Surveys have been carried out in both the armed forces and across MoD and other civilian functions to identify the numbers of personnel in ESA occupations. The results are set out below.

ARMED FORCES

ROYAL NAVY

Total population: 36,000 including the Royal Marines of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Storage, handling	100	200	250		
Maintenance & repair (ship)	150	200	500	250	
Safety management (ship & shore)	350				
Trials & development**	500	500	250		
Procurement/upkeep**	250	250	200		
Training	150	250	500	150	
Total	**1500**	**1400**	**1700**	**400**	
Grand total					**5000**

Prepared by Denise Clarke

ARMY

Total population: 100,000 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Transport: Drivers				10,000	
Transport: Escorts				10,000	
Transport: Authorized representatives				2500	
Storekeeping: Ammunition Storeman				1000	
Technical: ATO	250				
Technical: AT			330		
Total	**250**		**330**	**23,500**	
Grand total					**24,080**

ROYAL AIR FORCE

Total population: 65,341 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Total	**3091**	**4010**	**891**	**3984**	**2**
Grand total (inc. MoD civilians employed by the RAF)					**11,987**

SUMMARY OF ARMED FORCES ESA POPULATION

	Managerial	**Supervisory**	**Technician**	**Operator**	**Other**	**Total**
Royal Navy	1500	1400	1700	400		5000
Army	250		330	23,500		24,080
RAF	3091	4010	891	3984	2	11,987
Total	**4841**	**5410**	**2921**	**27884**	**2**	
Grand total						**41,058**

MINISTRY OF DEFENCE

DEFENCE PROCUREMENT AGENCY (DPA)

Total population: 4200 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
OME Safety Adviser	7	15	33		
OME Project Manager	9	23	66		
OME Commodity Manager		8		11	
OME Quality/Safety	1	9	15		
OME Policy & Regulation	5	10	30		
OME Science	7	8	23		
Total	**30**	**73**	**167**	**11**	
Grand total					**281**

AIR LAUNCHED MISSILE INTEGRATED PROJECT TEAM (ALM IPT)

Total population: 180 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
Assembly/Processing (inc. demil)			6		
Inventory Management/Procurement	5	15			
Supply/Demand Management	2	2		10	
Safety (all aspects)	8	30			
Total	**15**	**47**	**6**	**10**	
Grand total					**78**

SURVIVAL & AIRBORNE DELIVERY INTEGRATED PROJECT TEAM (S&AD (IPT)

Total population: 75 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
Transport & Distribution	2	1		1	
Inventory management/Procurement	2	1		1	
Safety (all aspects)	8	2			
Ops/Policy	8	2		1	
Total	**20**	**6**		**3**	
Grand total					**29**

SHIPS MISSILE SYSTEMS INTEGRATED PROJECT TEAM (SMS IPT)

Total population: 135 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
Inventory Management/Procurement	8	8			
Supply/Demand Management	3	6			
Safety (all aspects)	4				
Total	**15**	**14**			
Grand total					**29**

GUIDED WEAPONS SYSTEMS SUPPORT INTEGRATED PROJECT TEAM (GWSS IPT)

Total population: 125 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Transport & Distribution	1	1	2		
Assembly/Processing (inc. Demil)	2	1	2		
Warehousing	1	1	2		
Inventory Management/Procurement	5	5	3		
Planning/Scheduling	4	5	3		
Supply/Demand Management	2	1	3		
Safety (all aspects)	5	5	3		
Ops/Policy	5	5	3		
Total	**25**	**24**	**21**		
Grand total					**70**

DEFENCE MOVEMENTS AND TRANSPORT AUTHORITY (DTMA)

Total population: 400 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Drivers				50	
Total				**50**	
Grand total					**50**

DEFENCE GENERAL MUNITIONS INTEGRATED PROJECT TEAM (IPT)

Total population: 160 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other**
Transport & Distribution	4				
Assembly/Processing (inc. Demil)	2				
Warehousing					
Inventory Management/Procurement	38				
Planning/Scheduling					
Supply/Demand Management	20				
Safety (all aspects)	37	5	6		
Ops/Policy	8				
Total	**109**	**5**	**6**		
Grand total					**120**

DEFENCE STORAGE & DISTRIBUTION AGENCY (DSDA)

Total population: 45,000 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	**Managerial**	**Supervisory**	**Technician**	**Operator**	**Other (admin)**
Transport & Distribution	4	4		55	
Assembly/Processing	62	47	131	87	
Warehousing	11	29		241	
Inventory Management/Procurement	2	1		7	
Planning/Scheduling	23	5	18	25	
Supply/Demand Management	8	1		11	
Safety (Licensing)	9	3		2	
Policy/procedure	64	12	8	7	
Property Management	8	3	1	18	
Jetty Handling	1			21	
Quality	5				
Head of Establishment	1				
Total	**198**	**105**	**158**	**474**	
Grand total					**935**

SUMMARY OF MOD ESA POPULATION

Organization	Managerial	Supervisory	Technician	Operator	Total
DPA	30	73	167	11	**281**
ALM IPT	15	47	6	10	**78**
S&AD IPT	20	6		3	**29**
SMS IPT	15	14			**29**
GWSS IPT	25	24	21		**70**
DTMA IPT				50	**50**
DGM IPT	109	5	6		**120**
DSDA	198	105	158	474	**935**
Total	**412**	**274**	**358**	**548**	**1592**

DEFENCE RESEARCH

DEFENCE SCIENCE & TECHNOLOGY LABORATORIES (DSTL)

Total population: 1223 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
Range (ie trials)	2	7			1 Trainee
Magazine	1				
R&D	13	39	15	152	15
SHEF	1				
Total	**17**	**46**	**15**	**152**	**16**
Grand total					**246**

QINETIQ

Total population: 9000 of which the following roles are involved in ESA work:

Functional area (eg storekeeping, transport)	Managerial	Supervisory	Technician	Operator	Other
Research scientists and engineers	21	52	92	67	
ESA support staff	3		5	19	
Management of ESA operations	37				
Trials/Project Planning/Management	21	4		1	
Explosive Storage	4	7	13	8	
Explosive Transportation	2	7	12	24	
ESA Trials	13	14	12	17	63*
Range Support	1	2	9	16	2
Environmental Testing		5	8	39	
Demilitarization	4	7	2	41	
Proof and Test	10	13	10	2	
Demolition and CMD	17	5	5	3	
Armament Accounting	5	4	10		
Total	**138**	**120**	**178**	**237**	**65**
Grand total					**738**

* Weapons armourers who wire up explosive devices to test or military platforms (eg bombs on planes, ejector seats actuators, rocket motors). Many technicians working on aircraft weaponry have no formal ESA training but this is part of the package of training specific to the weapons system with which they work.

GRAND TOTALS

Total population: 5,237,997 of which the following roles are involved in ESA work:

Sub-sector	Managerial	Supervisor	Technician	Operator	Other	Total
Armed forces	4841	5410	2921	27,884	2	41,058
MoD	412	274	358	548		1592
DSTL	17	46	15	152	16	246
QinetiQ	138	120	178	237	65	738
Private sector	Not available	Not available	Not available	Not available	Not available	632,508
Grand Total						**676,142**

Prepared by Denise Clarke

ROLES

There are large numbers of people working with explosives in the military and civil sectors. Members of the armed services transport, store, use and dispose of explosives on a daily basis. In the civil sector, explosives are use in the mining, offshore and demolition businesses as well as explosives and fireworks manufacturing, special effects and retailing.

THE SUB-SECTORS

MOD

DEFENCE PROCUREMENT AGENCY (DPA)

INTEGRATED PROJECT TEAMS (IPTS)

Please see the DLO Munitions Business Area section for a description of IPTs.

DEFENCE ORDNANCE SAFETY GROUP (DOSG)

SAFETY POLICY AND REGULATION

Staff in the Safety Policy and Regulation area provide policy and regulatory oversight across a number of areas: Defence Land Range Safety; Military Laser Safety; ESA Safety Management; Explosives Safety; and Major Accident Control Regulation. They are responsible for producing and maintaining regulatory standards within the UK and represent the UK on NATO policy in certain areas relating to explosives safety. Close liaison is maintained with national legislative bodies such as the HSE, EA and SEPA. The group also provides a forum for exchange of information between the MoD and industry on ESA subject matters as well as providing the focal point for foreign government discussions.

Personnel in these roles combine military and civilian backgrounds as both technical and operational understanding is necessary, and who have science, engineering or safety management expertise. Typical work across the group involves the provision of safety advice, the development of Departmental safety policy and regulation, support to functional safety boards across the Department and carrying out assurance activities across MoD service and civilian boundaries.

These staff may hold a first or Masters degree in a relevant subject and have substantial relevant experience – for example, in explosives safety, equipment safety, health and safety management and operational experience.

SAFETY ADVISERS

Safety Advisers interface with DOSG's customers, of which IPTs are the major consumers of advice which might span the design, development, procurement, storage and disposal of ESA. As the size and remit of an IPT differs (from 15/20-strong to teams of 60/70, and covering a potentially wide range of systems or weapons systems, Advisers' input into an IPT also varies according to need and the nature of each Adviser's specialist expertise eg a particular weapon system or an environment (eg desert or under water).

Typically, personnel in these roles combine civilian and military backgrounds as both technical knowledge and operational expertise is necessary, and who have science, engineering and safety management expertise. Typical work involves independent safety advice and risk assessment, interpretation of safety tests and trials, development of ESA design standards, qualifications of energetic materials, management of technology demonstrator programmes, developing and applying Departmental Safety Policy. Other safety advice might cover developing safety policy on certain safety matters such as explosives storage and transport or land ranges safety policy and acting as the MoD focal point for enquiries on a given safety matter.

Safety Advisers normally hold a first or Masters degree in a relevant science subject, most relevant of which is the MSc in Explosive Ordnance Engineering and have substantial relevant previous experience – for example, in explosives safety, equipment safety, risk assessment, trails specification/management and operational experience.

SCIENCE AND TECHNICAL GROUP

Staff in the Science and Technical Group provide support to the policy-making group by providing technical expertise. They also provide the deep level of knowledge needed to support the compliance régime to meet the requirements of the advice provided by the Safety Advisers and provide expert advice to the Safety Advisers themselves. They judge the safety and suitability of ESA during UK procurement and service and represent the UK for NATO policy in certain areas. These roles are responsible for ensuring that new OME and adaptations to existing ESA meet NATO's current standards (STANAGS) and for developing appropriate new standards for future use.

Typically, personnel in these roles combine civilian and military backgrounds as both technical knowledge and operational expertise is necessary, and who have science, engineering and safety management

expertise. Typical work involves independent safety advice and risk assessment, interpretation of safety tests and trials, development of ESA design standards, qualifications of energetic materials, management of technology demonstrator programmes, developing and applying Departmental Safety Policy.

Personnel in these roles normally hold a first or Masters degree in a relevant science subject, most relevant of which is the MSc in Explosive Ordnance Engineering and have substantial relevant previous experience – for example, in explosives safety, equipment safety, risk assessment, trails specification/management and operational experience.

DEFENCE LOGISTICS ORGANIZATION (DLO)

DLO MUNITIONS BUSINESS AREA

The Munitions Business Area has three key components: Integrated Project Teams (IPTs), the Munitions Corporate Business Unit (MCBU) and the Defence Storage and Distribution Agency (DSDA).

INTEGRATED PROJECT TEAMS (IPTS)

These project-based organizations are founded to bring together all stakeholders and involve industry under a team leader able to balance the trade-offs between performance, cost and time within boundaries set by the approving authority. IPTs also provide a clearly defined customer-supplier relationship. Together, these changes will allow IPTs to deliver consistency and continuity throughout the project life cycle, and ensure close and effective involvement of all major stakeholders in key decisions. It includes all the skills necessary to manage the project. These range from requirements management through project management and engineering and technical skills to equipment support. IPTs are the Duty of Care Holders for intrinsic safety. Except during the assessment of competitive bids, the IPT will include representatives from industry and at the appropriate points, financial and technical scrutineers.

MUNITIONS CORPORATE BUSINESS UNIT (MCBU)

As head of the Munitions Business Area (MBA), the MCBU provides support and strategic direction to enable the defence munitions business, especially munitions-related IPTs such that they are able to deliver their outputs most effectively and efficiently. MCBU provides munitions-related operational, logistic and, when appropriate, technical advice to DLO ACDS (Log Ops), Permanent Joint Head Quarters (PJHQ), Front Line Commands (FLC), Director Equipment Capability (DEC) and Chief of Defence Staff, Chief of the Naval Staff, Chief of the Air Staff, and Chief of the General Staff (Centre Staffs). It hosts the work of the Inspector of Explosives (DLO), provides the MoD focus for the management of the MoD/RoD (Royal Ordnance Defence) Framework Partnering Agreement

and co-chairs the top level Steering Committee. It represents the DLO on the Defence Ordnance Safety Board (DOSB) and acts as the focus for explosives safety on behalf of CDL. MCBU also represents the munitions business on the DLO Contingency Planning Group.

Although listed here below, similar inspection roles also exist within the Royal Navy, the Army and the Royal Air Force.

INSPECTOR OF EXPLOSIVES (DLO) TEAM LEADER

This post is responsible for the development, implementation and management of DLO explosive risk management and explosive licensing policy and assuring Duty of Care Holder compliance with appropriate regulation and legislation on behalf of the DLO. The postholder also leads the DLO explosives licensing team and directs the activities of the site inspector. A prerequisite of working in this area is experience of working in and explosives processing and/or storage area and knowledge of explosives-related legislation and regulations.

INSPECTOR

The Inspector post carries out biennial explosives safety inspections of all DLO explosives sites and the IE (DLO) licensed sites in Gibraltar, providing safety advice on request to site operators.

DLO LICENSING STAFF

Posts in this area are responsible for preparing standard and non-standard explosives licences to DLO sites in the UK and also for berths and underground storage and processing facilities in Gibraltar. All licences are required to comply with the ALARP principle (ie that risks are as low as reasonably practicable).

OTHER ROLES COVERED ELSEWHERE

The MBA also employs ESA staff in roles such as transport (including road and jetty operators) and warehouse staff that are described in other sub-sectors.

OTHER ROLES

In its whole life assessment work as well as in operational outputs teams, the MBA requires personnel who have a deep understanding of ESA work – health and safety and legislative requirements in addition to a full understanding of operational requirements, and the nature and functioning of munitions and explosives. However, such roles do not necessarily have a hands-on responsibility for ESA activities.

DEFENCE STORAGE & DISTRIBUTION AGENCY (DSDA)

LOGISTICS SUPPLY MANAGERS

This group consists of logistic specialists. Comprising managers and supervisors, they are not involved in the physical handling of items, but they manage their storage, handling and distribution, and have traditionally started their career through internal specialist training regimes. Their responsibilities include ensuring that sufficient storage is allocated to particular items; that building licences are adhered to; that all health and safety records are kept; and for allocating workloads and planning outload/inload requirements. They are responsible for the stock correctness, accounting and security. They are also responsible for ensuring that in-store maintenance is followed (humidity indicator checks, downgrading etc) and for the serviceability of their holdings. Due to the potentially dangerous nature of the products, the work is heavily regulated and managerial staff need to ensure that the different categories of munitions are handled, stored and moved correctly, according to the designated risk, and that general departmental regulations are adhered to.

In Central Distribution Centres, road and rail vehicles are loaded and unloaded under the supervision of a Logistic Manager who is normally trained to Government Authorized Explosive Representative (GAER) or AR standards. His responsibilities are similar to those of the Jetty Manager in that he has to meet licence and segregation constraints for both the facility and for the vehicles.

Logistic staff are responsible for the safe loading and unloading of road and rail vehicles in accordance with MoD weapons-specific requirements and appropriate legislation such as ADR and CER. Munitions-specific Safe Systems of Work must also be applied. These duties also include ensuring that the correct paperwork is completed as required by the legislation. A clear understanding of the natures and risks of specific munitions handling requirements is essential for roles in Central Distribution Centres.

JETTY MANAGER

Depending on the location, the Jetty Manager is responsible for ammunitioning and de-ammunitioning HM ships/solid support Royal Fleet Auxiliaries (RFAs) including loading lighters and loading and unloading commercial ships. In general, the Jetty Manager is responsible for planning and arranging the delivery and collection of stores in the correct sequence. He is responsible for ensuring that the licence limit for the jetty (including the ship and any lighters involved) is not exceeded and that the correct segregation of munitions explosive Hazard Classes on the jetty or lighter is complied with. He is also responsible for the correct handling of munitions during jetty operations. For some areas,

particularly Naval Armaments Vessels (NAVs), he plans the stowage/segregation layout and loading plan including shoring requirements and displacement. He is accountable overall for safety and compliance with Queen's Harbour and MoD regulations, and International Maritime Dangerous Goods (IMDG) Safe Systems of Work. He is a Government Authorized Explosive Representative (GAER) A clear understanding of the natures and risks of specific munitions handling requirements is essential for this role.

For ammunitioning and de-ammunitioning HM ships/RFAs by lighter, the harbour party ensures the correct placement and sequencing for specific munition loading areas on the receiving ship. The harbour party also ensures the correct item-specific delivery/return configuration using the correct equipment. The Harbour Party is also responsible for general safety including explosive safety with particular responsibilities for lighter Net Explosive Quantity (NEQ) load segregation and integrity for movement by sea.

Jetty Managers are also employed in other business areas in the MoD – namely, the Warships Support Agency and the DLO which also operates jetties and licensed buoys

WAREHOUSE OPERATOR

Warehouse Operators are required to load and unload vehicles either manually, or using fork lift trucks or cranes, and to maintain the appropriate standards of health and safety, housekeeping and access within the warehouse. This might involve ensuring the compatibility of explosive products; ensuring that weight limits are not exceeded; helping to ensure that the maximum limit of the number of people in any space is not exceeded; ensuring that the correct materials are loaded onto the vehicles and that the correct paperwork is completed according to the nature of the Explosives Licence. The work also includes segregation of different stock natures, batches and standards; the proper stock location and identification; palletization of stocks; reconfiguration of pallets and loads to meet consignments; re-marking packages and carrying out general checks to ensure the integrity of stocks.

DRIVER

If carrying a terrorist-attractive load, in both the UK and in the EU, ADR drivers carrying explosives loads are required to work with another for reasons of safety and security. Both drivers and their mates are required to have successfully completed the ADR course in addition to having obtained the appropriate category of driving licence. Drivers need to understand the vehicle load storage requirements and to draw up a stowage plan if required (although this is often done by others). They must secure the load, drive the vehicle and unload on arrival at the destination. For other explosive loads, there is a general security reason to ensure that the load is attended at all times while parked. In such instanced, and depending upon the load content, the escort must be

ADR-trained, or trained to a certain level (the lowest being a “competent person”).

Drivers are also employed in other parts of the MoD.

EXPLOSIVES PROCESSING STAFF

This group includes Managers, Supervisors, Chargehands and Process Operators. Managers rarely handle explosives but have traditionally started their career in this sort of trade. Depending upon the nature of the task and the company’s business, these roles are responsible for a variety of activities using explosive materials ie high explosives, pyrotechnic flares and liquid fuel. They may carry out activities including assembly, integration, test and disposal of explosive materials and components. Due to the sensitiveness of the materials and the need to account for the location of explosive materials, all these roles require a high degree of precision and many require skills of manual dexterity. Some companies provide focused formal and certificated in-house explosives training for these roles.

WEAPONS ASSEMBLY TECHNICIANS

The main disciplines are mechanical and electrical (both being ESA-trained). Besides undertaking the explosive AI&T tasks, technicians must be fully aware of their configuration management responsibilities to ensure that the munitions comprising many “safe life” components and correctly assembled using the correct software and sophisticated automatic test equipment. Technicians are also responsible for ensuring that the correct documentation is completed.

ROYAL NAVY

The following three roles describe the explosives-related responsibilities of people on every RN vessel at sea. All these roles are fulfilled in combination with other responsibilities.

WEAPONS ENGINEER OFFICER/EXPLOSIVES RESPONSIBLE OFFICER

Reporting to the Captain, this role holds the higher management responsibility and the accountable officer at sea for the safe handling and storage of explosives. Role-holders need a clear understanding of the characteristics and effects of explosives as they will be generating local orders, interpreting legislation, and implementing emergency procedures. Trained in-service to in-service standards, this role provides advice and guidance to more junior staff.

OFFICER OF THE QUARTER (SENIOR RATE)

Reporting to the Weapons Engineer Officer, this hands-on role is responsible for the correct maintenance of magazines and for fire fighting equipment. On larger ships, he may drive fork-lift trucks and use other moving equipment, delivering explosives to the weapons and handing over to the user of the ammunition or to the hangar door in the case of aircraft. He accounts for the issue and receipt of unused ammunition, and prepares weapons for firing (eg fitting fins, fuzes and bombtails). He is also responsible for carrying out inspections and completing the associated paperwork. As other roles, this role is trained in-service to in-service standards.

JUNIOR RATE

Also reporting through the chain of command to the Weapons Engineer Officer, this role is responsible for routine maintenance tasks in the magazine such as assisting in preparing the weapons, using lifting equipment and delivering them to the user. This role is trained in-service to in-service standards and needs a basic understanding of the relevant storage and handling regulations.

INTEGRATED PROJECT TEAMS (IPTS)

Please see the DLO Munitions Business Area section for a description of IPTs.

TRAINERS

Ranging from Lt Commander to WO1/Petty Officer ranks, trainers use drill weapons ie without hazardous components. They need a detailed knowledge and understanding of legislation and its implications as they are a resource for operational personnel who seek their advice to clarify rules and regulations.

ROYAL MARINES

There are two relevant roles in the Royal Marines: Armourer (responsible for small arms and rifles) and Assault Engineer. The responsibilities of these roles relate directly to army roles.

SHORE ESTABLISHMENTS

Equivalent to Officers of the Quarter on board ship, roles in shore establishments include responsibilities for small arms and magazines in ensuring compliance with regulations. These roles are fulfilled in combination with other responsibilities.

WATERFRONT SUPPORT ORGANIZATION (FLEET)

The Waterfront Support Organization act as a quality assurance organization for the fleet's ships, for example, ensuring that periodic inspections are implemented, and that the correct standards are maintained in the magazine and storage functions. Although largely administrative, staff in these roles need a clear and detailed knowledge of the procedures and regulations, the characteristics, effects and hazard of explosives.

ARMY

Although known by a different nomenclature, many of the roles in the Field Army equate to those in the Royal Navy.

QUARTERMASTER (QM)

Located in a Regiment, and usually a Major or a Captain, the QM is responsible to the Commanding Officer (CO) for all aspects of ammunition accounting, storage, movement and use. This role holds the higher management responsibility for the safe handling and storage of explosives. Role-holders need a clear understanding of the characteristics and effects of explosives as they will be generating, promulgating and enforcing unit orders, interpreting legislation, and implementing emergency procedures. Trained in-service to in-service standards, this role provides advice and guidance to more junior staff.

MOTOR TRANSPORT OFFICER (MTO)

This role is responsible to the CO for ensuring that all vehicles used to convey ammunition and explosives are suitable for the purpose.

REGIMENTAL QUARTERMASTER SERGEANT (RQMS)

Ranked at WO2 and reporting to the Quartermaster, this hands-on role is responsible for the correct maintenance of magazines and for fire fighting equipment. He accounts for the issue and receipt of unused ammunition, and is also responsible for carrying out inspections and completing the associated paperwork. As other roles, this role is trained in-service to in-service standards.

AMMUNITION STOREMAN

Usually a Corporal, and also reporting through the chain of command to the Quartermaster, this role is responsible for routine maintenance tasks in the magazine such as assisting in preparing munitions for issue, using lifting equipment and delivering them to the user. This role is trained in-service to in-service standards and needs a basic understanding of the relevant storage and handling regulations.

AUTHORIZED REPRESENTATIVE

Located in every sub-unit of every Regiment, the Authorized Representative (usually a Junior Non-Commissioned Officer (JNCO) is a legislative requirement and is duly trained by the competent authority to supervise the conveyance, loading and offloading of ammunition and explosives.

INTEGRATED PROJECT TEAMS (IPTS)

Please see the DLO Munitions Business Area section for a description of IPTs.

TRAINERS

Ranging from Major to senior NCO ranks, trainers use drill and live weapons. They need a detailed knowledge and understanding of legislation and its implications as they are a resource for operational personnel who seek their advice to clarify rules and regulations.

DRIVERS

Drivers may be located in their own units, or in the Transport Regiment of in the Supply Regiment. Every driver transporting ammunition must be HAZMAT-trained. Briefed by the Authorized Representative, drivers are responsible for following their route plan to reach the destination by the optimum method. They ensure the stability of the load periodically and carry out checks to ensure that the load remains in good order.

In addition to the Field Army structure described above, there are other specialist supporting roles.

AMMUNITION TECHNICAL OFFICER (ATO)

Ranking from Captain to Colonel, Ammunition Technical Officers (ATOs) are responsible for planning and managing ammunition processes including inspection, modification, repair and disposal of land service ammunition. They manage the technical elements of proof firings including guided weapons; investigate ammunition accidents, defects and performance failures; execute technical and supply management of global ammunition stocks; plan and conduct battlefield simulations; plan and conduct explosives demonstrations; inspect unit or depot ammunition storage, infrastructure and stocks; plan, site, manage and license ammunition and explosives storage in the base, in transit and in the field. They manage HAZMAT relating to explosives, and conduct risk assessments for all aspects of ammunition management and explosives engineering.

ATOs undergo 18 months' training to degree standard at the Royal Military College of Science Shrivenham and the Army School of

Ammunition. They may also subsequently undertake additional specialist training.

ATOs may be seconded to other units or organizations to carry out particular projects.

AMMUNITION TECHNICIAN (AT)

Ranking from Lance Corporal to WO1, ATs support ATOs in planning and managing ammunition processes including inspection, modification, repair and disposal of land service ammunition. They supervise the technical elements of proof firings including guided weapons; investigate ammunition accidents, defects and performance failures; assist in quality, technical and supply management of global ammunition stocks; plan and conduct battlefield simulations; plan and conduct explosives demonstrations; inspect unit or depot ammunition storage, infrastructure and stocks; plan, site, manage and license ammunition and explosives storage in the base, in transit and in the field. They manage HAZMAT relating to explosives, and conduct risk assessments for all aspects of ammunition management and explosives engineering.

ATs undergo 6 months' training at the Army School of Ammunition. Following a 2 year period, ATs complete a further 5 months upgrading training.

ATs may be seconded to other units or organizations to carry out particular ammunition-related tasks. They may also be embedded within another organization's structure, such as the Royal Marines where a small team is incorporated into the Commando Logistics Regiment.

ROYAL AIR FORCE

Most explosives-related functions within the RAF are carried out within RAF engineering, whether by Engineer offices or by Armament Trade personnel. Logistics functions are carried out within the Supply and Engineering areas (including Mechanical Transport). Additionally, RAF Regiment personnel conduct ranges for Small Arms and other Battlefield Simulation Training. Civilians are employed to carry out related duties on many units, particularly in the Mechanical Transport Driver role.

RAF ENGINEER OFFICERS

Depending upon their appointment and seniority, RAF Engineer Officers authorize, formulate and/or influence policy regarding explosives safety matters and produce the related publications. They also provide a strategic overview of trends and forthcoming requirements. In addition, they may be responsible for providing subject matter expertise, risk assessment, intelligence work, procurement, whole life management and disposal of explosives-related systems. They are also responsible for the day-to-day management of all personnel under their command, including

management of related quality issues and training, authorization, management and supervision of all the related technical activity.

ARMAMENT TRADE JUNIOR MANAGERS

Usually of Warrant Officer, Flight Sergeant and Chief Technician ranks, Armament Trade Junior Managers are experienced supervisors and technicians. They carry out day-to-day management of specialist armament tasks, and often have specific responsibilities for safety and training delegated to them. Depending upon their appointment, they may also assist in the formulation and implementation of policy.

ARMAMENT TRADE SUPERVISORS

Chief Technicians, Sergeants, Corporals and Junior Technicians may carry out the differing supervisory roles in their specialist technical area depending upon their appointment. This may include responsibilities for training and independent and supervisory checks of technical work carried out depending upon their rank. All will be technicians and may be producers as well as supervisors or independent checkers.

ARMAMENT TRADE OPERATOR

Senior Aircraftmen fill Armament Trade Operator and technician roles. They will be supervised for most tasks. Depending upon their appointment, they may be responsible for storage, maintenance, preparation, loading an disposal of weapons and explosive components including ejection seats, weapons carriers and launchers, aircraft guns and small arms.

INTEGRATED PROJECT TEAMS (IPTS)

Please see the DLO Munitions Business Area section for a description of IPTs.

TRAINERS AND ADMIN TRAINERS

Trainers and Admin Trainers may be required to educate armament personnel from first principles to enable them to enter the trade. This requires a knowledge and understanding, and often experience of explosives and their modes of operation, including safety considerations.

RANGE SAFETY OFFICER/RANGE CONDUCTING OFFICER/DEMOLITION SAFETY OFFICER

Range work may be carried out for trials and operational training exercises. Where this involves explosives, selected personnel have to be appropriately qualified in best practice, safe procedures and the emergency drills. Air Traffic Control, Royal Air Force Regiment,

Engineering and other personnel including Air Training Corps and Reserves are affected by this requirement.

LOGISTICS ROLES

Management and implementation of logistics policies rests with the engineer and supply specializations of the RAF. All personnel involved in the storage, air and road transportation of explosives have to be appropriately qualified. Movements Officers (usually of supply and engineering specializations), Supply Officers and all personnel who drive vehicles containing explosives natures must meet the appropriate requirements.

OTHER ROLES

Survival equipment such as life vests and dinghies containing explosive gas generators are maintained by Survival Equipment personnel. However, all related explosives are inspected regularly during their storage and maintenance cycles by armament personnel.

Air Traffic Control personnel store and use flares and other cartridges for emergency and birdscaring purposes. Again, the items used are inspected regularly by armament personnel.

DEFENCE RESEARCH AND TEST AND EVALUATION

EXPLOSIVES CUSTODIAN

The Explosives Custodian is the “owner” of the explosive stock who takes responsibility for ensuring that it is safe before it enters the magazine. This role is responsible for resolving issues in storage, and for authorizing that it is safe to transport. All explosives-related queries are directed to the Explosives Custodian who holds the Hazard Data Sheet, and re-tests the stock as required to maintain its currency, selecting samples for testing if necessary. In addition to technical responsibilities, this role carries managerial responsibilities in administering the chargehands.

TRIALS OFFICER/MANAGER

The Trials Officer/Manager is responsible for the planning and execution of experimental trials to assure the fitness for purpose of weapons and/or ammunition in a safe manner. The Trials Officer might simultaneously hold responsibilities as the Firing Officer or he might be a project manager or scientist. The Trials Officer draws up the trial plan; ensures a peer review of the plan is carried out; ensures the plan is approved; that it contains hazard evaluation sheets; that a risk assessment has been carried out; that roles and responsibilities have been identified, and takes overall accountability for the safe receipt of explosives and conduct of the experiment. The Trials Officer/Manager analyses information provided by the Firing Officer and presents the performance data to customers and makes ballistic calculations to enable larger scale firings. For those

Trials Officers/Managers involved in homeland security, the analysis might be of terrorist devices to determine its functioning and researching new materials, methods and technologies to identify potential terrorist explosive devices. Those carrying out testing also need to know how to deal with failed munitions (see *Operations* under *Disposal*). Trials Officers/Managers need to be formally trained and certified by a nominated person. Historically, Trials Officers/Managers have undergone recognized training course for military personnel (the main source of recruitment) combined with on–the-job experience.

FIRING OFFICER

The Firing Officer is responsible for carrying out research experiments to test outputs in different ways to verify the end effect. This involves connecting explosives to power sources and setting off explosions on trial ranges. These responsibilities are usually combined with other responsibilities – either scientific or technical – which may or may not involve explosives. The Firing Officer receives delivery of the explosives from the magazine, lays out the experiments on the range or in a firing facility and ensures that that they are working to an approved trial plan (they may have drawn up the trial plan themselves or this may have been done by others). The trials will cover both conventional and improvised explosives (ie the raw ingredients). No qualifications are required for this role and appropriate training is carried out in-house.

RESEARCHER

Explosives researchers may be working either with explosives, or technologies and equipments using explosives (eg explosives detection equipment). Researchers need to be aware of the risks involved if they have not carried out the trial risk assessment themselves. To carry out experiments, they need to develop a hypothesis, devise a suitable experiment, execute the experiment plan (see *Trials Office/Manager* above) and make their report. To research energetic materials, a minimum of a first degree in a science discipline might be appropriate – most likely in a physical science. A post graduate award such as those offered at Cranfield University at the RMCS might be appropriate for some research jobs to ensure that research workers have the knowledge and skills to conduct explosives research safely. In-house training is then carried out.

LABORATORY TECHNICIAN

There are two levels of laboratory technician in defence research either of whom might assist on the trials range. The junior laboratory technician carries out routine tasks under the direction of the researcher, and needs only a basic understanding of explosives. Junior laboratory technicians normally hold an NVQ or HNC/D in chemistry or a related discipline.

A senior laboratory technician provides support to researchers or trial teams by undertaking a wide range of activities involving explosives. Such technicians will usually have a detailed knowledge of explosives and their handling procedures. Senior technicians would often work without detailed supervision and will have responsibilities for supervising junior staff. They would normally be qualified with an N/SVQ, an HNC/D or would hold a higher degree.

OTHER TEST-RELATED ROLES

In some defence research establishments, there are additional hierarchical roles relating to testing weapons and ammunition. The following five roles have been identified, each assisting in carrying out safety checks on others' work:

LEADING HAND: Traditionally recruited from the military at WO2 level, this role delivers the ammunition, ensures the range is safe, and selects an appropriate team according to the mix of competencies required. Training is similar to that of Gun Captain in that recruits undergo 9 months' in-house training before operating without supervision after a 2-year period following completion of training.

GUN CAPTAIN: This role prepares the gun for firing, placing the barrel according to the requirements for direction, elevation and distance in order to hit the target, and pulls the lanyard or operates the remote firing box. Usually with a military background, this role is already likely to have extensive military training and experience. Gun captains undergo 9 months' in-house training before operating without supervision after a 2-year period following completion of training.

RANGE WORKER: The Range Worker carries ammunition, sets up the gun cradle (eg bolting it in place), corrects elevation, and reports the gun as fit for purpose. He also dismantles the gun, and completes the documentation. No formal qualifications are required, and in-house training is given.

AMMUNITION INSPECTOR: This role is responsible for checking the UN Hazard Divisions to ensure the compatibility between different groups, types and quantities of explosives. He will also draw up storage plans, and acts as the interface between the depot and transport. The Ammunition Inspector is responsible for ensuring the correct receipt of explosives, and correct deliveries to the correct destination without damage. He will require IT skills to complete shipment documentation and is trained in-house in both explosives and supervisory skills to manage the ammunition workers.

AMMUNITION WORKER: This warehousing-type of role is responsible for moving ammunition around in the magazine, issuing, stock-taking and checking ammunition. Responsible for receiving ammunition, this role also makes up or adjusts propellant charges. No formal qualifications are required, and in-house training is given.

OTHER ROLES

All new explosives must be assessed to define their hazards (and therefore, their response as a material). Small Scale Hazard Tests provide the evidence for safety certification to enable the material to be manufactured, transported, used, and disposed of. Those carrying out these tests and those involved in manufacturing, transport, use and disposal who need to be able to interpret the certificate need to understand the meaning of the test results. They therefore need to have an understanding of the characteristics of explosives and appreciate their effects.

More senior personnel who are responsible for signing off risk assessments and ensuring that work has been carried out with due diligence also require a clear scientific understanding of the characteristics and potential risks of explosives.

DEFENCE MANUFACTURING

DESIGN ENGINEERS

Qualified to HND or BSc level in an engineering discipline (usually mechanical engineering), Design Engineers devise solutions to customers' problems that will deliver their objectives. As there is no nationally available training or qualification route, these roles are trained in-house and through Leafield's courses at Cranfield University at the RMCS to be explosives engineers. Typical tasks for which design engineers are responsible are designs of pyromechanisms and assemblies such as safety and arming units and command break-up units for missiles using mathematical models on in-house developed software from which devices can be manufactured, tested and – if necessary – refined.

ENVIRONMENTAL TESTING STAFF

Environmental testing staff are responsible for both destructive and non-destructive testing and proofing final products, using centrifuges, ovens and other testing methods to ensure that the customer's procurement quality specifications have been met. An ONC or HNC in an engineering discipline is generally a requirement. Although as the testing programme is prescribed (by the manager in conjunction with the customer), and implemented by the technician, these responsibilities could be learned by experience and in-house training including explosives training.

PROJECT MANAGERS

Project managers represent the interface between the customer and the company during the development and production phases. They are involved in progress-chasing to ensure that the requirement is met within

budget and timescale. Requirements vary from degrees to A levels. However, emphasis is placed upon experience in engineering and/or production. Appropriate explosives training is also necessary and would be provided in-house and through Leafield's courses at Cranfield University at RMCS.

WEAPONS ASSEMBLY TECHNICIANS

This role carries out a variety of assembly tasks such as inserting explosive devices into remotely controlled robots used by military personnel. For military contracts, work is carried out to AQAP101 standards and documented according to this standard's procedures.

EXPLOSIVES PRODUCTION STAFF

This group includes Managers, Supervisors, Chargehands and Process Operators. Managers rarely handle explosives but have traditionally started their career in this sort of trade. Depending upon the nature of the task and the company's business, these roles are responsible for a variety of activities using explosive materials ie high explosives, pyrotechnic powder and gun propellants. They may carry out activities including weighing gunpowder and sewing it into bags; filling cartridges or other receptacles to specified levels; assembly of pyromechanisms; gauging post-assembly; stemming and pelleting high explosives; inserting detonators; soldering; and packing into specified packages. Due to the sensitiveness of the materials and the need to account for the location of explosive materials, all these roles require a high degree of precision and many require skills of manual dexterity. Some companies provide focused formal and certificated in-house explosives training for these roles.

STORES STAFF/MAGAZINE ATTENDANTS

With two levels of accountability (Supervisor and Storemen), these roles are broadly the same as those described under *Transport, Distribution and Storage* and exist in every industry where explosives are stored. As for Explosives Production staff, some companies provide focused formal and certificated in-house explosives training for these roles.

OTHER ROLES

Defence manufacturing includes a number of roles that require a clear understanding of the characteristics and effects of explosives together with a detailed knowledge of the procedures by which they should be handled, the consequences of risk and the terms of the Explosives Licence. However, these groups do not themselves handle explosives. These groups include Drawing Office staff, Marketing staff, Production Engineers, Production Control staff and Purchasing staff. Some companies provide in-house explosives training for these roles.

COAL MINING

EXPLOSIVES SUPERVISOR (OPEN-CAST MINE)

This role relates directly to that of the Explosive Supervisor of a quarry. Formerly known as Blast Designers, it is the Explosives Supervisor who analyses rock type (usually by experience), and identifies faults from site investigations already carried out by Engineering Geologists. Explosives Supervisors are responsible for blast planning and ensuring that the blast is carried out to specification.

It is a requirement that Explosives Supervisors must have worked as Shotfirers prior to attending the 2-day training module and 4-day explosives courses. The 3 final examinations will qualify them as Explosives Supervisors.

SHOTFIRER (OPEN-CAST MINE)

This role relates directly to that of the Shotfirer in a quarry. Entrants to the industry typically begin their career as a machine operator before working as a Trainee Shotfirer for a period of months or years. Candidates must then complete the Shotfiring qualification, which is followed by a further period of practical experience under the supervision of an experienced Shotfirer before a final appointment can be made. The training programme includes basic geography, geology, chemistry, and some survey techniques (how to carry out a phase profile). It also provides some science of explosives and basic blast design.

OTHER ROLES (OPEN-CAST MINE)

A small number of people exist in the quarrying industry who handle explosives including the Explosives Storeman and the Shotfirer's helper. Unlike Explosives Storemen in quarries, in open-cast mines, it is not necessary to be qualified as a Shotfirer. There may be others licensed to transport, but as the use of mobile multi-blend vehicles increases, this is likely to decrease the need for open-cast mining staff to transport (except within the boundaries of the mine).

COMMAND SUPERVISOR (DEEP MINE)

Deep mine Command Supervisors are responsible for a geographical area and all the personnel and equipment within that area. They carry out any shotfiring underground, oversee the storage of explosives, and carry them to the location where they will be used. They place, supervise, and detonate explosives and oversee drilling operations. They deal with misfires, and carry out investigations. Command Supervisors are responsible for ensuring that all personnel follow safety processes and documents their reports. Command Supervisors are qualified through the statutory MQB scheme by attending the theoretical

course delivered by Mines Rescue and Doncaster College, and completing 20 days' practical work under supervision.

QUARRYING

EXPLOSIVES SUPERVISORS

This role relates directly to that of the Explosive Supervisor in an open-cast mine. Formerly known as Blast Designers, it is the Explosives Supervisor who analyses rock type (usually by experience), and identifies faults from site investigations already carried out by Engineering Geologists. Explosives Supervisors are responsible for blast planning and ensuring that the blast is carried out to specification. Their primary role under law is their responsibility for the day to day work with explosives in the quarry.

It is a requirement that Explosives Supervisors be a qualified Shotfirer prior to attending the 4-day Explosives Supervisor course. The 3 final examinations will qualify them as Explosives Supervisors.

SHOTFIRERS

This role relates directly to that of the Explosive Supervisor in an open-cast mine. Entrants to the industry typically begin their career as a machine operator before working as a Trainee Shotfirer for a period of months or years. Candidates must then complete the Shotfiring qualification, which is followed by a further period of practical experience under the supervision of an experienced Shotfirer before a final appointment can be made. The training programme includes drilling techniques, loading of shotholes, face profiling, blast design, characteristics of explosives, handling of explosives, methods initiation, mixing of explosives on site, storage of explosives, record keeping etc.

OTHER QUARRYING ROLES

A small number of people exist in the quarrying industry who handle explosives including the Explosives Storeman (who must have qualified as a Shotfirer) and the Shotfirer's helper. There may be others licensed to transport, but as the use of mobile multi-blend vehicles increases, this is likely to decrease the need for quarry staff to transport (except within the boundaries of the quarry).

OIL AND GAS EXTRACTION

SERVICE SUPERVISORS

Relating to the Explosives Supervisor in other industries, as an example, Service Supervisors work in Tubing-Conveyed Perforating (TCP). This role involves pre-job planning, assisting with the task design and estimating the resources required. Service Supervisors ensure that the

right equipment is in place; assemble perforating equipment; oversee the run into the well, ensuring that it is at the correct depth. They initiate the perforating guns; recover spent guns from the well; deal with misfires; rectifying faults; and are responsible for returning unused explosives to the base in a safe manner. Qualified to the IExpE's Code of Practice, this role undergoes in-company training that is specific to his job which includes supervised on-the-job experience for specific periods.

Service Supervisors also exist in work areas other than TCP operations – in pipe recovery, platform dismantling and sub-sea EOD operations. However, the responsibilities are broadly similar and the same training is completed.

ONSHORE LOGISTICS

A range of shore-based staff support offshore operations by importing explosives; shipping explosives to the rigs; storing them onshore; and obtaining the necessary licences. These roles combine administrative responsibilities with the movement of explosives.

OTHER ROLES

Managerial roles also exist that require an understanding of the characteristics and effects of explosives but do not necessarily handle them. These roles are concerned with liaising with customers, assigning equipment and personnel to jobs; and co-ordinating the work offshore with the client onshore. To carry out these responsibilities, role-holders need a sound background in explosives and their application in the oil and gas industry as well as knowledge of the international shipping import/export business.

EXPLOSIVES MANUFACTURE

EXPLOSIVES TECHNOLOGISTS

Usually qualified with a first degree in Chemistry, this role is responsible for mixing, casting and melting chemicals and explosive materials for development and formulation purposes. This role often carries a Quality Assurance responsibility.

MULTI-BLEND VEHICLE DRIVERS

Drivers of multi-blend vehicles must be both HGV-qualified and trained to mix different chemicals to form explosives for the quarrying market. For reasons of safety, the driver is always accompanied by a mate who has also been trained in the chemical blending process. Both roles are trained to ADR standards.

OTHER ROLES

Although the sales forces of explosives manufacturers do not handle explosives, they need specialist training to understand the characteristics and effects of their products. No formal qualifications are needed, and advertised posts often attract ex-regulars.

Explosives manufacturers also have storage, distribution and transport functions. These logistics roles are described under the relevant headings in this section.

DISPOSAL

The following roles were identified by the Occupational Map in Munition Clearance in 2001.

STRATEGIC MANAGEMENT

Strategic management will usually be the responsibility of a senior military officer or civil servant. This role is generic in its functions of strategy design and development. Depending upon the location within the sector of such an individual, this appointment may have a scientific or engineering background – this is not necessary at this level. This role is beyond the scope of any technically-focused qualification in munition clearance.

In the humanitarian mine action field, the Programme Project Manager of a Mine Action Centre may equate to a chief executive of a commercial company and fulfils the role of strategist at local level. Overall, the breakdown of roles relates to this area where the UN system is linked to the British military system. However, the perceptions of strategic and operational responsibilities may vary according to the scale of the project and the extent of global or local perspectives. The strategist may therefore equate more realistically to an operational role. Commercial contractors are more likely to regard their MD/CE as the strategist overall.

OPERATIONAL MANAGEMENT

In the military environment, operational roles are largely fulfilled by ranks at Major/Captain level and their equivalents in the RN and RAF. Decisions at this level are mainly generic but include some level of technical knowledge in the allocation and deployment of resources. Some aspects of this role – ie larger scale programme and operations planning – may be within scope of a higher level (ie level 4) N/SVQ in munition clearance. However, those involved should be already suitably trained in MC work.

In the RN, each of the three diving groups is commanded by a Lieutenant Commander. The RAF is more complex with Squadron Leaders

commanding 5131 (BD) and the Operations and Plans and Policy Departments of the RAF MC function plus other qualified personnel on major operating bases commended via the armament engineering function.

IN DSTL, this function is carried out by Group Leaders and possibly also Chief Technologists. In QinetiQ (formerly DERA), the Technical Manager role is unusual in the strength and focus of his technical role in addition to providing generic strategic and day to day management. A chemist by training, this appointment would carry out technical assessments on approaches, technologies and equipment, and will have a strong input into the strategic direction of the department.

Mine Action Centre project managers equate directly to the operational management role. These individuals are responsible for the day-to-day running of the project, operations, local liaison and medical issues. Within commercial contractors, they may also be a company's operations manager. Such appointments should have munition clearance experience themselves or a clear understanding of relevant processes and issues.

RESOURCING

The relative importance of this role may be determined by the size of the organization concerned. It may therefore be a function of another role or it may be a full time role in itself. Concerned primarily with manpower planning requirements, this role may be seen as corporate support rather than technical. However, some degree of technical understanding may be needed in order to make effective resourcing decisions. Typically, in the military environment, major project □cooping requirements may be determined at the Captain/Major level, although more junior ranks may be involved in detailed planning arrangements for specific field operations.

The roles of strategic management, operational and resourcing are largely combined into one post in the Metropolitan Police. This role includes the local refinement of policy, operational direction, allocating resources and day-to-day management functions.

Mine Action Centre Operational Officers equate directly to the resourcing/project manager function or they may simply be known as project managers. Commercial contractors prefer people with munition clearance experience in this role as they will be carrying out project resourcing tasks, ensuring that sufficient people, money, equipment, vehicles, supplies and so on are in place to enable project fulfilment.

OPERATIONS

Regardless of specialization, munition clearers tend to operate in pairs (the leader is commonly designated the "Number 1", with his partner in a support role as the "Number 2".

In services EOD, all ranks conduct operations. Explosviie Ordnance Disposal Officers (EODOs), also known as Bomb Disposal Officers range in rank from Sergeant equivalent to Captain equivalent. Although Majors and equivalents and higher ranks have been trained to the same (advanced) level, they fulfil a strategic management role. Majors and equivalents command operational squadrons and by virtue of their technical and command experience, they are often designated Senior EOD Commanders (SEODC).

Junior NCOs and other ranks complete a variety of elementary and intermediate training in order to equip themselves to support Bomb Disposal Officers (BDOs) in their operational duties. NCOs do not carry out the full range of EOD duties, but they may be authorized to carry out the destruction of munitions not exceeding a limit of 25Kg of high explosive.

In DSTL and QinetiQ, this role is also split into two levels. Project managers and senior project managers perform hands-on tasks in addition to the full range of project management responsibilities ie building the business case, winning contracts, delivering projects and budget and project management. All have a technical scientific or engineering background.

Team leaders and technicians deliver munition clearance projects. Team leaders require a practical background – although a technical or scientific background is not required. The focal point for team matters, the team leader is responsible for on-site matters and professional decisions needed to deliver tasks. The bulk of DSTL's and QinetiQ's practical work is carried out at this level. Possibly with a technical or scientific background, but certainly with a strong practical background, technicians carry out the day to munition clearance work. This role is multi-faceted and may involve demolition, collecting samples, operating specialist equipment, membership of a safety team or cryogenics. Trainee technicians are semi-skilled newcomers or those with a strong military background who carry out routine technical tasks under supervision.

For specific, MACP police-led major incidents, 11 EOD Regiment RLC and 33 Engineer Regiment (EOD) tie into the police management network of Gold, Silver and Bronze levels of command. The application of this framework varies in rank according to the complexity, size and nature of each individual situation.

Gold is the more strategic role that applies to major incidents only at home and abroad (for example, when a political consideration is involved). Silver is the operational role concerned with co-ordinating tactical operations with an incident's resourcing. Bronze provides the direct tactical input to the operation.

More normally, RLC IEDD teams throughout the world operate on the basis of a No 1 Operator and a No 2, and will deal with the whole incident, calling for more support in the event that it develops into a major incident. The No 1 Operator will range in rank from Sergeant to Captain.

Both the RAF and the RN operate on the same basis as land-based services, both using a two-tier structure of the “No 1” function supported by the “No 2” role. The RAF delegates operational command to a range of junior officers and S/NCOs depending on the operation. The RN operates a similar policy.

The Metropolitan Police also operates a pairing system in conducting field operations. Explosives Officers in the Metropolitan Police primarily fulfil IEDD functions. Each of 10 officers is a possible candidate for an N/SVQ in munition clearance. They are supported by 10 No 2s – usually specially trained police officers who are attached to the unit for 5 – 8 years. The No 2 role works on a par with RLC No 2s to support Explosives Officers in preparing and operating equipment, driving, and other support functions.

Reporting to the Operations Officer of a Mine Action Centre, EOD Officers and Mine Clearance Officers equate to field operators both at team leader and team member level.

The typical organization of roles in commercial contractors fits into the general pattern of a two-fold division of responsibilities. However, there is an added dimension in humanitarian mine clearance. Team leaders (experienced MC operators) – who may be responsible for a number of teams – are also responsible for training to build the capacity of local people (section leaders) so that the latter can take over both the practical issues and the “ownership” issues of a site on withdrawal of UN resources. Section leaders act as assistants to team leaders in much the same way as in the military environment. In some cases, there may be a third level of operator: site managers who are responsible for one site comprising around 8 people.

OTHER MUNITION CLEARANCE-RELATED ROLES AND FUNCTIONS

In addition to the five main roles identified, there are certain specialist roles reflecting the particular areas of expertise.

DSTL’s and QinetiQ’s remits in munitions work encompass R&D responsibilities. This includes R&D into conventional munitions and the design and trial of technologies to destroy the object. Around 12 people are involved in such work. A further 15 or so people are involved in trials conducting offices: disposing of munitions routinely, trialling the effectiveness of the munition itself (and disposing of it in the process). A further 30 – 40 people are involved in developing methods and technologies for locating objects. Such individuals need to have a clear technical understanding of munition-related work in order to arrive at effective solutions. This might involved the assessment of metal detectors and microwave technology.

The Royal Logistic Corps and the Royal Engineers provide subject matter experts on secondment to other organizations and other parts of the Army in a defence intelligence role. This involves the exploitation of existing knowledge, the prediction and interpretation of trends. Requiring

an MC technical background, around 15 ATOs from the Royal Logistics Corps and one Major from the Royal Engineers are currently engaged in such work.

The RAF also provides subject matter experts on weapons platforms and missile systems for defence intelligence and other engineering roles. The 30+ RAF personnel serving in this role at any time pass an MoD-sponsored MSc in Systems or Explosives Engineering: they are RAF Engineer offices and thus have a professional technical or engineering background and first degree.

This study identified two relevant roles in commercial companies: Explosives Supervisor and Explosives Assistant. These two roles correspond to the Operations personnel – albeit at a comparatively routine level – as described above. The Explosives Supervisors is responsible for the disposal of explosive material by detonation or burning. This role works with an assistant in a controlled environment. No formal qualifications are required. For safety reasons, the Explosives Assistant works with the Explosives Supervisor to carry out disposal tasks. No formal qualifications are required.

FIREARMSPROOFING

PROVERS

Firearms provers view and gauge the weapons, set up the weapon in a jig, and fire it remotely using ammunition that they have made on site. Subsequent analysis then determines whether the weapon has successfully been proofed. No formal qualifications are required, and candidates are accepted on the basis of their suitability as determined by their previous experience and general aptitude. Those previously employed in jobs that enable candidates to gain a familiarity with weapons and relevant legislation (eg police, services) and who have a healthy respect for the potentially dangerous nature of the work are favoured. Training is carried out on the job, and experience is the key determining factor in assessing competence is experience. The judgement as to whether a weapon will pass its proof is highly subjective and heavily reliant on visual inspections.

See *Defence Research* for descriptions of similar roles in proofing military ammunition and weapons.

MOTOR INDUSTRY

MOTOR VEHICLE TECHNICIANS

Motor Vehicle Technicians are responsible for fitting explosive airbag units and pre-tensioners (which are also fitted with an explosive charge) that ensure that seatbelts and airbags work in unison and that any sudden tightening of the seatbelt does not set off the airbag with undue haste. Technicians undergo 2 days in-company training covering the storage, fitting and removal of airbag units. Faulty units are normally replaced rather than repaired.

VEHICLE BODY REPAIRERS

Whilst not directly involved with fitting airbags, Vehicle Body Repairers need to understand the functioning of the airbag as the unit is extremely sensitive and care must be taken when carrying out other repair work not to send the signal inadvertently that sets it off.

DEMOLITION

EXPLOSIVES ENGINEERS

Trained in-house and through the IExpE courses and examinations to qualify in Shotfiring in the Construction Industry, Explosives Engineers carry out site surveys, design collapse mechanisms, and prepare method statements and risk assessments. They are responsible for planning and coordination, managing preparatory work (eg pre-weakening, drilling, fixing at source and protecting the surrounding area). Explosives Engineers fit detonators and carry out detonations, later liaising on clearance and re-occupation matters. No previous experience is needed but a minimum of 3 years' experience (more usually, 5 years) is needed before this role can take the responsibility for charging and connecting. Competence is judged not so much by the number of years' experience, but the variety of types of demolition work that have been carried out.

EXPLOSIVES TECHNICIANS

Also trained in-house and through the IExpE courses and examinations to qualify in Shotfiring in the Construction Industry. Explosives Technicians supervise preparatory work (such as cutting holes and ensuring the correct protection is in place), stems explosives and detonators. This role assists on the day a demolition is carried out (eg putting barriers in the right place outside the exclusion zone and supervising the post-event cleaning up).

SENIOR EXPLOSIVES ENGINEERS

This role's responsibilities, qualifications route and career path are the same as those of the Explosive Engineer, and includes total accountability for the explosives both received and used.

TRANSPORT AND STORAGE

JETTY MANAGER

For transport by sea, the Jetty Manager is responsible for receiving the cargo and holding it safely pending further transport. He carries out any necessary liaison locally, and with the relevant Port Authority, press and HSE inspectors. He is responsible for controlling the security force and is overall accountable for safety and compliance.

CARGO SUPERINTENDENT

The Cargo Superintendent identifies UN numbers, and based on this, draws up the ship's stowage plan, taking compatibilities into account. He obtain the ship's Master's approval to the loading, or refers to a higher authority in the case of disputes, and is responsible for checking and testing the safety of lifting equipment. The Cargo Superintendent is overall accountable for the location of explosives at all times and for ensuring compliance with regulations. This role is therefore often also combined with that of the legally required berth Explosive Security Officer – a Port Authority requirement which also includes reporting the source of the training undertaken for this role.

TALLYMAN

Reporting to the Cargo Superintendent is the tallyman who counts the cargo and reports any anomalies including that of labelling to the Cargo Superintendent.

FOREMAN STEVEDORE, RIGGER AND CARPENTER

The Foreman Stevedore supervises loading operations according to the plan in conjunction with the ship's Master, and secures the load in collaboration with the Foreman Rigger and Foreman Carpenter. He controls the workforce including hiring personnel (dockers, crane drivers and fork lift truck drivers). The Foreman Rigger and the Foreman Carpenter are responsible for securing the load with wood and wire.

DOCKER

Working under the supervision of the Foreman Stevedore, the dockers load and unload the ship both manually and using shore-based cranes. Fork lift trucks are also used both in the ship's hold and dockside. The

Port Authority is responsible for training the more junior levels of docker, and for training and certifying crane drivers. Fork lift truck drivers also need to be trained and certified.

DRIVER

If carrying a terrorist-attractive load, in both the UK and in Spain, drivers carrying explosives loads are required to work with another for safety reasons. Both drivers and their mates are required to have successfully completed the ADR course in addition to having obtained the appropriate category of driving licence. Drivers need to understand the storage requirements and to draw up a stowage plan if required (although this is often done by others). They must secure the load, drive the vehicle and unload on arrival at the destination.

AIR TRANSPORT STAFF

Each airline employs a Load Master who plans the stowage of explosive loads in agreement with the pilot. Freight handlers (see warehouse personnel descriptions below) load the cargo onto aircraft pallets (which have been built up in the warehouse) by fork lift trucks. Whilst the staff are typically employed by the airline, the roles and responsibilities are a direct parallel as for those employed in dockside functions.

WAREHOUSE/PACKING MANAGER AND CHARGEHANDS

Companies using explosives typically employ a hierarchy in the warehouse, consisting of a Warehouse/Packing Manager and Chargehands to ensure that sufficient storage is allocated for particular items; to ensure all health and safety records are kept; and to allocate workloads. Due to the potentially dangerous nature of the products, the industry is heavily regulated, and managerial staff need to ensure that the different categories of fireworks are handled correctly according to the designated risk.

WAREHOUSE OPERATOR

Warehouse Operators are required to load and unload vehicles either manually or using fork lift trucks, and to maintain the appropriate standards of health and safety. This might involve ensuring the compatibility of explosive products; ensuring that weight limits are not exceeded; helping to ensure that the maximum limit of the number of people in any space is not exceeded; or ensuring that the correct materials are loaded on vehicles and the correct paperwork is completed according to the nature of the Explosives Licence. Warehouse Operators need to carry out their duties with extreme care for – although few explosives are self-igniting – if an accident does occur, it can be fatal. A clear understanding of the nature of the Explosives Licence is crucial for this role and generic training courses are seen as lacking the necessary depth. Training is often carried out in-house, and some companies

required magazine attendants as well as their drivers to achieve the ADR course. This course covers topics such as load hazards, handling, damage, compatibility, packaging markings, and explosives regulations.

FIREWORKS

SALES OCCUPATIONS

Reporting to the Sales Director are Areas Sales Representatives and Major Account Managers. These functions are supported by Sales Order Processing staff. Little technical knowledge is needed by any of these functions beyond an understanding of product performance, use and the regulations affecting fireworks storage in retail premises (eg security, space, fire access etc) as this is considered a value-added rather than a critical service to customers.

See *Transport, Distribution and Storage* for more detail on warehousing functions.

PACKING STAFF

The Packing Supervisor is responsible for all the packing staff and general operatives and for ensuring all packing operations are correctly carried out (correctly packed and labelled according to the nature of the product).

FIREWORKS QUALITY CONTROL FUNCTIONS

A specialist activity, the Quality Control function's requirements and methods are determined by BS7114. Reporting to the Quality Control Manager are Quality Control testers. Each tester needs a detailed knowledge and understanding of each product and its performance, of the British Standard itself and of Health and Safety procedures. No formal qualifications are needed but previous experience within the industry is essential. Each tester's role is to set off fireworks, measure and record its performance to ensure that the promises as described on the label are true and accurate.

Damaged or faulty fireworks must be disposed of, and the nature of disposal is determined by the nature of the product. Disposal is carried out by staff in combination with other duties according to clearly defined relevant legislation and guidance.

FIREWORKS COMPANY DISPLAY MANAGERS

This role's responsibilities include the planning of displays to be carried out over the year, carrying out site reconnaissances and making risk assessments, and liaising with the relevant local authority.

FIREWORKS SITE SUPERVISOR

This role is responsible for the management of a particular display, and is the person with whom accountability rests.

FIREWORKS DISPLAY OPERATORS

This role carries out routine tasks under the instructions of the site supervisor such as transporting display materials, staking out the display area and positioning and storing materials.

PERFORMING ARTS SPECIAL EFFECTS

PYROTECHNICS SUPERVISOR

The Pyrotechnics Supervisor is responsible for designing, organising, providing and constructing all controlled fire effects and explosions, simulated bullet effects and pyrotechnic effects, such as firework displays. They will work closely with the Producer, Director and Production Designer to breakdown the script and establish what pyrotechnic and fire effects are required. They will discuss set design, construction, location and timing in order to establish when pyrotechnic and fire effects are required, and to allow for the safe and controlled filming of such effects, taking all necessary health and safety precautions. Holding budgetary responsibility, it is their responsibility to oversee the preparation, construction and execution of the required pyrotechnic and fire effects, liaising with other departments as necessary, particularly when specific props or costumes are required for fire safety. It is also their responsibility to purchase, maintain and control suitable storage facilities for pyrotechnics and explosives, in line with Government legislation and health and safety regulations. Excellent health and safety knowledge and awareness is essential, along with the ability to make things work in a safe and controlled way. Technical knowledge of the use of firearms and explosives for creative effects is essential, along with a thorough knowledge of camera angles, lenses and visual effects when setting up pyrotechnic and fire effects shots. Considerable experience in special physical effects and pyrotechnics is required, and some formal training may be necessary.

PYROTECHNICS SENIOR TECHNICIAN

The Pyrotechnics Senior Technician is responsible for the operation, maintenance and construction of pyrotechnic and fire effects machinery, plant and devices as required. Tasks may range from setting up simple firework displays for live shows, to creating realistic car or building explosion scenes on set. They control all pyrotechnic and fire effects in the absence of the Pyrotechnics Supervisor and must be aware of production requirements. They liaise with the Director, Director of Photography, Pyrotechnics Supervisor, 1st AD and Company Insurers

where necessary in order to ensure that all necessary safety requirements have been agreed and implemented and must ensure that health and safety regulations are adhered to by all personnel on set. Excellent Health and Safety knowledge and awareness is essential, along with the ability to make things work in a safe and controlled way. Technical knowledge of the use of firearms and explosives for creative effects is essential, along with a thorough knowledge of camera angles, lenses and visual effects when setting up pyrotechnic and fire effects shots. Considerable experience in special physical effects and pyrotechnics is required, and some formal training may be necessary.

PYROTECHNICS TECHNICIAN

A Pyrotechnics Technician assists the production of special effects for film and television programmes through the carefully controlled use of firearms and explosives. They assist with the preparation, construction, handling, operating, execution and maintenance of fire and pyrotechnics effects, ensuring the safety of personnel at all times. They liaise with other departments as necessary to ensure that all Health and Safety requirements have been implemented. Health and Safety awareness is or paramount importance and the ability to make things work in a safe and controlled way. Technical knowledge of the use of firearms and explosives for creative effects is essential. Considerable experience in special physical effects and pyrotechnics is required, and some formal training may be necessary.

PYROTECHNICS TRAINEE/ASSISTANT

A Pyrotechnics Trainee may only handle pyrotechnics under supervision at all times. They assist other pyrotechnics personnel in the preparation, construction and execution of pyrotechnic and fire effects, ensuring they are aware of all health and safety risks at all times. It is their responsibility to ensure that they are familiar with all materials and equipment used in the creation and operation of pyrotechnic and fire effects, keeping a comprehensive record of their work experience for the Pyrotechnics Supervisor. They must have a thorough knowledge of health and safety regulations.

EDUCATION AND TRAINING ARRANGEMENTS

THE SUB-SECTORS

MOD CIVILIANS

OME experts in MoD agencies (DPA, DOSG and DLO) are largely scientist or engineers, holding qualifications ranging from HNC/D to first or Masters degrees, or PhDs. These staff may be appointed by open competition, or they might result from level transfers from the armed forces or the MoD. Trainees are recruited with a first degree in science or engineering and complete 6 months' training at Cranfield University at the RMCS.

Specialist development programmes are designed to meet individual needs. More often, staff attend whichever short course run by Cranfield University at the RMCS is appropriate to their need, supplemented by attending technical conferences both in the UK and abroad.

In some parts of the MoD, civilian staff may attend a basic OME awareness day, run by the local Safety Officer. However, the vast majority of specialist training is carried out through on the job training or rarely, by the manufacturer. There is no set Departmental standard or curriculum.

ROYAL NAVY

New recruits are subject to the Navy's mainstream recruitment requirements. There are no qualifications relevant to explosives handling and in-service training is delivered to in-service specified standards.

ARMY

The Army School of Ammunition provides ammunition training for all Field Army Ammunition Storemen and Authorized Representatives. It also trains all the Army's ATOs and ATs.

The Defence School of Transport (DST) at Leconfield is the tri-service training facility that carries out HAZMAT training for all drivers in all armed forces.

ROYAL AIR FORCE

New non-officer recruits are subject to the RAF's mainstream recruitment requirements and may enter the service at a number of different levels.

Like all Trade Group 1 and 2 technical streams, Armourers have minimum academic entry requirements, and then, are trained in-service through an Advanced Modern Apprenticeship during which time they complete a BTEC in Aerospace Studies and/or an NVQ level 3 in Aeronautical Engineering before taking up their first appointment. Following further training and completion of an in-service qualification appropriate to the skills specification of the appointment, they will then be inducted locally before carrying out more specific training (eg on a specific aircraft type or another specialism depending upon the posting).

Officer recruits have to achieve a minimum level of academic qualification. In particular, Engineer Officers have to attain as a minimum an HND or equivalent in an engineering subject. On entry into the service, they receive further training appropriate to their branch and then to the skills specification of their future appointment, usually by attending in-service courses and gaining in-service qualifications.

DEFENCE RESEARCH

Cranfield University at RMCS offers a range of higher education awards including PhDs and MScs in a wide range of explosives-related subjects. In addition, it offers a wide range of specialist continuous professional development courses on explosives subjects. Students for all these courses are drawn mainly from the defence sector and include both military and civilian personnel. The Cavendish Laboratory of the University of Cambridge has an established research in explosives technology and is also a source of PhD-qualified scientists. More usually, scientists are recruited with a science or engineering degree and then trained in-house in explosives and risk assessment. This principle also applies at the junior level.

Defence research establishments tend to recruit from two streams – those scientists usually holding a Chemistry degree (first degree, masters or PhD), and ex-military personnel who have already completed extensive in-service explosives training and who have many year's experience. In some instances, recruits may be taken on by a Modern Apprenticeship route. Other new recruits are trained in risk assessment and risk management as well as explosives training in general.

DEFENCE MANUFACTURING

There are no formally accredited qualifications for roles relating to the manufacture of explosives-related devices. However, Leafield has been active for the last 20 years in providing formal certificated explosives training for its own staff and for other defence manufacturing companies (eg Martin Baker, Wallop, BAES). Some of the training (both in-house and at customers' premises) is entirely delivered by Leafield staff, and some is delivered in collaboration with Cranfield staff either at Cranfield or at the customer's premises.

COAL MINING

Doncaster College is the sole repository of expertise in the coal mining industry. The MQB – the statutory qualification requirement for deep mine Shotfirers – is delivered jointly by Mines Rescue and Doncaster College.

QUARRYING

There are no academic qualifications relevant to Shotfirers and Explosives Supervisors. The key deliverers of training are:

- British Fire Research Establishment
- Camborne School of Mines
- Exchem Explosives
- Institute of Explosives Engineers
- Newcastle University
- Orica
- Royal School of Military Engineering.
- Royal School of Mines.

OIL AND GAS EXTRACTION

In the absence of any common or recognized training in the sector, the offshore branch of the Institute of Explosive Engineers (IExpE) has produced a *Code of Practice: Safety Training Standards for Explosives Supervisors in the Oil and Gas Industry*. This document sets out the training requirements for Explosives Supervisors. Companies whose training meets these standards may then be accredited. In addition, employees are encouraged to become full members of the IExpE. The entry examinations consist of five papers, three of which are common to quarries and mines whilst the two remaining specialist papers are particular to the oil and gas industry.

EXPLOSIVES MANUFACTURE

Exchem offers a range of training courses for both its own staff and on a commercial basis to the civil industry.

DISPOSAL

This is described in the Search and Munition Clearance Occupational Map[2].

[2] Munition Clearance Occupational Map, 16 February 2001, prepared by Moloney & Gealy for the Standards Setting Body for Munition and Search Occupations

FIREARMS PROOFING

There is no formally accredited training programme for firearms proofing and training is carried out on the job at the Proof Houses.

DEMOLITION

The demolition industry has relied on applications from ex-service personnel who are then re-trained in-house on commercial considerations and who undergo the IExpE's professional qualifications.

TRANSPORT AND STORAGE

There are no specific arrangements relevant to the education and training of personnel in transport, distribution and storage sectors.

FIREWORKS

The British Pyrotechnics Association and the Explosives Industry Group of the CBI and the Event Suppliers Association are responsible for issues relating to professional display. Consumer fireworks are covered by the British Fireworks Association and the Explosives Industry Group of the CBI.

PROFESSIONAL BODIES

Professional bodies and institutes and trade associations relevant to explosives include:

- Association of Stage Pyrotechnists (ASP)
- British Fireworks Association (BFA)
- British Pyrotechnic Association (BPA)
- Forensics Society
- Gun Trade Association (GTA)
- Institute of Demolition Engineers (IDE)
- Institute of Explosive Engineers (IExpE)
- Institute of Marine Contractors Association (IMCA)
- Institute of Mechanical Engineers (IMechE)
- Institute of Munition Clearance and Search Engineers (IMCSE)
- International Pyrotechnics Society
- Quarry Products Association
- Royal Society of Chemistry
- Society of Chemists.

EXISTING QUALIFICATIONS

MOD

Cranfield University at RMCS at Shrivenham offers the following Masters degrees:

- MSc in Explosive Ordnance Engineering
- MSc in Weapon Effects on Structures
- MSc in Weapons and Vehicle Design
- MSc in Forensic Engineering Science.

Military staff may quality in any of these Masters degrees as appropriate. For civilian staff working on complex weapons, most entrants into the MoD would hold an engineering degree. Technicians would hold an ONC or have completed an apprenticeship in electrical or mechanical engineering resulting in an ONC. For staff working on conventional weapons, the Process & General Supervisor (P&GS) is available. In the logistic managers' group, the present training and qualifications relate more to the operational management function with either no or very limited training on the ESA aspects of the task. In the past, this has been mitigated by the depth of experience of the management staff who were often recruited young, and developed over a period of time, supported by a centralized career development strategy. This approach no longer prevails.

HM FORCES

Each service uses a wide range of qualifications appropriate to the appointment for recruitment and career management purposes. The most commonly encountered qualifications held by personnel in ESA roles is the RMCS Shrivenham's Masters degrees held by more senior roles. Ammunition Technical Officers (ATOs) complete 16 months' specialist training. At the most junior end of the spectrum, each Ammunition Storeman must complete a 2 week course which includes training in explosives categories and storage requirements.

The Royal Air Force College Department of Specialist Ground Training (DSGT) at Cranwell offers the masters degree in Advanced Systems Engineering course which leads to the award of an MSc through Loughborough and Cranfield Universities.

All drivers of hazardous materials must be HAZMAT-trained, which applies to all armed services.

N/SVQs in Search and Munition Clearance are relevant to personnel deployed on Explosive Ordnance Disposal (EOD) tasks. These are listed below under *Disposal*.

DEFENCE RESEARCH

Establishments involved in defence research look for recruits with first degrees in an appropriate discipline (Chemistry, Physics, Mathematics or Engineering) available from many universities. They also seek those with an appropriate Masters from Cranfield University at RMCS (see above) and the ISSEE Explosives Foundation C&G qualification (see below). HNCs and HNDs in Mechanical and Electronic Engineering are also sought.

DEFENCE MANUFACTURING

The ISSEE awards a City & Guilds certificate in Explosives Foundation.

COAL MINING

The following qualifications are relevant to those using explosives in deep and open-cast mines:

- Shotfiring for Deputies (statutory MQB qualification for Shotfirers working in deep mines) delivered by Doncaster College and Mines Rescue
- Shotfiring Operations N/SVQ level 3 (for open-cast mining)
- Engineering Maintenance N/SVQ level 3
- Health, Safety and Environmental Management in Quarries N/SVQ level 4.

QUARRYING

EPIC (the National Training Organization for extractive industries) awards the followingN/SVQs:

- Specialized Plant and Machinery Operations level 2
- Construction and Civil Engineering Services (Road Building) level 2
- Drilling Operations level 2
- Shotfiring Operations level 3
- Health, Safety and Environmental Management in Quarries levels 3, 4 and 5.

Qualifications other than N/SVQs mainly exist in the form of membership of professional bodies namely, the Institute of Explosives Engineers (IExpE) and the Institute of Munition Clearance & Search Engineers (IMCSE).

EPIC runs two examined courses:

- Quarry Shot Firing
- Explosives Supervisor.

The IExpE delivers:

- Shotfiring in the Construction Industry (for road-builders, underwater, demolition, tunnelling, land clearance and trench work)
- High Explosives course (the precursor to the Institute's examinations).

The IExpE has worked to set up a European Shotfiring Certificate, which is intended to ensure that shotfirers throughout the EC operate to a determined level of competence and that this can be demonstrated and accredited by an organization independent of the employer.

The certificate is open to IExpE qualified members and is delivered in conjunction with the European Federation of Explosives Engineers.

OIL AND GAS EXTRACTION

There are no industry-wide recognized and accredited qualifications relating to the use of explosives within the oil and gas sector. The offshore branch of the IExpE has developed a statement of training requirements although this is not expressed as competencies. Each company has developed its own training régime.

Many personnel enter the industry with a degree in Mechanical Engineering or an oilfield-related degree.

EXPLOSIVES MANUFACTURE

Except for QA roles where some positions require a BSc in Chemistry, there are no qualifications directly relevant to the explosives manufacturing process other than the EU requirement for an appointed and qualified Dangerous Good Safety Adviser (DGSA) in any company involved in explosives.

DISPOSAL

N/SVQs have recently been developed in Munition Clearance, although they are not appropriate to personnel working solely on routine tasks in a factory environment.

N/SVQ	Level 4	Planning and Management of Munition Clearance Operations
N/SVQ	Level 3	Supervisory Management of Munition Clearance and/or Search Operations
N/SVQ	Level 3	Search for Munitions and/or Specified Targets
N/SVQ	Level 3	Search for and Disposal of Munitions
N/SVQ	Level 2	Contribute to the Search and/or Disposal Function
N/SVQ	Level 1	Provide Support for Search or Munition Clearance Operations

City & Guilds and the International School for Search and Explosives Engineers (ISSEE) jointly deliver a Search and Explosives Engineers Certificate which can only be attained through the ISSEE.

FIREARMS PROOFING

There are no qualifications available for firearms provers.

MOTOR INDUSTRY

The relevant qualifications used by Motor Vehicle Technicians are:

N/SVQ Level 2 Vehicle Maintenance and Repair

N/SVQ Level 3 Vehicle Maintenance and Repair

The relevant qualifications used by vehicle Body Repairers are;

N/SVQ Level 2 Vehicle Body Repair

N/SVQ Level 3 Vehicle Body Repair

DEMOLITION

The IExpE delivers:

- Shotfiring in the Construction Industry (for road-builders, underwater, demolition, tunnelling, land clearance and trench work)
- High Explosives course (the precursor to the Institute's examinations).

The current suite of N/SVQs in Demolition Construction does not contain reference to the use of explosives as this is considered a specialist area and is not widely required by the industry. The present relevant N/SVQs are:

N/SVQ Level 2 Demolition Construction

N/SVQ Level 3 Demolition Construction

N/SVQ Level 4 Demolition Construction (available post review summer 2004)

N/SVQ Level 5 Demolition Construction

TRANSPORT, DISTRIBUTION AND STORAGE

Currently, the standards and qualifications for transport are contained in the Carriage of Explosives by Road Regulations 1996 as amended and the Carriage of Dangerous Goods by Road (Driver training) Regulations 1996. These are shortly to be replaced by the ADR Regulations and the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations.

The ADR certificate is a short course, combining classroom learning and practical exercises. Awarded by approved examining bodies such as City & Guilds, the certificate accredits the driver to transport dangerous loads for a period of 5 years. In practice, although many lorry drivers hold an ADR certificate, few hold the unit appropriate to explosives. Drivers are also required to hold an appropriate category of driving licence.

N/SVQs in warehousing are not seen as sufficiently detailed to cover the level of detail required to store and transport explosives.

The available relevant qualifications are as follows:

N/SVQ	Level 1	Assisting in Road Haulage and Distribution Operations
N/SVQ	Level 2	Driving Goods Vehicles
		Transporting Goods by Road
		Transporting Goods by Road (Tanker Operations)
		Organizing Road Transport Operations
		Distribution and Warehousing Operations
N/SVQ	Level 3	Driving Goods Vehicles
		Performing Road Haulage and Distribution Operations

FIREWORKS

Apart from Health and Safety at Work courses, there are no existing qualifications aimed specifically at fireworks manufacturers or retailers. The Institute of Explosive Engineers and the Royal Military College of Science offer a range of short but unaccredited course.

The BPA currently awards two levels of a Display Operator's Certificate and is developing the third level (note that these levels do not equate to NVQ levels). The levels are aimed at the following populations:

Level 1 General display operator (routine tasks carried out under instruction)

Level 2 Site supervisor (responsible for the management of a particular display and the person with whom accountability rests)

Level 3 Company display manager (carries out site recces, risk assessments, liaison with local authority etc).

The final qualification covers both the use of explosives and pyrotechnics. Successful candidates receive a Certificate in Explosives in the Entertainments Industry when they have both passed the appropriate examination and completed the accompanying logbook. The

operator then receives a photo-identity card and is registered on the BPA website of approved display operators.

PERFORMING ARTS SPECIAL EFFECTS

There are no N/SVQs in Pyrotechnics for personnel in performing arts special effects.

NOS AND N/SVQ OPPORTUNITIES AND CONSTRAINTS

OPPORTUNITIES

The UK and European Union are losing expertise and skills in explosives science and technology. The recognition for individual's skills and competence may help to increase the attractiveness of careers in this area, particularly if clear career progression paths are articulated. This is particularly relevant in the armed services where trained carried out in-service is not accredited and in the MoD.

For those positions that attract job applications from ex-regulars, an N/SVQ is seen as potentially useful by employers in interpreting the candidate's previous military experience and level of expertise.

Conversely the MoD finds attractive the prospect of an N/SVQ as an entry level qualification in practical environments such as setting up trials for testing and evaluation as it provides the training specification required in modular form. At present, there is no requirement for personnel to be licensed – even those giving expert advice and the MoD may be interested in developments in NOSs at the higher level. NOSs are seen as potentially useful to Safety Advisers in helping to ensure a consistency of approach, and providing an articulation of the constraints and limits of customer interaction which takes account of the impact of the advice given in a wider context. Critical subject areas include risk assessment, range safety, advice on legislation, laser safety. As the first step, the specification of competence could assist in building skills and competencies to deliver strategic and business objectives, and would form the basis of plans for future manpower needs.

The articulation of competence in functions that have been outsourced (eg toxicity testing and environmental impact developments) may also be useful as the MoD either lacks sufficient resource or does not have sufficient depth of expertise on such matters. Similarly, the definition of NOSs may help the DLO achieve its strategic procurement objective to: *Develop, in concert with DPA, supplier performance management and development tools and technologies*.

The competence of personnel has a significant impact on explosives safety, which can be assured by the implementation of NOSs. N/SVQs could also contribute positively toward the HSE's requirements in providing third party objective endorsements of the competence of personnel. NOSs can also be used to design training programmes that support competence. This demonstration of competence would be equally advantageous to organizations delivering solutions in a commercial, business-to-business environment. For these reasons, any

NOSs and/or N/SVQs developed should be as comprehensive and all-encompassing as possible.

Companies using explosives in the oil and gas industry would welcome the development of NOSs and nationally accredited qualifications that would demonstrate the competence of personnel who had achieved an industry-wide standard. Work already accredited by SQA would form a useful starting point.

All staff in the mining industry are required to be reassessed periodically under the HSE's Management and Administration of Safety and Health at Mines (MASHAM) legislation. As there are no clear agreed standards against which to assess competence following refresher training, NOSs could be useful in providing those industry standards. Similarly, where work in the mining industry is put out to contract, NOSs could again provide a useful benchmark against which to assessor contract bids.

However, if qualifications are to be designed, they should be fit for purpose in the application. Concerns have been expressed that although on the face of it, there may be similarities between quarrying, mining, demolition and oil and gas extraction, in fact the design of qualifications should be specifically aimed at each of these three industries that differ in their functioning and potential risks. The common elements, however, would be environmental issues, explosive science and legislation.

Concerns have been expressed in some industries that those carrying out work using explosives should be licensed to do so. In the absence of such a licence, the achievement of an N/SVQ is seen as a regulatory tool to assure individuals' competence.

NOSs could also fulfil other managerial requirements such as providing clear specifications of expectations and best practice and they might usefully be adapted for use by procurement teams in assessing contract bids. The DPA's key partner is the Defence Logistics Organization (DLO). Improved interoperability between these organizations is an important goal and developments made in common HR management and financial processes are now sought in other areas of business. The use of NOSs might facilitate this process.

The implementation of NOSs and N/SVQs may help to demonstrate commitment to other quality systems such as Investors in People, ISO 9002 or the European Foundation for Quality Management (EFQM). In areas where there is no formal structured training or validation process, NOSs could provide objective benchmarks against which externally delivered training could be verified.

Defence research establishments would welcome a defined progressive career route from induction to an advanced level. At present, Cranfield University at RMCS fulfils some of the higher level requirements, but this is lacking at the junior echelons and in non-routine research issues. N/SVQs are seen as potentially assisting with movement within the defence research sector in a coherent that is likely to help alleviate the

problems caused by the current and expected shortage of scientists in this community.

The fireworks industry notes that N/SVQs could offer a formal measurement of ability and good practice. It has considered developing a competence-based qualification for public display operators in the past and would welcome competence-based qualifications. Such a qualification would also need to address the related functions of transport and storage. Warehousing is seen as a further need due to the potentially hazardous nature of the job, and the stringent health and safety requirements.

For professional fireworks display operators, the achievement of an N/SVQ which includes a logbook describing a number of displays completed would be an attractive prospect in demonstrating competence to customers, and a lack of which would form a preventive measure to those whose experience and expertise do not match their claims to competence.

Companies transporting explosives have identified a possible appeal for an N/SVQ relating to explosives security. This is seen a potential growth area as recent events have brought security rather than material safety to the forefront of regulatory pressure.

For serving personnel, HM Forces has maintained its commitment that all service personnel will leave with at least an N/SVQ level 2 qualification where these exist. For those still serving, the achievement of an N/SVQ is seen as beneficial for personal development purposes. Any N/SVQs developed, however, should be aimed at professional working in roles requiring specialist expertise in explosives work. Were end-users to be included (“those who pull the trigger”), this would be seen as devaluing the qualification whose credibility should be maintained.

There are many occupational groups within the industry as a whole that need a clear understanding of the characteristics of explosives, the potential risks and the terms of the Explosive Licence. However, these groups do not necessarily handle explosives. Both for these groups and to underpin explosives-related functions, consideration should be given to specifying these needs as a separate requirement that would underpin a series of NOSs or even a whole qualification.

When developing NOSs, it should be borne in mind that although there are few qualifications relevant to explosives, training material does already exist which would be helpful in developing specifications of underpinning knowledge and understanding – particularly the explosives courses run by Leafield in conjunction with Cranfield University at RMCS. The British Pyrotechnic Association has also well-developed materials that may be relevant in this quarter. In addition, the Australian Defence Department has carried out extensive work in defining ESA competencies which may inform the development of their British counterparts.

CONSTRAINTS

In some quarters where there is previous experience of operating N/SVQ schemes, the sub-sector's view is coloured by previous experience. This may not always have been positive. Concerns about their value have been raised as have concerns about the time and resources required, together with an apprehensiveness as to how to implement N/SVQs.

The fireworks industry notes that there may be a limited number of interested parties compared with other industries. The explosive demolition industry is also small in comparison to others and this may pose problems with assessment and verification as, in order to find the necessary experience and expertise to carry out N/SVQ assessments, there may well be commercial conflicts of interest between assessors/verifiers from competitor companies carrying out those assessments.

N/SVQs have a limited appeal in the quarrying industry and a directly relevant N/SVQ exists in Shotfiring. However, since changes have been introduced to training in the industry, and competence issues have yet to be addressed for Explosives Supervisors, a possible route to an N/SVQ is seen as through the completion of a log book accompanying the achievement of an N/SVQ. Any developmental work should take into account the IExpE's existing Shotfiring Certificate.

Competence requirements in the mining industry are set out by the MQB, and employers do not expect that HSE will permit the achievement of an N/SVQ as a substitute for achievement of the MQB qualification. However, employers report that it would be helpful to the careers of mining shotfirers to map the MQB qualification against the requirements of the N/SVQ in shotfiring in the quarrying and demolition industries. Further, the competence requirements between those working in open-cast and deep mines are seen as different and these differences should be accommodated in the design of any competencies.

There is little demand for transport-related N/SVQs in the explosives transport sub-sector which is very heavily regulated. As small operations, transport companies tend to have a low staff turnover, and recruit easily from their own networks.

NVQs are not seen as appropriate in a blue skies research environment which is characterized by an intellectual thought process and academic qualifications. They are seen as more appropriate in more practical environments.

A commitment to sufficient funding and resources will be needed to ensure the successful implementation of N/SVQs. This is particularly evident in the need to implement effective assessment procedures which are seen as bureaucratic, and particularly in the case of the assessment and verification units.

As the development of standards and qualifications may raise expectations amongst individuals in some quarters, it is recommended

that early consideration should be given to “downstream” issues such as the delivery of and individual access to training to the standards specified.

GLOSSARY

Explosive	There are 2 main classes: “permitted” and “not permitted” ie those which are safe for use in coalmines and those which are not. Ammonium nitrate mixtures are mostly used in coal mines. ANFO (Ammonium Nitrate and Fuel Oil) is now widely used in hard rock mining. Explosives are used as propellants (low explosives) and for blasting (high explosives) in both civil and military applications.
Explosive forming	One of a range of high energy rate-forming processes by which parts are formed at a rapid rate by extremely high pressures. Low and high explosives are used in variation of the explosive forming process; with the former, known as the cartridge system, the expanding gas is confined; with the latter, the gas need not be confined and pressure of up to one million atmospheres may be attained.
Propellant	The comprehensive name for the class of low explosives (LE) which burn and are used to propel shell, bullets and rockets etc. In liquid propellants, it comprises the fuel (hydrocarbons, such as kerosene and hydrazine) and the oxidant (such as liquid oxygen and fluorine). Propellants are a sub-set of explosives. Modern solid military propellants used in cartridges and rockets are usually based on nitrocellulose (NC) as the only energetic material, or combined with another energetic material such as nitroglycerine (NG) to increase energy.
AWE	Atomic Weapons Establishment
Cranfield University at RMCS	Royal Military College of Science Shrivenham
DLO	Defence Logistics Organization
DPA	Defence procurement Agency
DSDA	Defence Storage & Distribution Agency
DSTL	Defence Science & Technology Laboratories
IM	Insensitive Munition (IM). IMs reliably fulfil their performance, readiness and operational requirements on demand, but are designed to minimize the violence of reaction and subsequent collateral damage if subjected to unplanned stimuli.
IPR	Intellectual Property Rights
IPT	Integrated Project Teams
MCBU	Munitions Corporate Business Unit

MoD	Ministry of Defence
OME	Ordnance, Munitions and Explosives
SSB for EMSO	Standards Setting Body for Explosives, Munitions and Search Occupations