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**Demilitarization, destruction and logistic
disposal of conventional ammunition**

Warning

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United Nations Office for Disarmament Affairs (UNODA)
United Nations Headquarters, New York, NY 10017, USA

conventionalarms-unoda@un.org

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Foreword

Ageing, unstable and excess conventional ammunition stockpiles pose the dual risks of **accidental explosions at munition sites** and **diversion to illicit markets**.

The humanitarian impact of ammunition-storage-area explosions, particularly in populated areas, has resulted in death, injury, environmental damage, displacement and disruption of livelihoods in over 100 countries. Accidental ammunition warehouse detonations count among the heaviest explosions ever recorded.

Diversion from ammunition stockpiles has fuelled armed conflict, terrorism, organized crime and violence, and contributes to the manufacture of improvised explosive devices. Much of the ammunition circulating among armed non-State actors has been illicitly diverted from government forces.¹ In recognition of these dual threats of explosion and diversion, the General Assembly requested the United Nations to develop **guidelines for adequate ammunition management**.² Finalized in 2011, the International Ammunition Technical Guidelines (IATG) provide voluntary, practical, modular guidance to support national authorities (and other stakeholders) in safely and securely managing conventional ammunition stockpiles. The UN SaferGuard Programme was simultaneously established as the corresponding knowledge-management platform to oversee and disseminate the IATG.

The IATG also ensure that the United Nations entities consistently deliver high-quality advice and support – from mine action to counter-terrorism, from child protection to disarmament, from crime reduction to development.

The IATG consist of 12 volumes that provide practical guidance for ‘through-life management’ approach to ammunition management. The IATG can be applied at the guidelines’ **basic, intermediate, or advanced levels**, making the IATG relevant for all situations by taking into account the diversity in capacities and resources available. Interested States and other stakeholders can **utilize the IATG for the development of national standards and standing operating procedures**.

The IATG are reviewed and updated at a minimum every five years, to reflect evolving ammunition stockpile-management norms and practices, and to incorporate changes due to changing international regulations and requirements. The review is undertaken by the UN SaferGuard Technical Review Board composed of national technical experts with the support of a corresponding Strategic Coordination Group comprised of expert organizations applying the IATG in practice.

The latest version of each IATG module can be found at www.un.org/disarmament/ammunition.

¹ S/2008/258.

² See also the urgent need to address poorly-maintained stockpiles as formulated by the United Nations Secretary-General in his Agenda for Disarmament, *Securing Our Common Future* (2018).

Introduction

There are a limited number of international treaties,³ agreements or instruments^{4,5} that refer to or require the mandatory destruction of ammunition and explosives. However, the principles of sound stockpile management and the inherent risks and hazards present during the storage of stockpiled ammunition mean that demilitarization or destruction should be a key component of conventional ammunition stockpile management programmes.

A recent report from the Group of Government Experts (GGE) established pursuant to UN General Assembly resolution 61/72⁶ identified that *'poorly managed ammunition stockpiles pose an excessive risk because they can become unstable and threaten public safety with explosions or contamination. Moreover, unsecured and poorly managed stockpiles of ammunition may be easily diverted to illicit use, which can increase fatalities arising from various forms of armed violence'*. The GGE recommended that a *'whole life management'* approach be adopted towards the stockpile management of conventional ammunition; such an approach includes the demilitarization or destruction of ammunition at the appropriate stage of its life cycle.

Demilitarization is an increasingly important aspect of munitions management. With a drive for higher performance and greater safety, new munitions and fillings render old munitions obsolete and munitions stockpiles cost money both to establish and maintain, so surplus munitions are an unwelcome expense and potentially a risk. The process of disposal is being shaped by a number of factors. Foremost is increasingly stringent environmental regulation restricting and modifying the methods. But other factors are also significant such as transshipment regulation, restrictions on proliferation of conventional weapons, and resource recovery, either through financial pressure or policy.

All munitions have a finite service life and will at some stage need to be either expended or disposed of. Disposal can involve dumping, resale and demilitarization. Dumping is banned at sea as a result of the London Convention and related agreements. Dumping on land is severely restricted if not banned in most jurisdictions. Resale is an attractive option in terms of recovering value from munitions, however, munitions must be serviceable to resell, and this option is restricted by issues of proliferation and security. This leaves demilitarization as the primary method of disposal. Demilitarization means removing or otherwise neutralising the military potential of an item, in this case a munition. This may or may not involve the destruction of the munition, but it does require that the energetic material is destroyed or converted⁷.

Techniques available for demilitarization range from the relatively simple open burning (OB) and open detonation (OD) destruction techniques to highly sophisticated industrial (demilitarization) processes. Security concerns and practical considerations, including safety and economies of scale, indicate that the most effective option is often the demilitarization of surplus or obsolete ammunition. This should preferably be achieved using an environmentally sound demilitarization process, whereby ammunition is stripped down to its component parts and compounds that are then recycled.

Surplus destruction or demilitarization removes many of the safety and security risks associated with surpluses, including problematic transfers and re-transfers, accumulations of unstable ammunition, and stockpiles that are at risk of theft or sabotage. The logistics of destruction or industrial

³ Currently Article 4 of the *Anti-Personnel Mine Ban Treaty (Ottawa Convention)*, 1997 and Article 3 (2) of the *Convention on Cluster Munitions (CCM)*, 2008 require the destruction of these ammunition types for those States that have ratified the treaties.

IMAS 11.20 (Second Edition incorporating Amendments 1 through 5) *Principles and procedures for open burning and open detonation operations*. 1 January 2003. IMAS

⁵ NATO STANAG 4518 (Edition 2) and AOP 4518 (Edition A Version 1) *Safe Disposal of Munitions, Design Principles and Requirements, and Safety Assessments*. NATO Standardization Organization (NSO). 2017

⁶ UNGA A/63/182 *Report of the Group of Government Experts established pursuant to General Assembly resolution 61/72 to consider further steps to enhance cooperation with regard to the issue of conventional ammunition stockpiles in surplus*. UN. 28 July 2008.

⁷ Previous 2 paragraphs from MSAIC2005.

demilitarization of conventional ammunition can, however, be very challenging because of the inherent risks and hazards during processing operations and the large tonnages and quantities of individual items involved. Decisions to demilitarize or destroy need to recognize a number of factors that can affect the efficiency and cost of the process, including the types and volumes of ammunition earmarked for demilitarization/destruction, the physical condition of the ammunition, the methods or technologies currently available and factors relating to domestic capacity. The most influential factor is likely to be economies of scale in that the more ammunition that requires demilitarization/destruction, the larger the economies of scale and therefore the wider range of available technology. Consequently, national authorities may wish to consider ammunition demilitarization/destruction on a co-operative basis in order to achieve larger economies of scale and hence more cost-effective demilitarization/destruction.⁸

Stockpile demilitarization/destruction can be carried out by different types of organisations, such as commercial companies, international organisations or military units. Despite differences in approach, common core activities exist which carry common responsibilities. This IATG module provides guidance and requirements for ammunition stockpile demilitarization and destruction. There are so many inter-relational factors involved in ammunition stockpile demilitarization and destruction that it would not be appropriate to provide a 'template solution' as part of this guide.

It is, of course, possible to reduce the amount of ammunition that needs to be disposed of at the end of its service life. Effective through life management, where ammunition is rotated throughout its life and expended before shelf life expiry date, is a tried and trusted method of reducing waste. This must be coupled with accurate accounting and stock control and the use of good storage facilities to minimise the deterioration of ammunition due to environmental influence.

⁸ For example, the NATO Support and Procurement Agency (NSPA) (on request) manages ammunition demilitarization and destruction on behalf of member States. This means that ammunition from a number of States can be dealt with under a single, larger, contract leading to cost savings for individual States.

Demilitarization, destruction and logistic disposal of conventional ammunition

1 Scope

This IATG module establishes the guiding principles and introduces technical methodology for the safe planning and execution of ammunition demilitarization and destruction activities in support of a conventional ammunition stockpile management programme. It includes Logistic Disposal of surplus ammunition stockpiles. Normative references

A list of normative references is given in Annex A. These documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

A further list of informative references is given in Annex B in the form of a bibliography, which lists documents that contain additional information related to the contents of this IATG module.

2 Terms and definitions

For the purposes of this module the following terms and definitions, as well as the more comprehensive list given in IATG 01.40 *Glossary of terms, definitions and abbreviations*, shall apply:

The term 'demilitarization' refers to *the complete range of processes that render weapons, ammunition and explosives unfit for their originally intended purpose.*⁹

The term 'destruction' refers to *the process of final conversion of weapons, ammunition and explosives into an inert state so that it can no longer function as designed.*

The term 'disposal' refers to *the removal of ammunition and explosives from a stockpile by the utilisation of a variety of methods, (that may not necessarily involve destruction)*.

In all modules of the International Ammunition Technical Guidelines, the words 'shall', 'should', 'may' and 'can' are used to express provisions in accordance with their usage in ISO standards.

- a) **'shall' indicates a requirement:** It is used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.
- b) **'should' indicates a recommendation:** It is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form, 'should not') a certain possibility or course of action is deprecated but not prohibited.
- c) **'may' indicates permission:** It is used to indicate a course of action permissible within the limits of the document.
- d) **'can' indicates possibility and capability:** It is used for statements of possibility and capability, whether material, physical or casual.

⁹ Demilitarization not only involves the final destruction process but also includes all of the other transport, storage, accounting and pre-processing operations that are equally as critical to achieving the final result.

3 Disposal options

Definitions are an important area for stakeholders in the area of ammunition disposal. For example, the term disposal does not necessarily mean that ammunition has been destroyed or demilitarized. Ammunition could have been disposed of by sale, which is very different to the demilitarization or destruction of ammunition. There are six traditional methods for disposing of surplus ammunition:

Method	Explanation	Advantages	Disadvantages
Sale Gift	Ammunition is either sold or gifted to another country. As a precondition for sale, ammunition should be in a serviceable condition.	<ul style="list-style-type: none"> Inexpensive for the donor country. 	<ul style="list-style-type: none"> Old ammunition is unattractive to reputable end users. Possibility of accidents causing casualties and damaging weapon systems and infrastructure. Ammunition may not be legal to move in accordance with international instruments. Transfers the eventual destruction problem to another location. Can be politically sensitive, not recommended by international agencies.
Increased use at training	Live firing is significantly increased during training of security forces.	<ul style="list-style-type: none"> Makes cost effective use of the ammunition. Improved training standards in security forces. 	<ul style="list-style-type: none"> Additional wear takes place on gun barrels, which will not last long enough to destroy significant stockpiles. Hence additional costs in barrel replacements. Could negate confidence and security measures between neighbouring States. Only limited stocks could realistically be destroyed this way. Larger calibre ammunition will require large training areas, which are often unavailable. Disposal of fuzed ammunition may lead to a higher incidence of "blinds", resulting in an increase in the need for Explosive Ordnance Disposal (EOD) action on ranges. Older ammunition may cause accidents, with casualties and damage to equipment.
Deep Sea Dumping This is now banned by international treaty.	The dumping of ammunition in deep water at sea in coastal or international waters.	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Banned by international treaty for some States. (See Clause 5.4). Long-term environmental impact of decaying ammunition on seabed is unknown. Previous shallow water dumping has led to pollution and dangerous munitions being washed ashore or being caught in fisherman's nets. Will not be supported by UN programmes.

Method	Explanation	Advantages	Disadvantages
Disposal by Landfill. This is now banned by international treaty.	The shallow or deep burial of ammunition and explosives.	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪ Long-term environmental impact of decaying ammunition on the ground and water table is unknown. ▪ There may be long term risks of spontaneous explosion due to degradation of safety mechanisms and chemical deterioration of the propellant and explosive content. ▪ Restricts future use of land for development. ▪ Will not be supported by UN programmes. ▪ Possibility of ammunition being recovered by criminals.
Destruction / Demilitarization	The physical destruction of ammunition, or the use of industrial processes to demilitarize ammunition and recover raw materials for reuse and recycling.	<ul style="list-style-type: none"> ▪ Proven technologies exist. ▪ Guarantees destruction or demilitarization. ▪ Can be environmentally benign. ▪ Can make effective use of recovery, reuse and recycling of components and materials. ▪ Several organisations are fairly advanced in developing mobile demilitarization facilities. 	<ul style="list-style-type: none"> ▪ Can be expensive, however, with rental options available, this technology should become more acceptable to donors due to environmentally benign filtering and purification techniques. ▪ The idea that these programs can be self-financing is unproven because, despite much effort, there will be some cost. ▪ OBOD can pose environmental risks (however, may be the only feasible option for disposal of unsafe ammunition).

Table 1: Traditional methods of ammunition disposal

The technology for mobile industrialised demilitarization techniques has reached a more advanced, more easily affordable stage. Therefore, this option should be considered before embarking on an OBOD reliant disposal programme.

4 International legislation, instruments and agreements

5.1 Anti-Personnel Landmine Ban Convention¹⁰

Article 4 of this convention, which entered into force on 01 March 1999, requires that, *except as provided for in Article 3, each State Party undertakes to destroy or ensure the destruction of all stockpiled anti-personnel mines it owns or possesses, or that are under its jurisdiction or control, as soon as possible but not later than four years after the entry into force of this Convention for that State Party.*

5.2 Convention on Cluster Munitions^{11 12}

Article 3(2) of this convention, which entered into force on 01 August 2010, requires that State Parties shall *destroy or ensure the destruction of all cluster munitions referred to in paragraph 1 of this Article as soon as possible but not later than eight years after the entry into force of this Convention for that State Party. Each State Party undertakes to ensure that destruction methods comply with applicable international standards for protecting public health and the environment.*

¹⁰ *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction.* Ottawa. 18 September 1997. (Entered into Force on 01 March 1999)

¹¹ *Convention on Cluster Munitions.* Dublin. 30 May 2008. (Entered into Force on 01 August 2010).

¹² As at 31 May 2017, a total of 100 were States Parties', and a further 19 States are signatories to the convention.

5.3 UN Firearms Protocol

Article 6 of the UN Firearms Protocol¹³ requires that States that have ratified the treaty *shall adopt, within their domestic legal systems, such measures as may be necessary to prevent illicitly manufactured and trafficked firearms, parts and components and ammunition from falling into the hands of unauthorized persons by seizing and destroying such firearms, their parts and components and ammunition unless other disposal has been officially authorized, provided that the firearms have been marked and the methods of disposal of those firearms and ammunition have been recorded.* These requirements, already agreed by many states, are a core component of this IATG for illicitly manufactured and trafficked ammunition that may be seized.

5.4 International instruments (environmental)

Ammunition and explosives are considered to be hazardous or industrial waste and as such fall under the remit of international treaties that have been signed and ratified:

- A) *the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, 29 December 1972;
- B) *the 1996 Protocol to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Amended 2006)*; and
- C) *the Convention for the Protection of the Marine Environment of the North-East Atlantic*, 1998.^{14 15}

Ammunition and explosives shall therefore not be dumped at sea by States that have ratified and signed the above treaties and should not be dumped at sea by non-participant States.

The United Nations shall not support any ammunition disposal activities that utilise deep sea dumping.

5.5 Supra-national legislation (environmental)

Supra-national legislation that covers emissions into the atmosphere from the incineration of hazardous waste is the European Union Council Directive 2000/76/EC *The incineration of waste*, 04 December 2000, amended by Regulation (EC) No 1137/2008 of 11 December 2008.

European Union Council Directive 2008/98/EC *Waste*, 19 November 2008, contains provisions on the management of waste. These should be applied to industrial ammunition demilitarization processes.¹⁶

The directives provide a comprehensive standard and are in use by all European Union countries and those countries with associate status. States should reflect the requirements of these directives in their own national environmental legislation where it relates to the destruction of ammunition.

¹³ United Nations General Assembly Resolution A/RES/55/255. *Protocol against the illicit manufacturing of and trafficking in firearms, their parts and components and ammunition supplementing the United Nations Convention against Transnational Organized Crime*. 08 June 2001. 'The Firearms Protocol'. (Entered into Force on 03 July 2005).

¹⁴ Also known as the *OSPAR Convention*.

¹⁵ Entered into force on 25 March 1998 and replaced the 1972 *Oslo Convention*.

¹⁶ Article 2, Paragraph 1(e) of the subsequent European Union Council Directive 2008/98/EC *Waste and repealing certain Directives*, 19 November 2006 excluded explosive waste from the provisions of Directive 2008/98. However, non-explosive hazardous waste products from the processing of explosives during demilitarization operations would be covered by this directive.

5.6 International standards (environmental)

5.6.1 ISO 4220:1993 Measurement of air pollution

ISO 4220:1983 *Ambient air - Determination of a gaseous acid air pollution index - Titrimetric method with indicator or potentiometric end-point detection*, whilst not specifically legislation, lays down internationally accepted standards for the determination and measurement of air pollution from industrial processes. These standards should apply to any pollution control systems used during industrial demilitarization operations, but only in terms of the measurement of emissions. The standard does not provide any guidance on what the overall emission limits should be; this remains the responsibility of the national authority.

5.6.2 ISO 9612:2009 Acoustics

ISO 9612:2009 *Acoustics - Determination of occupational noise exposure – Engineering method* may be applied to open detonation destruction operations.

5 Demilitarization cycle

The physical demilitarization or destruction process of conventional ammunition is only one process of the complete demilitarization or destruction cycle. The processes in this cycle should be considered in parallel with the technical factors, (see Clause 7), before a final disposal solution is produced. The cycle is complex, comprehensive and wide-ranging and includes activities such as transportation and storage, processing operations, equipment maintenance, staff training and accounting. Safety, security and environmental risks have to be balanced into a comprehensive solution for each task, taking all international and local factors into account. The full cycle is shown schematically at Annex C.

6 Technical factors

7.1 General

There are a wide range of technical factors that will determine the overall ammunition demilitarization or destruction plan, not least that of experienced and qualified personnel for demilitarization¹⁷ and potentially high funding requirements. There is a global shortage of qualified personnel experienced in developing ammunition demilitarization facilities and programmes.

In order that the demilitarization programme is developed efficiently and safely, national authorities may wish to consult with appropriate regional and international organisations that are experienced in the development of demilitarization programmes, as well as the commercial companies and NGOs with the practical experience of operational demilitarization.¹⁸

¹⁷ There is wider experience available for the destruction of conventional ammunition by open burning and open detonation.

¹⁸ The EU Explosives Certification (EU-ExCert) scheme (www.euexcert.org) has recently been developed to establish a stable framework for the vocational education of people in the European explosives sector. Training and education institutions as well as social partners will have a tool for competency development and assessment. New training methods will also be developed in order to ensure that the explosives sector has access to enough trained and experience staff and that the current shortfall in qualified and experienced staff is overcome. Other regions should consider the development of a similar type of system.

7.2 National legislation

Details of applicable international legislation, instruments and agreements can be found in Clause 5. National environmental legislation shall dictate the emission levels to be met¹⁹ which will in turn dictate the type of technology required to meet these emission levels, (also see Clauses 5.4, 5.5, and 5.6). Should this technology be too expensive, or not available, then agreement needs to be reached with the environmental authorities for an exemption. National environmental legislation should be based on the appropriate normative references at Annex A (from Clauses 5.3 and 5.4).

7.3 Chemistry of explosives

The stability in storage and degradation or deterioration rates of the explosive content should influence the degree of urgency for disposal, type of transport that can safely be used and destruction/demilitarization methodology.

7.4 Knowledge of ammunition design

A detailed knowledge of the ammunition design is essential to the formulation of a safe demilitarization/destruction plan. This knowledge should also include the type and rate of evolution of gases should a thermal destruction technique be under consideration as this will be a requirement for the design of a pollution control system that can meet the air emission levels laid down by national legislation.

7.5 Quantity for disposal

The most influential factor is likely to be economies of scale, in that the more ammunition that is requiring demilitarization or destruction, the larger the economies of scale and, therefore, the wider range of available technology at an affordable price. Consequently, national authorities may wish to examine the problem of ammunition demilitarization and destruction on a cooperative or regional basis in order to achieve larger, and hence more cost effective, economies of scale. With the advent of new, mobile facilities a collaboration between several states in a region becomes more practical and, with rental available, more cost effective.

7.6 Available technology

See Clause 9.

7.7. Safe systems of work

Safe systems of work are a pre-requisite when handling and processing any types of ammunition and explosives. Formal risk management processes shall be developed to support ammunition demilitarization or destruction in accordance with the requirements of ISO Guide 51 and IATG 02.10 *Introduction to risk management principles and processes*.

7.8 Security

Stockpile security is obviously an important issue. Every effort should be taken to ensure the physical security of ammunition during storage, transportation and processing in accordance with the requirements of IATG 08.10 *Transport of ammunition* and IATG 09.10 *Security principles and systems*.

7.9 Logistics

¹⁹ Although donors may insist on higher standards if national legislation is less than the international norms at Clause 5.4.

7.9.1 Logistic factors

The demilitarization or destruction of ammunition stockpiles is primarily a logistics problem. The technology exists to destroy most ammunition types, yet the major phases of the demilitarization/destruction cycle involve logistics. The demilitarization or destruction methodology should be dependent on logistic factors such as: 1) the availability of suitably qualified and trained manpower; 2) location and type of ranges and demolition grounds; 3) distance from storage to demilitarization facilities; 4) the availability of transport; and 5) the availability of water supply, power etc. States must ensure all these factors are included when considering different demilitarization options.

7.9.2 Transport of ammunition

Ammunition should be transported in accordance with the requirements of IATG 08.10 *Transport of ammunition*.

7.10 Transparency and accounting

The transparency of the demilitarization or destruction programme is an important security and confidence building measure. International organisations, national ambassadors, media and non-governmental organisations (NGO) should be invited to witness the destruction process. They may also be given access to the surplus or unserviceable ammunition account in order that they can verify the ammunition demilitarized or destroyed against the declared surplus stockpile levels.

Ammunition should be accounted for in accordance with the requirements of IATG 03.10 *Inventory management*.

7.11 Staff competencies

The logistic disposal of ammunition and explosives is based on the first principles taught to every ammunition technician or ammunition technical officer and their national equivalents. Staff planning demilitarization and destruction, or engaged as the OIC Disposals for destruction by open burning or open detonation, should either be trained ammunition technical personnel or fully compliant with the related, detailed criteria in the following competency standard:

Test and Evaluation Protocol 09.30/01/2014 Version 1.0 30 October 2014 Explosive Ordnance Disposal (EOD) Competency Standards

7 Priority for demilitarization or destruction

The demilitarization and destruction of surplus ammunition stockpiles in countries that do not currently adopt a 'through life management' approach to stockpile management does not often follow logical destruction priorities. Small arms ammunition often has priority as donors have budgets to support the demilitarization or destruction of these natures. Yet the destruction of the large stockpiles of other generic ammunition natures has been identified as a humanitarian and security priority. The hazards that certain ammunition natures present to local communities and the associated large costs of destruction mean that States shall determine demilitarization or destruction priorities.

Conventional ammunition should be destroyed in the priority order shown in Table 2:

Priority	Ammunition	Remarks
1	Ammunition that poses the greatest risks to the civilian community in terms of explosive safety.	<ul style="list-style-type: none"> ▪ This will usually be specific types of ammunition stored in a stockpile very close to the civilian community. Not all the ammunition in the Explosive Storage Area will require destruction. ▪ This ammunition can be identified by surveillance (chemical analysis and visual inspection) and proof (performance) as part of ongoing stockpile management processes.
1	Ammunition that is a security concern, e.g. Attractive to Criminal and Terrorist Organisations (ACTO).	<ul style="list-style-type: none"> ▪ Detonators, Shoulder Launched Anti-Tank Rockets, Man Portable Air Defence Systems (MANPADS), Bulk Explosives etc. ▪ Or enhance security measures at current storage locations to reduce risk of proliferation.
2	Ammunition that must be destroyed in order to meet treaty obligations.	<ul style="list-style-type: none"> ▪ Anti-Personnel Mines and Cluster Munitions for those States that have ratified the relevant treaty.
2	Small arms ammunition.	<ul style="list-style-type: none"> ▪ <20mm calibre. ▪ Classed as Priority 2 as an Armed Violence Prevention (AVP) matter. The proliferation of this ammunition is particularly undesirable.
3	Ammunition that needs to be destroyed to release storage space.	<ul style="list-style-type: none"> ▪ Usually as part of security sector reform and downsizing of armed forces.
3	Remaining ammunition types.	<ul style="list-style-type: none"> ▪ May be done in order of ease of destruction.

Table 2: Demilitarization or destruction priorities

In order to determine demilitarization or destruction priorities it may be necessary to conduct an Ammunition Technical Assessment of the complete stockpile in order to determine 'at risk' ammunition.²⁰

Donors should ensure that one of their major priorities is capacity building of national institutions to develop and guarantee continuance of a longer-term nationally financed, safe, efficient and effective destruction of ammunition to appropriate technical standards.

8 Demilitarization and destruction technology and techniques

9.1 Open burning (OB) and open detonation (OD) (LEVEL 1)

Open burning (OB) and open detonation (OD) are usually regarded as the easiest way of stockpile destruction and are often the only cost-effective option for States that have small quantities of ammunition for destruction (<1,000 tonnes), or do not have access to, or the resources to develop, more sophisticated ammunition demilitarization technology. OB or OD are sometimes the safest methods for disposal of unsafe ammunition.

There is obvious potential for environmental pollution and States should complete a formal environmental impact assessment before they select either of those options.²¹

²⁰ Examples available from UNDP for Croatia and Montenegro.

²¹ SALW ammunition destruction – environmental releases from open burning (OB) and open detonation (OD) events. SEESAC, 30 May 2004, provides useful data on the emissions to air to be expected from OBOD processes.

Open burning (OB) is usually used for the destruction of propellants and pyrotechnic compositions and has potential for significant environmental impact, producing harmful chemicals. Unconfined high explosives may also be destroyed by burning but only in small quantities to reduce the risk of burning to detonation. When using OB techniques on high explosives, the danger area has to be calculated the same as for the explosives being destroyed by detonation – high explosives do not always react as expected. OB is generally done on concrete pads or specially designed burning trays (metal pans) to improve operational efficiency.

Open detonation (OD) uses serviceable explosive as donor charges to destroy surplus or unserviceable ammunition by sympathetic detonation.²² It allows for the destruction of ammunition without the need for special equipment, but it does have disadvantages:

- A) large 'danger areas' are required to ensure safety from blast and fragmentation. **Significantly greater safety distances are required for protection from OBOD operations than those required for ammunition storage, for which quantity-distances (QD) are detailed in IATG 02.20;**
- B) production is weather and time dependent (normally restricted to daylight hours);
- C) it is labour intensive;
- D) there is a possibility of ammunition being thrown out of a poorly planned/laid demolition pit, resulting in it not being destroyed, hence requiring further Explosive Ordnance Disposal (EOD) clearance;
- E) environmental impact through noise, air and ground pollution (harmful chemicals produced), geology (water table and ground-shock); and
- F) requires trained personnel to carry out the task (the level of training they require should not be under-estimated).

OBOD operations should be planned and conducted in accordance with Annex D.²³ Appropriate safety distances that take into account increased hazards from blast and fragments shall be applied. Additional consideration should also be given to the risk differences of OBOD of commercial explosives as compared to military ammunition, which may present greater blast and fragment threats. Explosive Ordnance Disposal (EOD) or other internationally accepted safety distances²⁴ and requirements shall be used for the protection of the public and other exposed sites (ES) from OBOD operations.

For larger stockpiles the sheer amount of ammunition requiring destruction, with the resultant logistic challenges on a demolition area, will mean that industrial demilitarization may be a more efficient and cost-effective approach.

9.2 Industrial demilitarization (LEVELS 2 and 3)

9.2.1 General

Industrial demilitarization of ammunition combines the skills of mechanical, production, chemical and explosives engineering and is a highly specialist operation to plan. Appropriate technical advice should be taken and internationally accepted documents reviewed before planning and developing such an activity. Other possible demilitarization options are detailed in NATO AOP 4518 (Edition A Version 1).

²² The process of sympathetic detonation is the 'induced detonation of an explosive or ammunition item containing high explosive by exploding another high explosive charge adjacent to it'.

²³ Developed from IMAS 11.20 *Principles and procedures for open burning and open detonation operations*.

²⁴ AASTP-1 Edition B Version 1, Part IV, Chapter 7 *Destruction of ammunition and explosives*. NATO Standardization Organization (NSO). December 2015.

9.2.2 Advantages and disadvantages of industrial demilitarization

Industrial scale demilitarization has significant advantages:

- A) mechanical disassembly using machines, thereby increasing operational efficiency and reducing risk to personnel;
- B) destruction (usually incineration) in environmentally controlled systems; and
- C) the ability to operate 24 hours a day, up to 365 days a year.

Major disadvantages of industrial demilitarization are the high costs of design, project management, construction and commissioning, although their operating costs are generally lower than OBOD (when amortisation of the development capital is discounted).²⁵

In many cases the development of such purpose-built demilitarization facilities to enable States to destroy their ammunition stockpiles will be well beyond available resources and therefore may not be a practical option. Factors such as low ammunition stockpile levels, cost, location and safety may mean that OBOD is the only pragmatic and feasible option.

9.2.3 Pre-processing

In many cases it may be necessary to disassemble or breakdown ammunition prior to the destruction process. Consequently, ammunition will be destroyed at the component level rather than the complete round. This could be necessary because of limitations on the amount of contained explosive that can be incinerated, the ammunition design or the requirement for different components to have separate destruction methods. This could require the movement of exposed bare explosive to the final destruction facility.

Table 4 summarises the technology options, which may be used singly or in combination:

Technology	Remarks
Manual disassembly (LEVEL 2)	<ul style="list-style-type: none"> ▪ Uses human resources, usually on a process line, to physically remove components and breakdown ammunition using simple hand tools. ▪ Labour intensive and there is an obvious degree of risk.
Mechanical breakdown (LEVEL 2)	<ul style="list-style-type: none"> ▪ Technology includes: 1) band saw; 2) guillotine; 3) cracker mill; 4) rock crusher; 5) punch; 6) hydraulic press; and 7) lathe.
Mechanical disassembly (LEVEL 2)	<ul style="list-style-type: none"> ▪ Technology includes: 1) pull apart; 2) de-fuzing; and 3) de-priming.
Mechanical removal (LEVEL 3)	<ul style="list-style-type: none"> ▪ Uses hydraulic press, water-cooled mechanical cutting or similar technique to remove cast explosive such as RDX, HMX. ▪ Only suitable for 'straight walled' ammunition. ▪ Requires removal of ogive and base/boat-tail by cutting
Robotic disassembly (LEVEL 3)	<ul style="list-style-type: none"> ▪ Expensive technology that requires very large quantities and economies of scale to be cost effective. Usually used for the conversion of small arms ammunition from military to civilian use. Also often used for guided missiles containing cluster munitions.
Cryo-fracture (LEVEL 3)	<ul style="list-style-type: none"> ▪ Developed originally for the demilitarization of chemical munitions. ▪ This involves freezing the ammunition body in liquid nitrogen to make it more brittle and hence easier to crack open by mechanical breakdown.
Hydro-abrasive cutting (LEVEL 3)	<ul style="list-style-type: none"> ▪ The use of abrasive entrained in, or directly injected into, high pressure water jets to cut open ammunition. Only suitable for large economies of scale. Requires a waste water collection and treatment facility to prevent ground water pollution.

Table 3: Demilitarization pre-processing technology

²⁵ Labour costs account for a large percentage of the OBOD costs but these are much lower in lesser-developed countries. OBOD can be a cheaper option dependent on the economy of scale.

9.2.4 Explosives removal

Technology is often required to remove the explosive filling from the metal body of the ammunition after initial pre-processing (although explosives removal can be considered as a pre-processing operation it is also a major industrial process in terms of improving the recycling and re-use of military explosives for commercial use, hence a separate clause in this IATG).

Table 4 summarises the technology options.

Technology	Remarks
Hot steam/water melt out ²⁶ (LEVEL 2)	<ul style="list-style-type: none"> ▪ Hot water or steam is used to melt out TNT and TNT derivative (TNT/RDX) fillings, which melt at approximately 80°C.²⁷ ▪ Conversely RDX melts at 206°C and therefore RDX filled munitions are not suitable for this technique. ▪ The waste explosive is then often reprocessed and used in commercial blasting explosives. ▪ Can also be used for white phosphorus ammunition if the process is all done under water. ▪ The ammunition body will require further processing as a thin residue of explosive will remain. (See car bottom furnace below).
Water jet washout (LEVEL 3)	<ul style="list-style-type: none"> ▪ High pressure water is focused on the explosive, which is then washed out of the ammunition body using a rotating nozzle. ▪ Suitable for RDX and PBX²⁸ ammunition. ▪ Requires a waste water treatment facility to prevent ground water pollution.
Solvent washout (LEVEL 3)	<ul style="list-style-type: none"> ▪ Uses a solvent that will easily dissolve the explosive, which is then extracted and reprocessed. (Methyl alcohol, methylene chloride, acetone or toluene are options). ▪ Large quantities of solvent are required. ▪ It is not a cheap process. ▪ It is best considered when high value explosive such as HMX needs recovering for re-use.

Table 4: Demilitarization explosives removal technology

9.2.5 Physical destruction during demilitarization

The smaller ammunition calibres (<20mm) may be destroyed by incineration with no pre-processing necessary in a demilitarization programme. Large calibre ammunition may require pre-processing unless it is to be destroyed in a contained detonation chamber.

Table 5 summarises the technology options:²⁹

²⁶ Microwave melt out is a new technology under development that has future potential to replace this system.

²⁷ **WARNING. Do NOT attempt to steam out explosive compositions of TNT and Aluminium or Aluminium Powder as they will detonate.**

²⁸ Plastic or Polymer Bonded explosives.

²⁹ There are also experimental techniques including: 1) super critical water oxidation; 2) plasma arc pyrolysis; 3) electro-chemical oxidation; and 4) biodegradation. All these techniques are designed for the conversion of specific types of explosive waste. Their limitations and lack of general production experience means that they are unlikely to be suitable for the majority of States and are therefore not yet considered further in this IATG. As each technology develops they will be included in future editions of this IATG.

Technology	Remarks
Rotary kiln incineration ³⁰ (LEVEL 3)	<ul style="list-style-type: none"> ▪ This is the controlled thermal destruction of ammunition within a high temperature (>500°C) oven that rotates. ▪ It is proven technology from the 1950s and is still among the most efficient destruction systems available today. ▪ It must be operated in parallel with a pollution control system to treat the exhaust gases. ▪ Dependent on design it can destroy ammunition of <20m calibre or an explosive filling of less than 1kg with no pre-processing required. ▪ Transportable versions are approximately 33% of the cost of static systems yet have up to 70% of the capability albeit with lower explosive limits which restricts them to small arms ammunition, detonators, primers, fuzes, propellant and pyrotechnics.
Fluidised bed incineration (LEVEL 3)	<ul style="list-style-type: none"> ▪ Only suitable for the incineration of explosive waste and not complete munitions. ▪ The waste is pumped as a slurry onto hot silicon oxide (sand) particles, which act as a liquid because of the high temperature. ▪ It is a specialised system that is only really suitable for those States with excessively large stockpiles. (>100,000 tonnes). ▪ Can cause problems if trying to dispose of pyrotechnics. This method is NOT suitable for the disposal of pyrotechnics as the metal contents will form eutectic salts and these will reduce "fluidity".
Car bottom furnace (LEVEL 3)	<ul style="list-style-type: none"> ▪ Usually used in combination with a rotary kiln furnace and heated through a heat exchanger. ▪ Used to remove trace explosive contamination from munition parts after explosive removal, although it can deal with small calibres in limited quantities. ▪ A larger version is sometimes referred to as a Hot Gas Decontamination Facility. ▪ Supports demilitarization rather than being a system in its own right.
Contained detonation chamber (CDC) (LEVEL 3)	<ul style="list-style-type: none"> ▪ Effectively uses open detonation techniques within a protected structure, which has an integral pollution control system. ▪ Production rates are limited but is a useful system for States with smaller stockpiles of ammunition that do not justify capital investment in explosive removal technology. ▪ Ammunition of up to, and including 155mm calibre, can be destroyed in the appropriate chamber.
Hot detonation chamber (HDC) (LEVEL 3)	<ul style="list-style-type: none"> ▪ Destruction of explosives, propellants and munitions by 'cook-off' in a heated detonation chamber. The explosive material is destroyed through either burning, deflagration or detonation (dependent on the type of ammunition). ▪ Operation temperature is around 500°C. ▪ No additional donor charges are necessary. ▪ High capacity, automatic process from loading to emptying with low energy consumption.
Moving bed reactor (MBR) (LEVEL 3)	<ul style="list-style-type: none"> ▪ Developed for smaller calibre ammunition (105mm) (2002). Technology concept proven. ▪ New technology for large calibre ammunition (155mm) (2010). ▪ HE munitions are heated in a vertical chamber containing over 50 tonnes of constantly moving and re-circulating 25cm diameter steel balls. ▪ The steel balls present a mass to the blast wave, the kinetic energy of which is then absorbed because of the mass and dissipated because of all the interstitial boundaries. ▪ The steel balls also trap the fragmentation.

Table 5: Demilitarization destruction technology

³⁰ Also often generically referred to as Explosive Waste Incinerators (EWI).

9.2.6 Pollution control systems (LEVEL 3)

Pollution control systems (PCS) for ammunition demilitarization destruction technology shall:

- A) destroy volatile organic compounds (VOC);
- B) neutralise acid gases; and
- C) filter out particulate and solid matter.

The final emissions to air, solid waste and liquid waste shall fall within the emission and waste toxicity levels contained within the appropriate national environmental legislation.

Table 6 summarises the technology options.

Technology	Remarks
Afterburner	<ul style="list-style-type: none"> ▪ Required in all PCS to destroy the VOC. ▪ Minimum requirements are 850°C for >2sec. ▪ The VOCs then burn to carbon dioxide, water and acid gases, which are treated further downstream in the PCS. ▪ Can be ammonia injected to reduce nitrogen oxides.
Acid gas neutralisation	<ul style="list-style-type: none"> ▪ Sorbents, usually sodium bicarbonate and charcoal, are added to neutralise acidic gases and reduce dioxin formation. ▪ Safe and inert solid waste (sodium chlorides, sulphates and nitrates) is produced that can be safely sent to landfill.
Wet scrubbing	<ul style="list-style-type: none"> ▪ Neutralises acid gas by the addition of compounds in a fine spray. ▪ Its efficiency is reduced because of the high exhaust gas temperature on entry to the 'wet scrubber' system. ▪ Can require an expensive waste water filtration and treatment system.
Activated carbon adsorption	<ul style="list-style-type: none"> ▪ Required to remove high mercury (Hg) levels. ▪ Process gas is drawn through a bed of activated carbon granules for a gas residence time of just less than 3 seconds. ▪ The fixed bed requires renewal on a bi-annual basis.
Baghouse fabric filtration	<ul style="list-style-type: none"> ▪ Uses fabric filter bags to remove particulate waste. A typical bag-house comprises an array of long, narrow bags, each about 25 cm in diameter, that are suspended upside down in a large enclosure. ▪ Prone to bag-house fires, which can require replacement of the entire bag-house if not caught quickly enough.
Ceramic filtration	<ul style="list-style-type: none"> ▪ Use hollow ceramic filters to remove particulate and solid waste. ▪ Individual filters are generally 1.0m x 0.06m and there are typically 256 filter elements in a system, giving a filtration area of 48m². ▪ Filters down to 1 micron and is fire resistant. ▪ Also supports bed of sorbent, thereby improving overall acid gas neutralisation efficiency. ▪ Regarded as one of the most effective filtration systems.
Online monitoring	<ul style="list-style-type: none"> ▪ Required to monitor emission to air levels. Systems will require: <ul style="list-style-type: none"> • Tribo-electric (Particulate) • Flame ionisation (VOC) • pH of solution (HCl, HF) • Velocity (Flow Rate) • Zirconia Electrode (O₂) • Thermocouple (Temperature) • Pressure (Diaphragm Strain) ▪ It also requires a data processing system to calculate and display emission rates, concentration and history.

Table 6: Pollution control system (PCS) technology

The emission levels to air and water from pollution control systems during ammunition demilitarization operations may comply with those in Tables 7 and 8, which are generally regarded as international best practice.^{31 32}

Serial	Polluting substance		Limit value (mg/m ³)
Daily average values			
1	Total Dust		10
2	Gaseous and vaporous organic substances, expressed as total organic carbon		10
3	Hydrogen Chloride	HCl	10
4	Hydrogen Fluoride	HF	1
5	Sulphur Dioxide	SO ₂	50
6	Nitrogen Monoxide and Nitrogen Dioxide ³³	NO NO ₂	400
7	Dioxins and Furans		0.0000001 ³⁴
8	Carbon Monoxide ³⁵	CO	50

Table 7: Emission to air daily average limit values

Serial	Polluting substance	Limit values ³⁶	
		95% / 30mg/l	100% / 45mg/l
1	Totally suspended solids as defined by Directive 91/271/EC		
2	Mercury and its compounds, expressed as mercury (Hg)	0.03 mg/l	
3	Cadmium and its compounds, expressed as cadmium (Cd)	0.05 mg/l	
4	Thallium and its compounds, expressed as thallium (Tl)	0.05 mg/l	
5	Arsenic and its compounds, expressed as arsenic (As)	0.15 mg/l	
6	Lead and its compounds, expressed as lead (Pb)	0.2 mg/l	
7	Chromium and its compounds, expressed as chromium (Cr)	0.5 mg/l	
8	Copper and its compounds, expressed as copper (Cu)	0.5 mg/l	
9	Nickel and its compounds, expressed as nickel (Ni)	0.5 mg/l	
10	Zinc and its compounds, expressed as zinc (Zn)	1.5 mg/l	
11	Dioxins and furans, defined as the sum of the individual dioxins and furans in accordance with Annex 1 to the Directive.	0.3 mg/l	

Table 8: Waste water discharge daily average limit values

9.2.7 Recovery, recycling and reuse (R3) (LEVEL 3)

Certain demilitarization techniques result in the production of 'special' or 'hazardous' waste which itself requires destruction or disposal in an environmentally benign manner. This should be done by a specialist environmental disposal company.

³¹ Annex IV to Directive 2000/76/EC of the European Parliament and of the Council on the *Incineration of Waste*, 04 December 2000. (Emission limit values for discharges of waste water from the cleaning of exhaust gases).

³² Annex V to Directive 2000/76/EC of the European Parliament and of the Council on the *Incineration of Waste*, 04 December 2000. (Air emission limit values).

³³ Expressed as Nitrogen Dioxide for existing incineration plants with a nominal capacity of 6 tonnes per hour or less.

³⁴ 0.1 ng/m³.

³⁵ Annex V(d) to Directive 2000/76/EC of the European Parliament and of the Council on the *Incineration of Waste*, 04 December 2000. (Emission limit values for discharges of waste water from the cleaning of exhaust gases).

³⁶ Expressed in mass concentrations for unfiltered samples at discharge point.

The salvage of metallic scrap, or explosive waste, can result in an income stream. Some explosive fillings of ammunition may be useful to the commercial explosive industry whilst scrap steel is always in demand. Ammunition demilitarization programmes should aim to recover, recycle and reuse (R3) the maximum amount of waste possible. In the case of reclaimed explosive fillers, they will often contain a minor amount of contaminants from the recovery process and hence may not fulfil the tight quality requirements for re-use in military explosive ordnance. Instead, such explosives can be used as precursors for commercial blasting explosives. However, note that the cost of reclaiming military explosives, and then mixing with commercial slurry explosives, can be far greater than purchasing commercial slurry explosives.

9.2.8 Future techniques

States, commercial companies and INGOs should aim to develop more environmentally benign techniques for the demilitarization of ammunition and explosives.³⁷ Several are currently developing mobile, environmentally friendly demilitarization systems.

9 Management of stockpile demilitarization or destruction

The demilitarization or destruction management process that should be followed is shown in outline in Annex E. In practice, the process may not be linear and the activities may not always be consecutive. Nevertheless, the process indicates the general sequence and logical progression from defining the problem to the final demilitarization or destruction of the stockpiled ammunition. The four stages of the management process (planning, preparation, destruction and verification activities) are addressed below.

10.1 Planning

Planning is the collection, assessment and processing of information, selection of an appropriate way to proceed, and subsequent formulation of the detailed method by which a task is to be carried out.

Planning for stockpile demilitarization or destruction requires accurate and timely information on the quantity, storage location, type and technical design of the ammunition, together with a knowledge of the available demilitarization or destruction technology. Finance will obviously have an influence, but until the destruction of the stockpile has been planned it is difficult to calculate the real costs. Indeed, once the real costs have been identified, it may be necessary to re-plan the destruction operation in an attempt to find a more cost-effective route.

For new stockpile demilitarization or destruction programmes, the planning process should ideally start with a formal assessment of the country situation. This assessment, which may take the form of an Ammunition Technical Assessment, will draw heavily on existing information provided by the military, research agencies and, if applicable, commercial companies. Technical expertise is essential during the planning process and countries can request the support of the UN,³⁸ or regional organisations,³⁹ to assist in the planning process.

³⁷ See Footnote 27 for some examples of ongoing work.

³⁸ UNDP BCPR and UNMAS have previous experience of either ammunition demilitarization or destruction projects.

³⁹ NSPA and OSCE also currently provide this capability. Other regional organisations should be encouraged to develop a similar capability.

10.2 Preparation

Preparation should include all enabling activities that help clarify the demilitarization or destruction requirement and develop the capacity of a national authority and demilitarization/destruction organisation to carry out a demilitarization or destruction task. All aspects of the demilitarization and destruction cycle at Clause 7 should be considered.

10.2.1 Ammunition account

The accuracy of the national ammunition account is very important to ensure that future monitoring and verification activities do not identify accounting errors once the stockpile demilitarization or destruction process has started. A 100% stock check of the ammunition stockpile should take place prior to the commencement of the demilitarization or destruction process. Any accounting errors should then be rectified at this point which also contributes to security and confidence building measures.

Ammunition should be accounted for in accordance with the requirements of IATG 03.10 *Inventory Management of Ammunition*. The accounting system must also account for all sub-components.

10.2.2 Storage at demilitarization or destruction facility

Sufficient stocks of ammunition should be stored at the demilitarization or destruction facility to ensure that destruction is a continuous process. This ammunition should usually be stored in accordance with the safety requirements of IATG Series 02 *Risk management* and IATG Series 06 *Explosives facilities (storage and operations)* although temporary storage in accordance with IATG 04.10 *Temporary storage* may be permitted.

10.2.3 Selection of demilitarization or destruction technology

See Clauses 8 and 9 for factors and technologies that will influence the final selection.

10.2.4 Development of demilitarization or destruction facility

National authorities should be aware that the development of even relatively simple demilitarization or destruction systems can be a time consuming process. Safety shall be paramount, therefore there is little opportunity to 'fast track' many of the necessary processes.

The development of OBOD processes will take weeks to months, whilst the development of industrial demilitarization processes can take months to years. This time requirement should be incorporated into the planning and preparation processes. That said, with the advent of the option to rent mobile facilities, the development time is replaced by preparation time for the facility, which will reduce the timeframe considerably.

10.2.5 Funding (resource mobilization)

The funding of ammunition demilitarization or destruction programmes comes from many sources. Funding may be provided by the host government, from donor governments, the United Nations or other international organisations. Funds may be held in trust funds or some other form of controlled accounts. Regardless of the source of funding it is important that the funds match the true cost of demilitarization or destruction and that a long term commitment is provided by the donor. This is particularly important for major projects that require the demilitarization/destruction organisation to make major investments in staff, infrastructure and expensive new equipment such as furnaces and pollution control systems.

The cost of ammunition destruction is probably the most important factor as the destruction of large quantities of conventional ammunition is expensive. Little data is publicly available on the costs of ammunition demilitarization.

Donors should recognize that the costs associated with the structural development, technical training, and equipment procurement of demilitarization facilities mean that the initial costs per tonne will be high in the first year but subsequent demilitarization is a lot cheaper as economies of scale take effect and national capacity has been built. This is sometimes a problem when the donor single-year funding cycle is applied as the decreasing cost of demilitarization in subsequent years is often difficult to specify.

If equipment is rented, these costs will substantially reduce, making a mobile facility more attractive to donors as it will come within a single-year funding cycle, without an investment budget.

10.2.6 Training

Demilitarization programmes require well-qualified managers and well-trained workers. The majority of training should be conducted at the demilitarization facility, not only for cultural and linguistic reasons, but also for access to details of the ammunition stockpile and destruction technology. Training programmes should be included in all contracts for the procurement of equipment.

A rented facility would come with everything required, including trained personnel. Training for local labour would be required, but this could be carried out by the technical personnel provided with the rented facility.

10.3 Physical demilitarization or destruction

Throughout the demilitarization or destruction process occupational health and safety shall be a priority. Similarly, an effective quality management system should be implemented.

10.3.1 Safety and occupational health

Managers of ammunition demilitarization or destruction programmes shall achieve a safe working environment by providing effective management and supervision, by developing working practices that contribute to risk reduction, by selecting equipment with inherently safe design, by providing appropriate training, and by making available effective personal protective equipment (PPE). Given the wide range of possible technical solutions, it is not possible to provide a precise and complete set of specifications that apply to all situations. Thus, ammunition demilitarization/ destruction organisations should develop and maintain management procedures and processes that will enable safety and occupational health (S&OH) risks to be identified, evaluated and reduced in a systematic and timely manner for each demilitarization or destruction task and for each demilitarization or destruction worksite.

10.3.2 Explosive safety procedures

The need for effective and safe operational procedures is essential. Standing operating procedures (SOPs) should be prepared for all operational procedures, practices and drills. SOPs are instructions that define the preferred method of conducting an operational task or activity. Their purpose is to establish recognisable and measurable degrees of uniformity, consistency and commonality within an organisation with the aim of improving operational effectiveness and safety. SOPs should reflect local requirements and circumstances but shall remain flexible and responsive to new concepts and technologies.

10.3.3 Quality assurance

Demilitarization or destruction involves the establishment and monitoring of management processes and operational procedures before and during the ammunition demilitarization or destruction process. Internal quality assurance will be conducted by demilitarization/destruction organisations themselves, but external inspections by an external monitoring body should also be conducted.

The purpose of quality assurance is to confirm that management practices and operational procedures for destruction are appropriate, and will achieve the stated requirement in a safe, effective and efficient manner. Monitoring should involve structured discussions with management and employees and formal inspections of SOPs, reports and records.

The national authority may appoint an agent to carry out the monitoring and inspections of the demilitarization/destruction organisation and its sub-units under its authority and responsibility, exercised under conditions agreed in the contract or formal agreement. Any agent so appointed by the national authority shall be required to have all the facilities, qualified staff, management systems and SOPs necessary for adequate monitoring.

More detailed guidance on quality management is included in Clause 11 of this IATG.

10.4 Verification and accounting

10.4.1 General

Records should be kept in accordance with IATG 03.10 *Inventory management*.

10.4.2 Media operations

Transparency of the demilitarization or destruction process is an important pre-requisite as a security and confidence building measure. The role of the media in obtaining national and international visibility of the demilitarization or destruction of an ammunition stockpile should not be underestimated. The national authority, in conjunction with the demilitarization/destruction organisation, should develop a media plan during the planning phase of the operation. This plan should include:

- a) press releases;
- b) access to the demilitarization or destruction site by journalists and film crews at short notice; and
- c) video and photographic record of destruction.

10.4.3 Post project review

Wherever possible, demilitarization/destruction organisations should conduct a formal post project review (PPR). This will identify lessons-learned during the planning, preparation and demilitarization or destruction phases of the operation. The PPR should include a report on the suitability of the equipment, procedures, training and support. Issues of concern should be identified and prioritised, and solutions proposed. The requirement for PPRs should be included in demilitarization or destruction contracts by donors and national authorities. PPRs should be distributed to the appropriate international organisations, regional organisations, donors and sponsors. Where PPRs highlight shortcomings in established equipment or procedures, particularly issues involving safety, they should be more widely distributed.

10 Quality management (LEVEL 3)

The effective management of demilitarization or destruction operations shall aim to destroy ammunition stockpiles in a safe and efficient manner. This is achieved by developing and applying appropriate management processes, by establishing and continuously improving the skills of managers and workers, by obtaining accurate and timely information on the stockpile, by applying safe and effective operational procedures, and by using appropriate and efficient equipment. But management is not just about planning and supervising current tasks, it is also about reviewing current practices and procedures to improve safety, effectiveness and efficiency. In the case of the disposal of ammunition by industrial demilitarization a quality management process should be developed and applied.

The process and procedures that aim to achieve this continuous improvement to an organisation's management system and operational practices is commonly referred to as quality management. One method of demonstrating quality management for an organisation is to become ISO 9001:2015 compliant. There is much general information and training materials available for ammunition demilitarization organisations that choose to adopt the ISO 9001:2008 approach.

A summary of how the ISO 9001:2015 approach can relate to the demilitarization of ammunition stockpiles is given in Annex F. ISO 9001:2015 is a series of international standards for quality systems. They specify requirements and recommendations for the development of a management system, the purpose of which is to ensure that the 'products' or 'services' delivered meet the agreed needs. In this case, the product is the safe and efficient demilitarization of the ammunition stockpile.

Managers of ammunition demilitarization organisations should be encouraged to examine how to apply the principles of quality management to ammunition stockpile demilitarization. In doing so they should take particular note of two issues. Firstly, how special processes should be planned, implemented, monitored and reviewed. Secondly, the responsibilities of all managers and workers to identify and take advantage of opportunities for improvement to the process.

11 Environmental management

Destruction and demilitarization organisations may address the issue of environmental management through compliance with the ISO 14001:2015(E) *Environmental management systems* standard.

An environmental management system that is ISO 14001:2015 compliant provides a management tool enabling an organisation of any size or type to:

- A) identify and control the environmental impact of its activities, products or services;
- B) improve its environmental performance continually; and
- C) implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved.

ISO 14001:2015 does not specify levels of environmental performance. If it did the levels of environmental performance would have to be specific to each business activity, and this would require a specific Environmental Management Standard (EMS) for each business. That is not the intention as environmental performance levels, such as emission to air limit values, are the responsibility of the State.

The intention of ISO 14001:2015⁴⁰ is to provide a framework for a holistic, strategic approach to the organisation's environmental policy, plans and actions. The standard provides the generic requirements for an environmental management system. The underlying philosophy is that whatever the organisation's activity, the requirements of an effective EMS are the same.

⁴⁰ ISO 14004:2016 *Environmental management systems - General guidelines on principles, systems and support techniques*. This provides general guidelines on environmental management systems.

Annex A (normative) References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this module. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this module are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO maintain registers of currently valid ISO or EN:

- A) AASTP-1 Edition B Version 1, Part IV, Chapter 7 *Destruction of ammunition and explosives*. NATO Standardization Organization (NSO). December 2015.
<http://nso.nato.int/nso/nsdd/listpromulg.html>;
- B) CWA 15464-1:2005. Humanitarian Mine Action. EOD Competency Standards. Part 1. *General requirements*. CEN. 18 November 2005;
- C) CWA 15464-2:2005. Humanitarian Mine Action. EOD Competency Standards. Part 2. *Competency matrix*. CEN. 18 November 2005;
- D) CWA 15464-3:2005. Humanitarian Mine Action. EOD Competency Standards. Part 3. *EOD Level 1*. CEN. 18 November 2005;
- E) CWA 15464-4:2005. Humanitarian Mine Action. EOD Competency Standards. Part 4. *EOD Level 2*. CEN. 18 November 2005;
- F) CWA 15464-2:2005. Humanitarian Mine Action. EOD Competency Standards. Part 5. *EOD Level 3*. CEN. 18 November 2005;
- G) *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction*. Ottawa. 18 September 1997;
- H) *Convention on Cluster Munitions*. Dublin. 30 May 2008;
- I) *Convention for the Protection of the Marine Environment of the North-East Atlantic*. (Entered into Force 25 March 1998);⁴¹
- J) European Union Council Directive 2000/76/EC *The incineration of waste*, 04 December 2000, amended by Regulation (EC) No 1137/2008 of 11 December 2008.
- K) European Union Council Directive 2008/98/EC *Waste*, 19 November 2008;
- L) IATG 01.40 *Glossary of terms, definitions and abbreviations*. UNODA;
- M) IATG 02.10 *Introduction to risk management principles and processes*. UNODA;
- N) IATG 03.10 *Inventory management*. UNODA;
- A) IATG 04.20 *Temporary storage*. UNODA;
- B) IATG 08.10 *Transport of ammunition*. UNODA;
- C) IATG 09.10 *Security principles and systems*. UNODA;
- D) IMAS 09.30 (Second Addition, Amendment 5) *Explosive Ordnance Disposal*. IMAS October 2014. IMAS. www.mineactionstandards.org;
- E) IMAS 11.20 (Second Edition incorporating Amendments 1 through 6) *Principles and procedures for open burning and open detonation operations*. June 2013.
- F) ISO Guide 51:2014 *Safety aspects – Guidelines for their inclusion in standards*. ISO. 2014;

⁴¹ Also known as the OSPAR Convention.

- G) ISO 4220: 1983(E) *Determination of a gaseous acid air pollution index - Titrimetric method with indicator or potentiometric end-point detection* n. ISO. 1983;
- H) ISO 9001:2015(E) *Quality management systems – requirements*. ISO. 2015;
- I) ISO 9612:1997(E) *Guidelines for the measurement and assessment of exposure to noise in a working environment*. ISO. 1997;
- J) ISO 14001:2015(E) *Environmental management systems – Guidelines*. ISO. 2015;
- K) *London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, 29 December 1972, (amended by the London Protocol 1996);
- L) *London Protocol to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, 1996, (Amended 2006);
- M) *SALW ammunition destruction – environmental releases from open burning (OB) and open detonation (OD) events*. SEESAC. 30 May 2004;
- N) NATO STANAG 4518 (Edition 2) and AOP 4518 (Edition A Version 1) *Safe Disposal of Munitions, Design Principles and Requirements, and Safety Assessments*. NATO Standardization Organization (NSO). 2017; and
- O) United Nations General Assembly (UNGA) Resolution A/RES/55/255. *Protocol against the illicit manufacturing of and trafficking in, their parts and components and ammunition supplementing the United Nations Convention against Transnational Organized Crime*. 08 June 2001. 'The Firearms Protocol'. (Entered into Force on 03 July 2005).

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references⁴² used in this guideline and these can be found at: www.un.org/disarmament/un-safeguard/references. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/ammunition. National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition stockpile management programmes.

⁴² Where copyright permits.

Annex B (informative) References

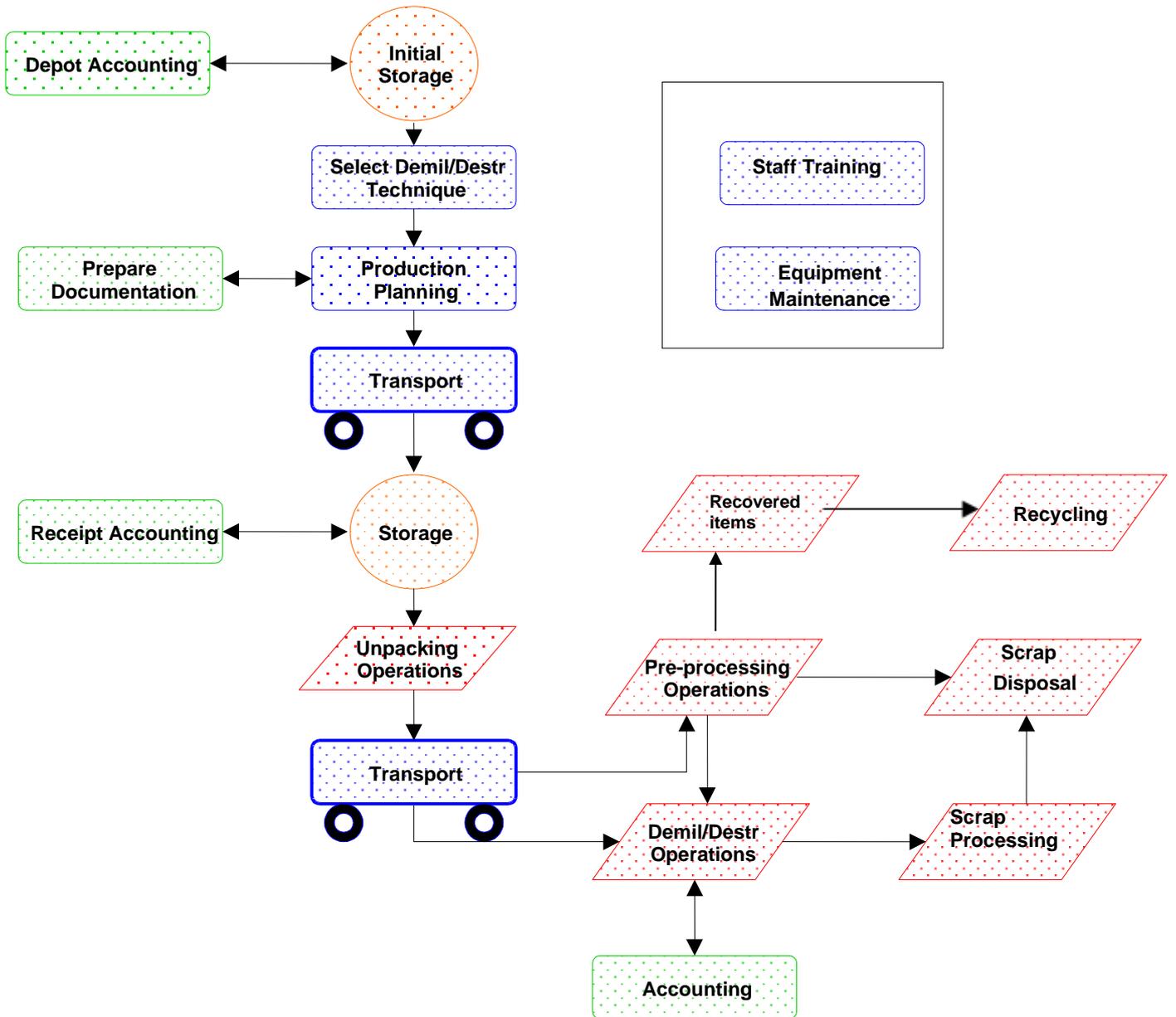
The following informative documents contain provisions, which should also be consulted to provide further background information to the contents of this module:

- A) *A Destruction Handbook – small arms, light weapons, ammunition and explosives*. UN Office for Disarmament Affairs (UNODA). 2001;
- B) *Conventional Ammunition in Surplus – A Reference Guide*. Small Arms Survey. ISBN 2-8288-0092X. January 2008;
- C) *Handbook of Best Practices on Conventional Ammunition*, Chapter 5. Decision 6/08. OSCE. 2008;
- D) ISO 14004 *Environmental management systems - General guidelines on principles, systems and support techniques*. ISO. 2016; and
- A) UNGA A/63/182, *Report of the Group of Government Experts established pursuant to General Assembly resolution 61/72 to consider further steps to enhance cooperation with regard to the issue of conventional ammunition stockpiles in surplus*. UN. 28 July 2008.

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references⁴³ used in this guideline and these can be found at: www.un.org/disarmament/un-safeguard/references. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/ammunition. National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition stockpile management programmes.

⁴³ Where copyright permits.

Annex C (informative) The demilitarization or destruction cycle



Annex
(normative)
Procedures and principles for OBOD operations

D

D.1 Scope

The purpose of this Annex to the IATG is to explain the principles and procedures for the conduct of large-scale Open Burning and Open Detonation (OBOD) operations. It includes recommendations as to the layout of demolition grounds and the contents of Standing Operating Procedures (SOPs) in order to ensure a safe system of work.

D.2 Priorities and principles

The destruction of ammunition and explosives is a potentially hazardous task. The risks are minimised if the correct procedures are followed. If they are not, the possibility of serious accident becomes very high.

The following priorities, that shall always be observed, are:

D.2.1 Safety

The safety of both personnel and property is paramount. If a method is not safe it shall not be used.

D.2.2 Security

Both the items destroyed and the explosives used to destroy them are attractive to terrorists and criminals. The security of target and donor explosives shall be ensured at all times. This includes any explosive items for recycling.

D.2.3 Accounting

This links with security. Any loss shall be promptly identified, investigated and reported.

D.2.4 Speed of Work

This shall never be achieved at the expense of the first three priorities.

There are many different detailed disposal procedures, but certain principles apply to all disposal tasks.

D.2.5 Know the ammunition

Know in detail both the item being destroyed and the explosives used to destroy it. Unless the design characteristics of both are known, it will not be possible to determine a safe and effective means of disposal.

D.2.6 Plan the task carefully

Do not leave the planning until arrival at the disposal site. Work out the programme and procedures, in detail, well in advance.

D.2.7 Create a safe working environment

Create and maintain a safe working environment so that it is safe for the Demolition Party, other personnel, property, livestock, vehicles and equipment. Inspect the area on arrival

D.2.8 Give and obey directions precisely

The disposal site is no place for ambiguity or misunderstanding. Directives must be clearly understood by all personnel.

D.2.9 Observe all the safety precautions and use only the approved methods.

Do not take short cuts, they kill.

D.2.10 Clear the disposal area prior to departure

No disposal task is complete until the demolition area has been cleared of all hazards and contamination. Implicit in this is also the clearance of all rubbish and litter. Inspect the area prior to departure.

D.2.11 Summary

Almost all known accidents that have occurred would not have happened had the priorities and rules given above been obeyed. After every accident, the Officer in Charge (OIC) of Disposals concerned shall be called upon to explain why it was not prevented.

D.3 Authority for disposal

The responsibility for authorising ammunition disposals is vested in the national authority.

No ammunition disposal should take place without the prior approval of the national authority. The exceptions to this rule are:

- a) Ammunition identified during surveillance or repair tasks which the local Ammunition Officer considers to be dangerous; and
- b) Blinds and stray ammunition, which by definition are potentially dangerous. (See IMAS 09.30 *Explosive Ordnance Disposal* for further details).

Foreign ammunition should be destroyed using the appropriate procedure based on sound first principles. Should no procedure exist, then instructions for its disposal must be requested from the national authority. Foreign ammunition is not to be broken down without the specific authority and instructions from the national authority.

D.4 Methods of local disposal - general

There are three methods of local destruction:

- A) open detonation;
- B) open burning; or
- C) incineration.

The method used with a particular ammunition type will obviously depend upon its type of explosive filling and design.

D.4.1 Detonation

Non-HE ammunition can be disposed of by inclusion in mixed stacks during large-scale demolitions. The quantities of such items included in a mixed stack have to be kept down to a small percentage of the overall stack.

D.4.2 Burning

This is generally used with propellant (bagged or loose), smoke, pyrotechnic and lachrymatory stores but is also suitable for certain plastic-bodied items. It can also be used as an alternative to detonation for certain explosives, ie composition explosive, TNT, nitro-glycerine based explosives and black powder - but detonation is the cleaner method. Local legislation related to the environmental impact of open burning must always be taken into account.

D.4.3 Incineration

A specialised form of burning, involving an external heat source, authorised for certain types of ammunition. with minimal explosive content.

D.5 Siting of disposal sites

D.5.1 Definition

A disposal site is in an area authorised for the destruction of ammunition and explosives by detonation and burning. These in turn are referred to as demolition grounds and burning grounds and may be co-located on a disposal site.

NOTE 1 The national authority shall approve and formally licence disposal sites within ammunition depots only after professional ammunition technical advice.

D.5.2 Hazards of detonation

The hazards created by detonation are:

- a) flash and heat;
 - a) blast and noise;
 - b) ground shock;
 - c) fragments; and
 - d) toxic smoke.

D.5.2.1 Flash and heat

These effects are localised but still significant. Flash could injure the eyes, but the reddish flash produced by most detonations is unlikely to do so. Heat will start fires if combustible materials are present: dry grass, undergrowth, trees or peaty soil.

D.5.2.2 Blast and noise

These have greater range. Blast can cause injury or damage - but persons and equipment would have to stand unprotected and reasonably close to a detonation to be affected by blast. Injury and damage are far more likely to be caused by fragments.

Noise presents a greater problem. At close range, it can cause ear damage and at a greater range it will have a nuisance effect that will generate complaints from the general public.

D.5.2.3 Ground shock

The main effect will be on persons and equipment relatively close to the detonation - although rock strata can sometimes transmit the effect for considerable distances. It is another potential source of public nuisance and complaint.

D.5.2.4 Fragmentation

These are the real killers. In practice, the size of the “danger area” is determined by the maximum range of fragments. All persons, property and equipment that are within this range and which are not adequately protected are in hazard.

D.5.3 Properties of demolition grounds

To overcome the above hazards, demolition grounds require the following properties:

D.6.5.1 Isolation

This is the most important requirement. They must be as remote as possible from a person and all his/her artefacts.

D.5.3.2 Deep soil

Free of rocks and stones with no peat (which could burn underground).

D.5.3.3 No secondary fire hazards

Demolition grounds should not be located over pipelines, near power cables or near fuel storage areas.

D.5.3.4 No radio/radar transmitters

Major demolitions are normally initiated using electric cable or radio control (RC) systems and, as such, are vulnerable to external electro-magnetic force (EMF) influence. Consequently, demolition grounds shall not be situated near radar installations, radio transmitters or near high-voltage power lines.

D.5.3.5 High ground

High ground reduces the effects of blast and ground shock and is also relatively well drained. The latter property aids digging. However, high ground also tends to increase fragment range.

D.5.4 Hazards of burning

The hazards created by burning ammunition are:

- a) intense heat;
- e) Intense light; and
- f) toxic fumes (occasionally).

But there are no blast, ground shock or fragmentation hazards unless the demolition burns to detonation. When burning HE natures, danger areas always have to be calculated based on the potential for a high order detonation no matter how many times the burn has been a success.

D.5.4.1 Properties of burning grounds

To counter these hazards burning grounds require the following properties:

- a) no secondary fire hazards;
- g) an adequate water supply;
- h) sufficient isolation to prevent heat or fume casualties; and
- i) sandy soil with no peat.

An isolated, sandy, barren area is the most suitable site. Avoid sites near high cliffs as these encourage rising hot air currents that can carry burning debris considerable distances. Where possible, 'wet' the area with fire hoses prior to, and after, the burn.

D.6 Approval of disposals sites and SOPs

Formal approval, (commonly referred to as licensing), of the disposal site and its associated SOPs shall be given by the national authority prior to the commencement of disposal activities on a site. Such approval shall be based on consideration of the following factors:

D.6.1 Reference to publications

All SOPs are in effect the local interpretation of regulations issued by a higher authority. The SOPs should open by listing all such regulations (and any related local SOPs).

SOPs should not reproduce large slabs of information contained in other publications. Rather they should concentrate on detailing how these regulations are to be applied under local conditions.

D.6.2 Maps and grid references

Maps shall be sent to the national authority with the draft standing orders. These shall include:

- A) a map of the area upon which the grid reference, name and area of the site are marked. This information should be repeated in the body of the SOPs; and
- B) a larger scale sketch map of the disposals site showing its layout (a schematic layout is at Appendix 1 to Annex D). This sketch map shall be included as an Annex to the SOPs. The layout of the disposals site is worked out with careful regard to safety and, once approved by the national authority, shall be mandatory. Any required changes shall be re-approved by the national authority.

D.6.3 Locations of sentries and Observation Posts

Sentries have to be placed so that they control all access routes into the disposal site. In ammunition depots sentries will normally be located on the edge of the disposal site in Splinter/Fragment Proof Shelters (SPS). When SPS are not available, e.g on open ranges, the sentries must be located outside the danger area.

D.6.4 Marking of the site

Disposal sites shall be marked with notice boards sited so that they are visible on all possible approaches. In ammunition depots, the disposal site shall also be fenced.

D.6.5 Location of the firing point

This shall be close enough to blows for the OIC Disposals to be able to hear partial explosions. The firing point is normally inside the danger area and within an SPS.

D.6.6 Communications

Good communications are essential to safety and the following telephone links are required:

- A) firing point to emergency services. Fire, Medical, Police via the local main (military or civil) exchange;
- B) firing point to sentries; and
- C) sentries to firing point. There shall also be a back up system e.g radio, whistles, vehicle horns.

The SOPs shall list all the emergency telephone numbers and lay down an accident telephone drill. If radios are used, a list of emergency frequencies and vital call signs is to be included.

D.6.7 Explosive limits

These are determined by two main limiting factors:

- A) maximum fragmentation range. This determines the danger area and all persons and equipment must be either outside this area or under shelter in SPS. The perimeter of the disposal site shall contain the danger area. The size of the disposals area will therefore limit the permissible size of blows. No blows shall be permitted above the level where fragments may travel further than the perimeter; and
- B) ground shock and noise effect. The local “tolerance” level of the public to the effect of shock and noise on themselves and their property has to be determined and may impose lower limits than the fragment range.

A method of determining the explosive limit for a new disposals area is as follows:

- A) from Explosive Ordnance Disposal (EOD) or ammunition technical advice;
- B) position observers in communication with the firing point at the perimeter and at all sensitive points; and
- C) carry out a series of blows, gradually increasing in net explosive content (NEC) until the theoretical limit is reached. Stop before this point if the observers report that the local “tolerance” level for noise and vibration has been reached. Check with the observers on this after each blow.

The end result of the trial shall be an explosive limit, which will ensure that:

- A) a person standing unprotected at the disposals area perimeter is safe from blast and fragmentation. This person should also be safe from toxic fumes regardless of the wind direction;
- B) there is no possibility of injury to persons or damage to property outside the perimeter of the disposal site; and
- C) the effect of noise is kept to a tolerable level.

Where it is intended that more than one type of activity will be carried out in a disposal site, e.g burns, demonstration, White Phosphorus (WP) and pyrotechnic burning tanks, then a location for each type of activity has to be specified, and separate explosive limits have to be laid down for each type of activity.

D.6.8 Personnel limits

The number of persons present shall be the minimum required to ensure efficiency. Certain tasks are subject to mandatory personnel limits given in the detailed procedures for these tasks.

D.6.9 Spectators

Spectators shall be allowed at official demonstrations only. Civilian spectators (or their organisations) shall be required to sign a standard indemnity form before the demonstration commences.

D.6.10 Orders for sentries

These are normally contained in a separate Annex to the local SOPs and shall cover the following points:

- A) their duties. “To keep all approaches to the disposal site under observation and to prevent any intrusions”;

B) reporting. To report to the OIC Disposals any intrusions that they cannot prevent; and safety. To remain under cover in their SPS when disposals are in progress.

D.6.11 Contraband

This includes all fire making, smoking materials and cell phones. These shall be kept under control in a locked container by the OIC Disposals. Smoking shall only take place in a designated area - remote from all explosives - at times decided by the OIC Demolitions. Cell phone usage shall be strictly prohibited except in an emergency, and only then in a declared safe location

D.6.12 Eating and drinking

This has also to be controlled to prevent the ingestion of explosive particles or contaminated materials. The OIC Disposals shall ensure that personnel wash and scrub their hands before meal and refreshment breaks.

D.6.13 Transport discipline

The points to be covered are:

D.6.13.1 Vehicle routes

These shall be laid down (preferably using hard core tracks) and shall not cross firing or telephone cables unless they are adequately buried and protected.

If possible, develop a one-way circuit to avoid delays and vehicle accidents.

No vehicle shall approach to within 30 metres of the disposal pits or ammunition being unpacked and prepared for disposal.

D.6.13.2 Unloading and parking

Engines shall be switched off when vehicles are loaded or unloaded.

Vehicles shall be parked in a designated parking area outside the danger area during blows.

D.6.13.3 Segregation of loads

Separate vehicles shall be required for Condition A ammunition, Condition D ammunition, WP stocks and personnel. A person in charge of loading/unloading shall be nominated.

D.6.14 Dress

Special dress is called for with certain disposal tasks. In addition to personnel protection issues, consideration should be given to the electrostatic nature of some clothing. In all other cases the dress should be appropriate to the weather conditions. Sentries require adequate protection against bad weather. Clothing shall be of appropriate sizes and forms to provide equal levels of protection to both male and female personnel.

D.6.15 Safety precautions peculiar to the disposal site

Mandatory use of ear protectors by the firing party Limitations on WP disposals and burns are required when the wind direction may carry fumes towards a sensitive area.

D.6.16 Accident procedures

The mandatory requirements shall be:

- A) the disposals party shall include at least one person trained and equipped to administer first aid;
- B) this person shall stay readily available outside the danger area, or under cover at the firing point SPS, to deal with casualties; and
- C) there shall be an established casualty evacuation procedure and standby medical cover must be available.

Following an accident, the following procedure shall be implemented:

- A) stop disposals, make safe prepared demolitions, carry out first aid and casevac/call on back up medical aid;
- B) inform higher authority. Note all details pertinent to the eventual enquiry;
- C) take photographs if possible; and
- D) render safe and repack all ammunition and explosives that have been unpacked and prepared for disposals - segregate awaiting investigation.

D.6.17 Records and reports

A permanent disposals diary shall be kept. This shall be completed daily and signed by the OIC Disposals.

D.7 Planning and preparation

The first step should be to prepare a list of the items awaiting local disposals. Confine the list to those items where local disposal has been approved by the national authority. Do not anticipate approval.

Select the most suitable disposal method and location:

- A) if the list is confined to small quantities of items with low NEC use a local disposal area (with a small explosive limit);
- B) if the list contains larger quantities of items with NEC in excess of the explosive limit of the local disposal area, the programme will have to take place at a more distant disposals area with a larger explosive limit. These must be selected well in advance;
- C) determine the best method of disposal for each item. This will necessitate knowing the make up of each item. You must achieve safety and complete destruction of the item and its filling(s);
- D) determine the types and quantities of serviceable explosive required to effect disposal;
- E) breakdown the list of items for disposal into individual serials;
- F) ensure that the total NEC per pit (including serviceable demolition explosives) does not exceed the explosive limit for the disposals area; and
- G) ration out high capacity items between the pits to enhance the effect of the serviceable demolition explosives. The combination of items within blows will influence the method of disposal chosen.

Produce a Demolition Order, the disposals programme and list:

- A) date, time and location;
- B) nominal roll of personnel in disposals party;
- C) list of ammunition to be destroyed;
- D) list of serviceable explosives required;
- E) breakdown of disposals by serials and pits;

- F) safety and casualty evacuation arrangements;
- G) administration arrangements, (accommodation, food, transport);
- H) route(s) - if applicable; and
- I) list of stores required. Duplicate essential items.

Give notice of disposals as required, in organisation orders and to the general public. Means of communication should account for literacy and access differentials between men/women, as well as for the presence of linguistic minorities and transient populations to ensure maximum reach.

Earmark and check explosives, ammunition and equipment. The equipment should also be tested for serviceability at this point.

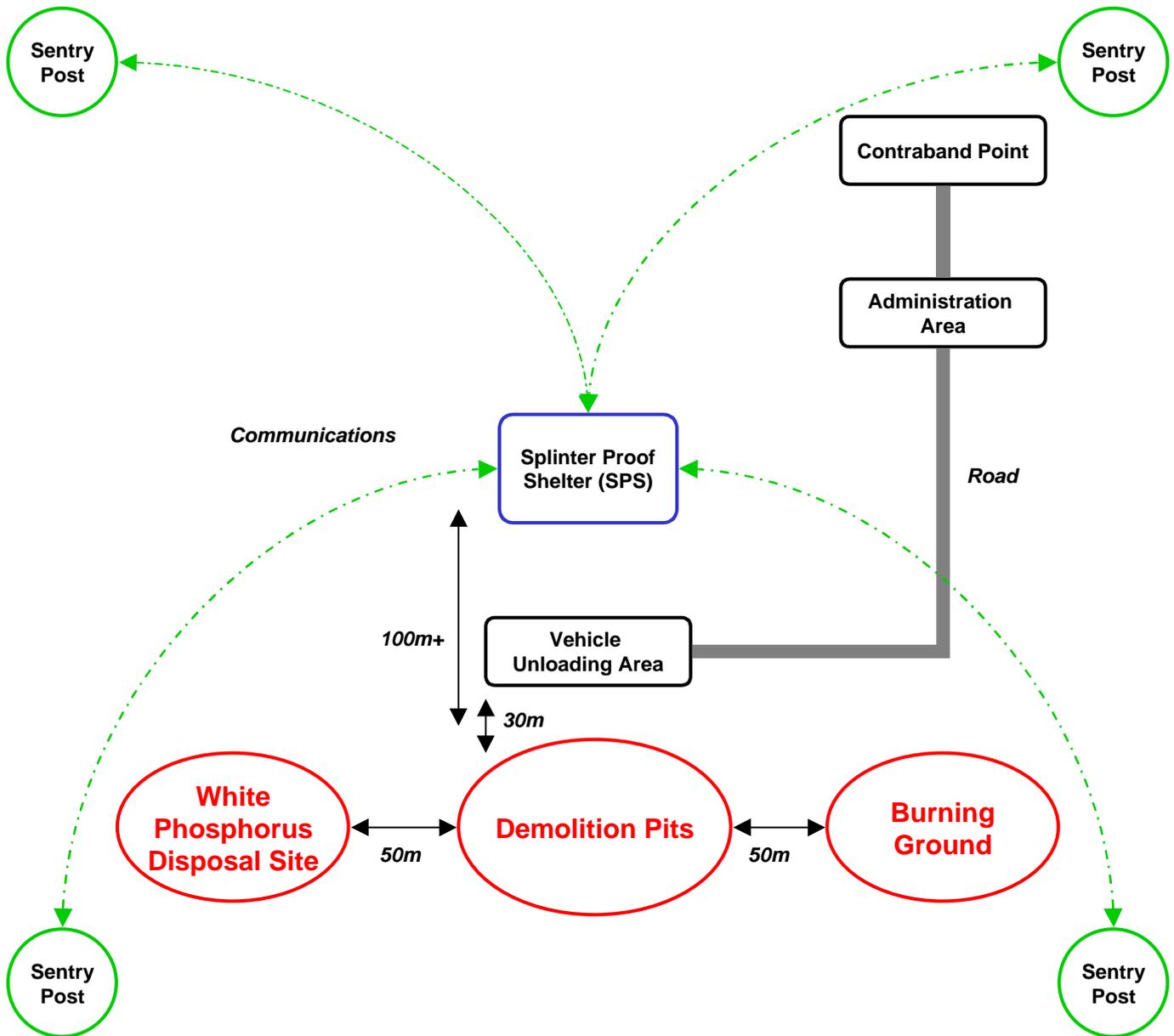
Brief personnel who are involved in the disposal programme.

D.8 Conduct of disposals

Detailed instructions should be given in local technical instructions for particular disposals tasks.

Procedures for the control of disposal activities at the disposal site are given at Appendix 2 to Annex D.

Appendix 1 to Annex D (Informative) Schematic layout of a disposal site



Appendix 2 to Annex D (Normative) Control of disposals activity

2.D.1 On arrival before disposals commence

2.D.1.1 Contraband

The Officer in Charge (OIC) of Disposals shall apply contraband restrictions and advise all personnel of smoking break arrangements.

2.D.1.2 Briefings and nominal roll

The OIC Disposals shall:

- A) check the nominal roll and brief all personnel;
- B) establish the nominated first aid person and his/her equipment in the first aid point. This must be in a Splinter/Fragment Proof Shelter (SPS) if inside the danger area;
- C) instruct the sentries on their duties and the means of communication. Post the sentries and instruct them to hoist the red flags;
- D) detail the routes for vehicles and personnel; and
- E) detail the parking area. All vehicles shall be parked outside the danger area while disposals are in progress.

2.D.1.3 Safety checks

The OIC Disposals shall:

- A) check the telephone links both to the exchange and to the sentries. Phone around the system with final warning of disposals (as required by local instructions);
- B) check the routes are clear of suspect Unexploded Ordnance (UXO) and, if any are present, treat them as blinds. This shall be checked before and after each blow;
- C) ensure that routes do not cross cables unless these are adequately buried;
- D) nominate a safety vehicle. This is to be equipped with a stretcher and blankets. It is to remain available for the evacuation of casualties throughout the disposals programme. Primary and secondary drivers should be nominated and the keys kept ready at all times. Drivers should be familiar with the route to emergency services;
- E) when disposing of ammunition by burning await the arrival of Fire Brigade cover or establish and test fire fighting parties and equipment;
- F) check the demolition pits (where applicable). OIC Disposals shall check again for suspect UXO before and after each blow. He/she shall establish a safe and firm route into the pit and firm working areas and create sandbag "steps" and working platforms as necessary;
- G) ensure that personnel do not walk over or stand on undercuts; and
- H) where appropriate, e.g with bare explosives, establish hand washing facilities. Give instructions that all persons who handle explosives shall wash and scrub their hands before they eat or drink, even if gloves have been used when handling explosives.

2.D.1.4 Unloading of ammunition

The OIC Disposals shall:

- A) order the unloading of ammunition. Serviceable and unserviceable items shall be kept separate. A nominated individual shall control the accounting and issues for each series;
- B) ensure that vehicles avoid soggy ground. Vehicles should keep to hard standing or rubble tracks. Create sandbag “stepping stones” for personnel as necessary;
- C) ensure vehicles do not approach within 30 metres of the disposal pits or of unpacked ammunition and explosives; and
- D) ensure engines are switched off during loading and unloading. Keys should remain readily available in case of emergency.

2.D.2 During disposals

2.D.2.1 Supervision and control

The OIC Disposals shall remain free to supervise all activity. He/she shall not become responsible for the activities of one group or area to the exclusion of others.

The nominated person shall remain free to guard the ammunition and explosives. He/she shall control and account for the issues to pits for disposal.

2.D.2.2 Safety

2.D.2.2.1 General

Observe all safety precautions.

2.D.2.2.2 Preparation of demolition or burn

Safe areas away from the edge of the pits shall be earmarked for the unpacking and preparation of ammunition and explosives. Serviceable and unserviceable items shall be prepared in separate areas:

- A) protect sensitive items when unpacked. Do not step on or over ammunition or explosives - this includes detonating cord;
- B) do not “dribble” plastic explosive (PE) or other explosives during preparation;
- C) eliminate all contaminated material; and
- D) avoid the inclusion of packages on stacks as much as possible. Check all surplus packaging is free from explosive (FFE) and remove to a central empty package point.

Site undercuts and stack positions in the pits so that the blast and fragmentation/debris effects are minimised and directed away from sensitive areas. As far as possible blow uphill - this facilitates drainage.

Test the firing cables between each blow. Repair cables and retest as necessary before detonator is attached.

2.D.2.3 Stack configuration

In terms of the stack configuration, the OIC Disposals should aim for:

- A) minimum use of serviceable explosives compatible with complete destruction of the item(s) being disposed of;
- B) make the best use of the explosive fillings of items to effect destruction;
- C) the correct mixture of high capacity and low capacity items etc in mixed stacks;
- D) no air gaps and the minimum of metal/material between explosive fillings;

- E) stacks and their exploding chains are to be stable enough and sufficiently shielded so as not to be affected by detonations in other pits; and
- F) do not place un-bagged earth directly onto stacks. Tamp with sandbags - this facilitates digging out partial explosions.

2.D.2.4 Preparation of detonating cord

Ensure that the detonating cord:

- A) is as straight as possible and not crossed over;
- B) has taped junctions of at least 100 mm and spare ends of at least 300 mm. The cut ends should be taped over to prevent moisture ingress, prevent spillage of loose explosive and thereby reduce the risk of a misfire due to detonating cord failure; and
- C) all junctions must be outside the pit and the main lead must extend at least two metres out of the pit. This facilitates dealing with misfires.

2.D.2.5 Tools and explosives

Tools and explosives shall be carried in separate marked boxes. Loose items shall not be carried on the person. Detonators shall be carried in totally enclosed, marked metal boxes.

2.D.2.6 Misfires

Misfire procedures shall be produced prior to demolitions and are dependent on the type of exploder being used and the type of initiator. However, safety times should not be less than the following:

- A) For electrical misfires, wait 10 minutes after the last attempt to initiate the serial before approaching demolition site.

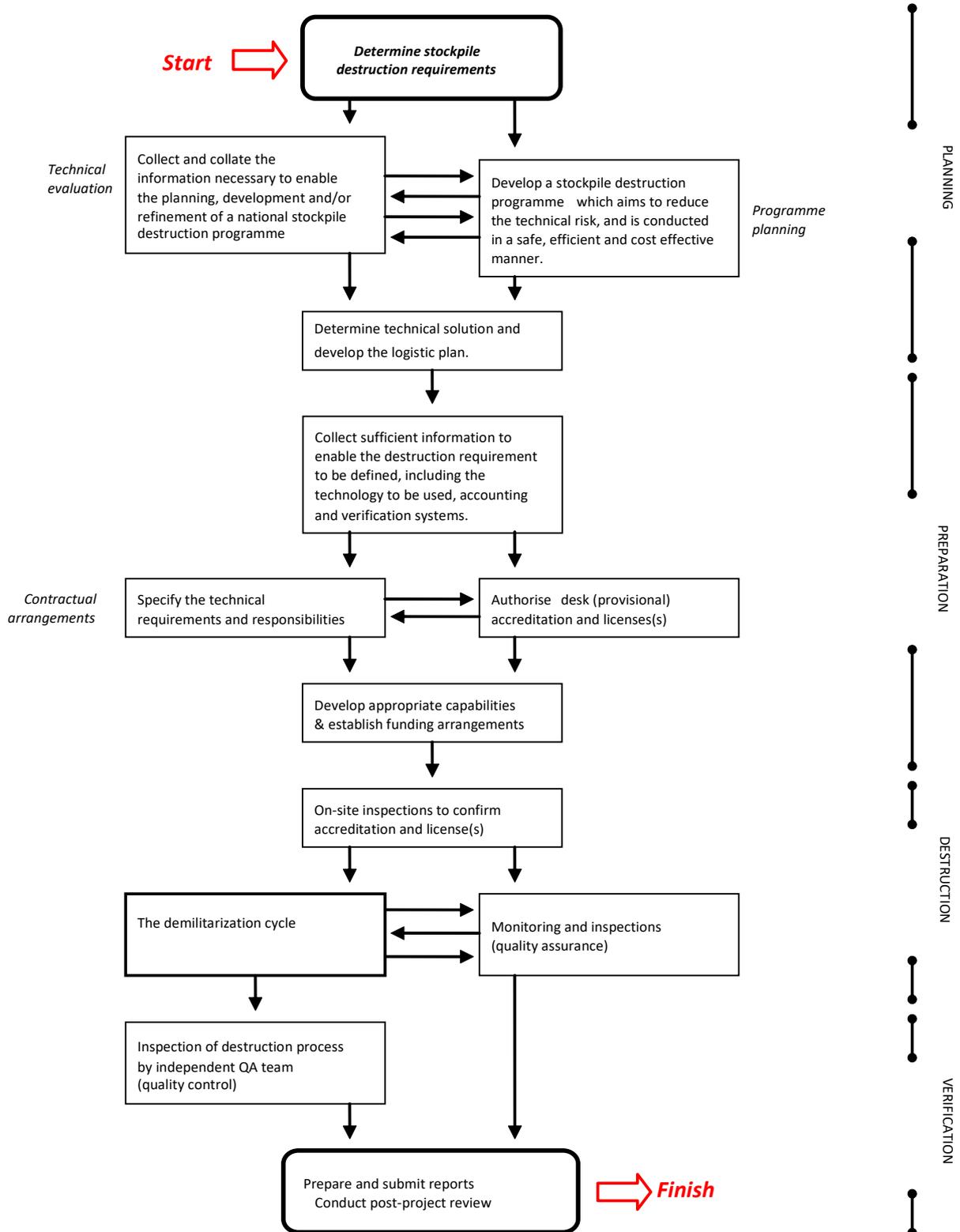
For igniferous means, wait 30 minutes after the last attempt to initiate the serial, or the last sign of smoke or burning (whichever is latest) before approaching demolition site.

2.D.3 At close of work

The OIC Disposals shall:

- A) arrange a full search of the disposal area, ensure that it is FFE and free of all litter contamination;
- B) ensure that empty packages are re-inspected, sealed and marked FFE;
- C) reconcile the closing stocks of ammunition and explosives with the record of what has been destroyed. Do not allow personnel to leave the disposals area until all discrepancies have been satisfactorily investigated and explained;
- D) take a declaration from each person in the disposals party that he/she has no explosives, ammunition or accessories in his/her possession before he/she leaves the disposals area; and
- E) complete and sign the disposals diary.

Annex E (informative) Stockpile destruction management schematic



Annex F (informative) **Stockpile demilitarization and ISO 9001:2015 (LEVEL 3)**

This Annex should only be used to support large-scale ammunition demilitarization operations.

The concept of total quality management (TQM) and the development of quality management systems (QMS) evolved in the 1980s and were used by management to achieve levels of excellence in manufacturing. Those companies that embraced the philosophy to change their organisations and empower their staff achieved remarkable levels of performance and a clear competitive edge. During the 1990s this approach has been applied to the public sector and 'non-profit' organisations with similar improvements in performance.

Quality management systems comprise three components: (1) standards and common procedures that define the rules, norms and required performance of an organisation; (2) an internal management system (such as ISO 9001:2015)⁴⁴ that encourages an organisation to achieve these standards; and (3) institutional arrangements, such as national and international professional bodies that establish the rules, norms and required performance and monitor the performance of its member organisations.

Organisations that seek ISO 9001:2015 accreditation are required to comply with an agreed set of criteria: the 5 major standard clause 'areas' that define the agreed criteria. The interpretation of the criteria depends on the role of the organisation and whether it delivers a product or service. Many professional bodies have produced guidelines that relate to their own business sectors and professions. Currently no agreed international criteria or guidelines exist for ammunition stockpile destruction.

The 5 major standard clause 'areas' of ISO 9001:2015 need to be modified to reflect the role of organisations engaged in ammunition stockpile demilitarization.

The relevance of these clauses to ammunition stockpile demilitarization can be established by mapping them onto the IATG 10.10: compliance clauses, as shown in Appendix 1 to Annex F. The resulting matrix provides a deeper and more comprehensive understanding of the total quality requirements of ammunition stockpile demilitarization. For example, a demilitarization organisation seeking ISO 9001:2015 accreditation would be expected to demonstrate how its internal quality assurance and quality control procedures would be used to identify critical non-conformities, an action that is currently required in many contracts.

Such an approach would provide a common framework to assess and evaluate the suitability and preparedness of contractors and sub-contractors as part of any contractual, accreditation or licensing procedures. It would generate transparency and this, in turn, would improve confidence in the product.

⁴⁴ ISO 9001:2015(E) *Quality management systems – requirements*. ISO. 2015.

Appendix 1 to Annex F (informative) IATG 10.10 and ISO 9001:2015 (LEVEL 3)

IATG 10.10:2020 Clauses 		Terms and definitions	Disposal options	International legislation	Demilitarization cycle	Technical factors	Priority for destruction	Demilitarization technology	Management of stockpile destruction	Quality management
ISO 9001:2015 Clauses 		Clause 3	Clause 4	Clause 5	Clause 6	Clause 7	Clause 8	Clause 9	Clause 10	Clause 11
4	Quality Management System									
4.1	General requirements		X	X	X	X			X	X
4.2	Documentation requirements								X	
5	Management Responsibilities									
5.1	Management commitment									X
5.2	Customer focus									X
5.3	Quality policy	X								X
5.4	Planning				X		X	X	X	
5.5	Responsibility, authority and communication			X	X	X	X	X	X	X
5.6	Management review								X	
6	Resource Management									
6.1	Provision of resources							X	X	
6.2	Human resources								X	
6.3	Infrastructure					X		X	X	
6.4	Work environment							X	X	X
7	Product Realization									
7.1	Planning of product realization			X	X	X	X	X		
7.2	Customer-related processes			X						
7.3	Design and development			X		X		X		
7.4	Purchasing							X		
7.5	Production and service provision			X		X		X		
7.6	Control of monitoring and measuring equipment									
8	Measurement, analysis and improvement									
8.1	General				X	X			X	
8.2	Monitoring and measurement			X		X		X	X	
8.3	Control of nonconforming product			X				X		
8.4	Analysis of data			X	X	X		X	X	
8.5	Improvement								X	

