A US Marine positions C-4 charges as he prepares to destroy ordnance found at a former army ammunition depot in western Iraq, January 2005. © Bob Strong/Reuters

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The Three Ds: Disposal, Demilitarization, and Destruction of Ammunition

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Introduction

There are currently insufficient donor resources to make more than a small dent in the global stockpile of ammunition that needs to be disposed of. In order to change the status quo and develop effective and relevant national and international policies to address the problem of ammunition disposal, policy-makers, governments, donors, implementing agencies, and other stakeholders must develop a basic understanding of the challenges involved.[1] Among these issues are the scale of the problem, policy requirements, and technical issues surrounding the disposal, demilitarization, and destruction of ammunition and explosives.[2]

This chapter is primarily designed to clarify these main issues. It does not cover technical solutions, nor does it present a full technical assessment of the risks and hazards involved.

Instead, this chapter serves to educate all stakeholders about the issues so that they can develop long-term strategies to tackle the problem and assist in building realistic and safe local capacities.

In this context, the chapter examines the importance of relevant definitions, explains why ammunition disposal should be on the international political agenda, and identifies the scale of the problem (the risks and hazards presented by large stockpiles of ammunition are covered in Chapter 8). The chapter also considers international efforts made thus far and concludes with a set of priorities for policy-making.

Definitions and challenges of ammunition disposal

In such a technical area, it is important that the international community agrees on common definitions (see Box 1). Agreement will not only facilitate diplomatic and political negotiations, but it can also serve legal and safety purposes. For example, if a country states that it has 'disposed' of a proportion of its ammunition stockpile, the international community should know that disposal does not necessarily cover demilitarization or destruction of the ammunition. Rather, the disposed ammunition could have been sold to a conflict region.

There is a tendency for donors, implementing agencies, and other stakeholders to regard weapons and ammunition as a single task area. The reality is that the destruction of weapons is a relatively straightforward—albeit logistically challenging—task. The destruction of ammunition requires a more detailed technical response because the risks and hazards are greater than those for weapons, and the stockpiles are larger in terms of weight and number. The multi-item destruction by explosive demolition of very large quantities of ammunition, as opposed to that of a single item of Unexploded Ordnance (UXO), requires a level of training that ordinary field engineers or Explosive Ordnance Disposal (EOD) technicians do not necessarily possess.

If the demolition is not prepared correctly, ammunition can be projected off the worksite by explosive effects—a process known as 'kick out'—effectively

Box 1 Key definitions

Disposal

'The removal of ammunition and explosives from a stockpile utilising a variety of methods, (that might not necessarily involve destruction). Logistic disposal may or may not require the use of RSP.'[3] (UNMAS, 2001, p. 15).

Demilitarization

'The complete range of processes that render weapons, ammunition and explosives unfit for their originally intended purpose. Demilitarization not only involves the final destruction process, but also all the other transport, storage, accounting and pre-processing operations that are equally as critical to achieving the final result.' (SEESAC, 2006a, Annexe 2).

Destruction

'The process of final conversion of ammunition and explosives into an inert state that can no longer function as designed.' (SEESAC, 2006a, Annexe 2).

spreading UXO contamination to the local area. An additional problem is the fact that this 'kicked out' ammunition could have been subjected to external forces similar to those found when fired from a weapon.[4] Under the effect of these forces, the ammunition could end up in an armed condition and therefore be unsafe (these effects are the same as when an ammunition depot explodes; see Chapter 8). Such problems can be avoided by proper planning at the risk assessment stage. It is also necessary to seek professional explosive engineering advice to ensure that the location chosen for the destruction will not put the civilian population, their property, and surrounding infrastructure at risk.

For the destruction of larger stockpiles of ammunition in non-conflict environments, destruction by demolition is often not an option. The potential for environmental and noise pollution, and the sheer quantities of ammunition involved, will often mean that an industrial demilitarization approach is more effective and cost-efficient. This industrial demilitarization of ammunition combines the skills of production management with those of mechanical, chemical, and explosive engineering. It is a highly specialized operation and, again, appropriate independent technical advice should be sought before planning such an activity.

From the perspective of the control of small arms and light weapons, the United Nations (UN) definition includes weapons and related ammunition types of 100 mm calibre and below (UNGA, 1997, para. 26). The destruction factors and issues surrounding the destruction of calibres above 100 mm are similar, however, and it makes sense when planning destruction under the auspices of small arms and light weapons control to ensure that the systems developed are capable of supporting the destruction of the larger calibres, which present similar risks and hazards.

Why should ammunition disposal be a global political issue?

Stockpiles of conventional ammunition in post-conflict environments, and ammunition that is surplus to new national security requirements and therefore awaiting destruction in many developing states, pose potentially significant security and safety risks. The population and environment close to ammunition depots are put at risk by such stockpiles and sustainable development is hampered.

Of equal importance is the risk of leakages from these stockpiles; illicit trafficking and uncontrolled proliferation, especially to terrorists and other criminal groups, could fuel armed violence within communities and compromise the security of neighbouring states. The destruction of these stockpiles should thus be considered a conflict prevention measure, a confidence and security building measure, and a post-conflict human security issue. (For the safety arguments in favour of ammunition destruction as a human security issue see Chapter 8.)

To date the demilitarization and destruction of ammunition in developing and post-conflict countries have been carried out in a number of contexts, which include:

- Compliance with the Mine Ban Treaty (MBT) for the destruction of anti-personnel mines;
- National requests as part of Confidence and Security Building Measures (CSBM) such as the Nairobi Declaration, the North Atlantic Treaty Organisation (NATO) Partnership for Peace (PfP), or the Organization for Security and Co-operation in Europe (OSCE) Document on Conventional Ammunition;
- Destruction activities to support demobilization, disarmament, and reintegration (DDR) in immediate post-conflict states;
- Destruction activities to support small arms and light weapons control interventions; and
- Destruction activities to support armed forces restructuring as part of wider security sector reform (SSR).

Donor support for the destruction of elements of ammunition stockpiles as part of confidence and security building measures is understandable and should be supported. There is also an argument, however, that the impact on the reduction of risk to the civil population (the human security task area) or the physical security of small arms and light weapons (the proliferation of small arms and light weapons task area) should also be considered. One problem is that the term small arms and light weapons means different things to different stakeholders and there is therefore a lack of consistency when responses are planned or funded.

Small arms ammunition is often given priority because donors have budgets to support the destruction of these particular items.[5] Larger calibre ammunition and bulk explosives, which can present greater explosive and security

risks, are afforded a lower priority by donors. While this is understandable from a political perspective because of the range of international and local agreements concerning small arms and light weapons, it may not be the most effective or efficient methodology for approaching the destruction of a national stockpile in a holistic manner.

Additionally, in some cases of commercially-led destruction for profit, ammunition was selected purely on the basis of its ease of destruction—or of the potential financial return on scrap recovery or reuse of explosives—and minimal consideration was paid to selecting ammunition on security or humanitarian grounds.[6]

What is the scale of the problem?

Over the past decade the amount of surplus ammunition in the national stockpiles of many countries has increased dramatically as a result of a reduction in the size of their armed forces. There are huge quantities of excess ammunition from the cold war era, mainly in the countries of the former Soviet Union although the stockpiles of Iran, Iraq, India, and China are also thought to be very large and could also be a cause for concern. Because of their relative remoteness, the Warsaw Pact states in Central and Eastern Europe were used to host a number of strategic industries for the Soviet Union, including ammunition factories. As a result they have inherited significant amounts of armaments and ammunition.

Ukraine, for example, as a past base for strategic reserves of weapons and ammunition, had a large military industrial complex. It is now faced with a huge challenge in terms of ammunition stockpiles that pose a threat to the entire region. Estimates suggest that up to 2.5 million tonnes of ammunition may be stored in Ukrainian ammunition depots designed to store far less than that amount.[7] A significant proportion is therefore stored in exposed and inappropriately equipped storage facilities, which can only result in greater risk to communities and accelerate the deterioration of the ammunition. In Belarus, available information suggests that government agencies hold more than 48,000 tonnes of small arms ammunition alone, although it is not clear how much of this is designated as surplus (Faltas and Chrobok, 2004, p. 120). In Russia, 140 million rounds of small arms ammunition were reportedly designated for disposal in 2002–05 (Pyadushkin and Pukhov, 2004, p. 109).

The 'forgotten legacy' of the cold war ammunition stockpiles is gradually coming to the fore. The initial problem is estimating the size of the ammunition stockpile because of a combination of insufficient national data and a culture of secrecy. Records kept in many developing or post-conflict countries have not been reliably maintained, and ammunition stockpiles are regarded as national secrets because some nations argue that knowledge of a stockpile level provides an indicator of the state's war-fighting capability. Even where information on the disposal of surplus ammunition is made available, figures provided are inconsistent and depend on the source used. Inefficient or non-existent accounting systems make it impossible to immediately calculate the global requirement for the destruction of surplus or unstable stocks of ammunition.

This lack of accountability, when combined with a perception that stockpile levels are a secret national security issue, makes assessing the global or regional problem, and hence developing plans to deal with it, very difficult. Until states provide more transparency about the scale of the problem, the international community can only attempt to define it in terms of 'order of magnitude' rather than in any statistically accurate manner. The true scale of the problem will only be known once the future ammunition requirements of armed forces undergoing restructuring are identified, more effective ammunition management systems are implemented where necessary, and there is improved transparency in what is still a highly sensitive issue from a security perspective.

Ammunition stockpiling issues exist at differing levels in other regions throughout the world, including Latin America, South Asia, Central Asia, and South Eastern Europe (see Table 1). Afghanistan, for example, still has large stockpiles of ammunition as a legacy of the events of the past 30 years. After an initial assessment, the United Nations Development Program (UNDP) Afghanistan New Beginnings Programme (ANBP) is trying to collect or dispose of more than 100,000 tonnes of ammunition at identified sites. The programme aims to identify serviceable ammunition for the new Afghan Army, as well as ammunition that is dangerous and unstable (IRIN, 2005), but it is being forced to take technical risks because of a lack of qualified personnel and resources and does not necessarily present 'best practice' in dealing with the problem.

After three major conflicts since 1980, Iraq also has massive ammunition stockpiles, which were estimated at 650,000 tonnes after the invasion by the

US-led coalition.[8] US military estimates suggest that 400,000 tonnes have been secured by the US military, leaving 250,000 tonnes unaccounted for. This situation was created by the failure of the coalition forces to make operational plans and commit assets to secure ammunition storage sites during the ground campaign in 2003. The widespread looting of these unsecured sites fuelled the subsequent insurgency in Iraq. This suggests that there is a need for the development of a concept of operational disarmament that could inform military planners of future operations.

Table 1 Indicative ammunition and explosive stockpile statistics*

Country[9]	Estimated stockpile (tonnes)	Estimated demilitarization requirement (tonnes)	Remarks/source
Central and Eastern Europe (CEE)/Central Asia			
Belarus		97,000	Declared to OSCE (2004)
Kazakhstan		36,000	Declared to NATO PfP (2005)[10]
Ukraine	2,500,000	130,000	Declared to NATO PfP (2004)
Middle East/Central Asia			
Afghanistan	100,000		Identified under UN-backed ANBP[11]
Iraq	650,000		See AP (2004)
South Eastern Europe (SEE)			
Albania	180,000	140,000	NATO EODASST Author's personal information (1999)
Bosnia and Herzegovina	67,000	32,000	Ammunition Demilitarization Study[12]
Bulgaria	153,000	76,099	Declared to OSCE (2004)
Serbia and Montenegro	More than 100,000[13]		SEESAC estimate

* The information in this table covers only those states where there is a currently declared stockpile disposal issue to be resolved and where information is available. It should in no way be considered to be a definitive analysis. The large gaps in information only serve to illustrate the current dearth of publicly available verifiable data.

Ammunition disposal options[14]

There were traditionally five methods for disposing of surplus ammunition: sale, gift, increased training use, deep-sea dumping, and destruction. International security concerns, international legislation, and practical considerations, however, indicate that the most effective option remains the physical destruction of ammunition.

Selling or giving away ammunition is the most cost-effective means of disposal, but there are factors that need to be considered: (*a*) any sale or gift should comply with international export control and transfer best practice; (*b*) the quality of ammunition nearing the end of its useful shelf life will not be as high as newly manufactured ammunition. This makes it unattractive to reputable end users because it is unlikely to meet their performance standards. Any end user wishing to purchase ammunition of this age should be the subject of the deepest scrutiny; and (*c*) in order to comply with international transportation regulations and guidelines, the ammunition should be physically inspected to ensure that it is safe to export or transfer beyond national borders: this will mean additional costs. The sale or gift of surplus ammunition is strongly discouraged by much of the international community because, in effect, it only transfers the problem elsewhere.

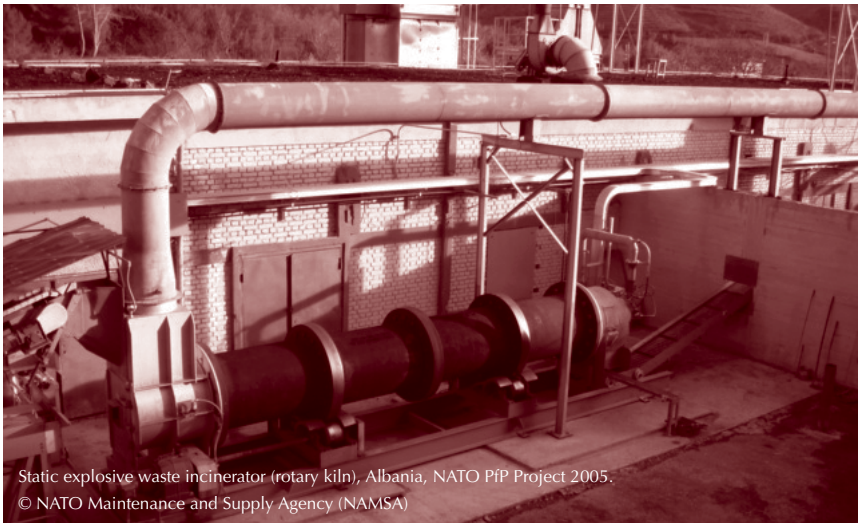
Increasing training use may initially seem a desirable option, but associated factors may make it undesirable. When ammunition is used it creates additional wear on equipment such as gun barrels, vehicle automotive systems, and so on. This reduces the life of the parent equipment and results in additional maintenance costs. These additional costs should be balanced against the value of the training obtained from firing surplus ammunition stocks. Any significant increase in training may also negate security and confidence building measures with neighbouring states. Furthermore, only limited stocks can be disposed of in this manner because the associated costs of training, and the time taken, would be an uneconomic means of destroying a large proportion of a surplus ammunition stockpile.

Dumping ammunition at sea is the subject of international agreements[15] because it is considered to be either hazardous or industrial waste. Even if a state is not party to such an agreement, it is unlikely that it would receive international donor assistance to dispose of its surplus ammunition in this manner.

There would also potentially be a very strong negative reaction from international environmental groups.

The most realistic disposal method is therefore destruction. Stockpile destruction can be defined as 'the process of final conversion of weapons, ammunition and explosives into an inert state that can no longer function as designed' (SEESAC, 2006a, Annexe B). The effective management of stockpile destruction planning and operational activities aims physically to destroy ammunition in a safe, cost-effective, and efficient manner.

Physical destruction methods available range from relatively simple Open Burning and Open Detonation (OBOD) techniques to highly sophisticated industrial processes. The detailed arguments for and against each process are beyond the scope of this chapter but it is important to note that selection of the most appropriate destruction technique will depend primarily on a range of factors that include: (*a*) the donor resources available; (*b*) the physical condition of the stockpile; (*c*) the quantity of ammunition in terms of economies of scale; (*d*) national capacities; and (*e*) national explosive safety and environmental legislation.[16] A summary of available industrial demilitarization technologies is provided in Annexe 1.



Static explosive waste incinerator (rotary kiln), Albania, NATO PfP Project 2005.
© NATO Maintenance and Supply Agency (NAMSA)

Of the above, the most influential factors have usually been the donor resources available and economies of scale. The more ammunition there is for destruction and the wider the range of available, affordable, and efficient technologies, the more likely it is that an industrial demilitarization facility can be developed. Industrial scale demilitarization has many advantages, including mechanical disassembly, incineration in environmentally controlled systems, and the ability to operate 24 hours per day and 365 days per year. Its major disadvantage is the high capital set-up costs of design, project management, construction, and commissioning. Operating costs are generally lower than OBOD (once amortization of the development capital is discounted). It must be remembered that the physical destruction process for ammunition is only one process in the complete demilitarization cycle. This operational cycle is complex, comprehensive, wide-ranging, and includes activities such as transportation and storage, processing operations, equipment maintenance, staff training, and accounting. The full demilitarization cycle is shown schematically in Annexe 2.

It inevitably takes time to develop a safe, effective, and efficient industrial demilitarization capability within a state that also reflects the safety and environmental concerns of donors, but this should not prevent the initial steps being taken to support the development of such facilities. In many regions this sort of capacity must be developed from the semi-dormant and under-resourced state ammunition production facilities, which requires infrastructure investment, staff training, and demilitarization equipment procurement. It is likely that the solution is a balance whereby OBOD should be used to destroy potentially unstable stocks in the short term while, at the same time, a facility is developed in those nations with large stockpiles. For those countries with insignificant stockpiles, OBOD will remain the only economically practical option.

A solution that is often proposed at international conferences is the development of a regional demilitarization facility. While this seems an attractive concept for donors and the recipient country, it raises a number of political and technical difficulties. The large stockpiles present in many countries in the region mean that national economies of scale could justify a national demilitarization capacity. Many states within the region would support a regional facility if it were in their own country, because it would represent a major economic investment and a potential source of income. They are however unlikely to commit funds for

destruction at a regional facility 'next door'. Technically, the most efficient means of transporting ammunition and explosives is usually by rail. The effectiveness of the rail infrastructure and the distance ammunition is required to travel would therefore have a significant impact on the location of any regional demilitarization facility. Last, the international donor community is unlikely to have the resources to pay for destruction of the total surplus stockpile, which would become an economic issue between countries.

It is difficult to estimate the destruction costs for ammunition because there are so many factors to consider, including: (*a*) the type of ammunition; (*b*) economies of scale; (*c*) existing indigenous capacity and resources; (*d*) explosive and environmental legislation; (*e*) the training levels of local staff; (*f*) the economic level of the host nation; (*g*) the fact that destruction projects often include weapons and ammunition at an overall fixed cost, as opposed to costs per ammunition type; and (*h*) donor priorities. This makes estimating the costs of an intervention to support the destruction of ammunition difficult when large stockpiles are involved, particularly when there is not an effective ammunition management system in place. Experience in Eastern Europe has indicated that assessments by properly qualified and experienced technical personnel are a valuable prerequisite for demilitarization planning. Donors must be prepared to fund the costs of these assessments. It is also important that donors recognize

Table 2 Indicative ammunition destruction and demilitarization costs, in USD

Ammunition calibre	Lower range		Upper range		Remarks
	Cost per tonne (AUW)	Country	Cost per tonne (AUW)	Country	
Small arms ammunition (less than 12.7 mm)	90	Albania[17]	800	UK[18]	Demilitarization
Medium calibre (60 mm–122 mm)	540	Albania[19]	1,000	Paraguay[20]	Open detonation (includes equipment procurement)
Guided missiles	Unknown	Georgia	2,000	Germany[21]	

that the costs associated with structural development, technical training, and equipment procurement mean that while initial costs per tonne are high, subsequent destruction is a lot cheaper as the economies of scale take effect and national capacity is built. Table 2 sets out indicative costs but should not be considered authoritative for planning purposes.

Initiatives to address ammunition disposal[22]

International frameworks

Specific references to the management and destruction of ammunition stockpiles in the framework of international legislation or agreements are less than comprehensive. Relevant instruments either do not mention ammunition explicitly, or the instrument is limited in scope to small arms and light weapons with an emphasis on weapons. Ammunition is generally regarded as a secondary consideration. Although there is no specific provision for ammunition under the most comprehensive instrument at the global level, the *UN Programme of Action on Small Arms and Light Weapons* (PoA), some argue that ammunition can be inferred to fall under the same umbrella as weapons.[23] This would include destruction of stockpiles (UNGA, 2001b, art. 18 and art. 19). The scope of this instrument and others at the global and regional level (see below) is limited to *illicit* trade, however, and fails to address national surpluses of ammunition in detail.

At the global level also, the scope of the UN Firearms Protocol includes an obligation to destroy illicitly manufactured and trafficked firearms that extends explicitly beyond small arms and light weapons to include their ammunition (UNGA, 2001a, art. 6), but not the medium- and large-calibre ammunition which account for over 70 per cent of national stockpiles.

These two instruments apart, the ammunition stockpile destruction issue is uncoordinated at the global level. While the recent decision by the UN General Assembly to include 'problems arising from the accumulation of conventional ammunition stockpiles in surplus' on the provisional agenda of its 60th session might be an indication of the increased importance of the issue to the UN,[24] nothing substantive has happened since.

Regional frameworks

At the regional level, the Council of the European Union Joint Action of 12 July 2002 explicitly identifies small arms and light weapons ammunition as a cause for concern and recognizes the importance of the safe storage, and the quick and effective destruction, of small arms and light weapons ammunition (EU, 2002, Preamble and art. 4). The 2001 Protocol on the Control of Firearms, Ammunition and Other Related Materials in the South African Development Community (SADC) Region also stresses the need to maintain effective control over ammunition—and not just that related to small arms and light weapons—especially during peace processes and in post-conflict situations, and to establish and implement procedures to ensure that firearms ammunition is securely stored, destroyed, or disposed of in a way that prevents it from entering into illicit conflict.

The 1997 Inter-American Convention against the Illicit Manufacture and Trafficking in Firearms, Ammunition, Explosives and Other Related Materials also explicitly includes ammunition and explosives. The OSCE went furthest in directly addressing the destruction of ammunition by adopting in November 2003 the OSCE Document on Stockpiles of Conventional Ammunition.[25] This document outlines detailed procedures for assistance from other OSCE participating states with the destruction of ammunition. The role of those states in a position to do so in assisting other states with their efforts to destroy surplus weapons (and ammunition) is also incorporated into the UN framework.[26] The EU too is committed, under the EU Joint Action, to provide financial and technical assistance 'as appropriate' to countries requesting support with programmes and projects to control or eliminate surplus small arms and their ammunition (EU, 2002, art. 4(a) and 6).

Strategic and operational guidelines

As mentioned above, the physical destruction of ammunition is a highly specialized task that can only be efficiently and effectively undertaken by appropriately trained and qualified personnel. Detailed guidance on the practicalities involved can be found in a number of documents and guides. The UN Department for Disarmament Affairs (DDA) *Destruction Handbook: SALW, Ammunition and Explosives* (UNDDA, 2001) is designed to assist planners in the field to choose

Canadian soldiers place explosive charges to destroy recoilless rifle rounds at the Indigo Range, south of Kabul, Afghanistan. June 2005. © Levon Sevunts/WPN

methods of destruction that are most appropriate to the theatre of operations they find themselves in.

The OSCE has developed best practice guides for small arms and light weapons, which are really strategic-level guidelines. The equivalent guide for ammunition will be published soon. The South Eastern Europe Regional Micro-Disarmament Standards and Guidelines (RMDS/G) have been developed by South Eastern and Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC) to support the operational and programme level. This means that national governments and international organizations in South Eastern Europe have strategic guidelines (OSCE) and operational procedures (SEESAC) available to assist them to develop safe, efficient, and effective destruction programmes.

The UN Mine Action Service, through the Geneva International Center for Humanitarian Demining (GICHD), has developed International Mine Action Standards (IMAS) that cover the destruction of stockpiles of anti-personnel mines, but these standards are generic in outlook and can be effectively applied to cover the destruction of most types of ammunition (SEESAC, 2006a). Their aim is not to provide 'template solutions', but to inform national authorities of

the technical and logistic issues involved in stockpile destruction, and to outline the advantages and disadvantages of the various available options.

The problem is not the lack of technical guidance, but the global shortage of qualified technical staff experienced in the best international technical practice in demilitarization project development and operations. Few people have had the experience of establishing a demilitarization capability or facility from scratch in post-conflict environments. The technical standards of staff in those countries with large ammunition stockpiles are often not in accordance with best international practice. Commercial industry experience is often limited to its own techniques and the military are generally not trained in demilitarization. Consequently, with a few exceptions, programmes in post-conflict or developing countries are often not designed in the most safe, effective, and efficient manner. Because no UN department has overall responsibility for the coordination of ammunition destruction, and regional organizations are often competing for the limited amount of donor funding available, there is no international strategy or policy to deal with the issue, or international standards for planning and conducting ammunition destruction, although high quality national and regional guidelines do exist which could easily be adopted with only a few changes to reflect global needs.

International support for ammunition destruction initiatives

The UN Secretary-General reported in 1999 that the UN, supported by donors, had been involved in the safe storage, disposal, and destruction of weapons, but stated that 'the number and scale of such programmes remains small compared with the apparent requirements' (UNGA, 1999, para. 66). In spite of some limited progress there is a huge disparity between even known needs and international donor support.

Although there is a growing political awareness of the issue, to date, the international response has been limited in terms of financial support for surplus ammunition stockpile destruction. Significant support has been provided for the destruction of anti-personnel mines (APM) in support of Article 7 of the MBT, and it is likely that this support will continue.[27] The United States has funded the destruction of significant quantities of man-portable air defence systems (MANPADS), primarily as part of its counter-proliferation programme.

In terms of wider ammunition stockpile destruction, the donor and international response has been limited because of: (*a*) the amount of finance required; (*b*) the fact that it is not a major issue for some donors; (*c*) other donor mandates not allowing for it; and (*d*) only a limited number of major donors being engaged in the issue. The most extensive engagements at the operational level have probably been through the UNDP Small Arms Demobilization Unit (SADU)[28] and the NATO PfP Trust Fund,[29] while the OSCE has primarily been engaged at the political level (OSCE, 2003). A summary of known projects specifically dealing with ammunition stockpile destruction is included in Annexe 3.

It is perhaps not surprising that some, but not all,[30] donors have a tendency to provide assistance to states in their own geographical region. Reports by states under the PoA indicate, for instance, that European donor countries give support primarily in Central and Eastern Europe (Kytömäki and Yankey Wayne, p. 111). Current levels of assistance must be dramatically increased if the true scale of the problem is to be seriously addressed. This presents challenges in terms of donor—and wider—awareness, increasing understanding of the complexity of the issues involved, and commitment—in terms of both financial and technical resources.

Conclusion

It is unlikely that the international donor community could fund the destruction of all surplus ammunition within a single region, let alone the much larger global stockpiles. The stockpiles stored in the wider Europe as a legacy of the cold war probably present the largest challenge, but the impact of poorly controlled stockpiles at the community level is also a major issue—as the tragic event of January 2002 in Lagos, Nigeria, demonstrates.[31]

Prioritization for future ammunition destruction is complicated and the hard priorities of available national and donor resources versus threat should be considered. These could include:

- Destruction of ammunition that is at greatest risk of proliferation or is 'attractive' to terrorists and criminals. The detailed ammunition types will inevitably be subject to the judgement of individual donors (see Chapter 8);

- Identification of ammunition that poses the greatest risks to the civilian community in terms of explosive safety;
- Ensuring the physical security of ammunition in order to reduce the risks of proliferation;
- Destruction of ammunition that presents a direct explosive safety risk to the civilian population and can therefore be justified on humanitarian grounds alone; or
- Capacity building of national institutions to continue longer-term, nationally financed, safe, efficient, and effective destruction of ammunition to appropriate technical standards.

While a number of successful donor-assisted programmes have been carried out, the major donor base is still quite limited. International political momentum to identify the true size of the problem needs to be generated, and governments should be encouraged to accurately audit ammunition stockpiles and share data. Old ammunition in decaying stockpiles is a human security issue, and also a proliferation threat because criminals and terrorists do not care about ammunition stability or performance.

Finally, wherever possible, ammunition stockpile destruction must be coordinated with other small arms and light weapons control or security sector reform programmes and initiatives. There is significant synergy, and the opportunities for rationalizing administrative costs should be explored for each project. This will require better coordination than exists today between international organizations, donors, and other stakeholders.

Annexe 1 Summary of ammunition demilitarization technologies[32]

Process operation	Technology	Advantages	Disadvantages	Remarks
	Pre-processing operations			
Manual disassembly	• None	• Low level of capital investment required	• Labour intensive • Low production rates	The use of human resources to physically dismantle ammunition by manual labour using simple hand tools.
Mechanical disassembly	• Pull apart • De-fusing • De-priming	• High production rates • Lower staff requirements	• Medium level of capital investment required	The use of mechanically operated systems to dismantle ammunition. Some of the available technologies are shown in the table, but systems tend to be specifically designed to deal with each type of munition.
Robotic disassembly	• Ammunition dependent	• High production rates • Lower staff requirements	• Highly capital investment • Reliability	A fully automated disassembly system. This system would only be economically viable for very large production runs due to the high start-up costs.
Mechanical breakdown	• Bandsaw • Guillotine • Cracker mill • Rock crusher • Punch	• Lower staff requirements • Medium production rates • No secondary waste stream at this phase of the demilitarization cycle	• Explosive safety risks of initiation • Medium capital investment • Wide range of equipment required to deal with all ammunition types	This process is mainly concerned with techniques required to expose the explosive fillings of ammunition prior to the destruction phase.

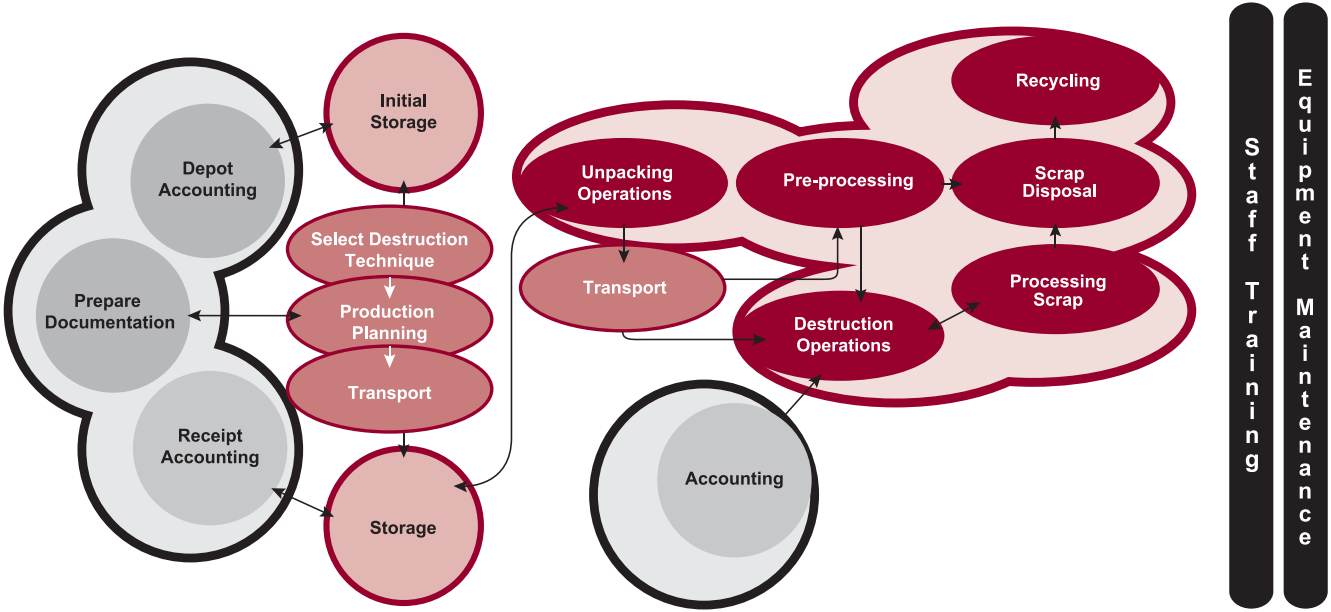
Cryofracture	• Liquid nitrogen cooling	• Environmentally benign • High production rates • Can be used for virtually all ammunition types • Low level of capital investment required for equipment • No secondary waste stream at this phase of the demilitarization cycle	• Large process area requirements • Costs of liquid nitrogen • Health and safety issues for staff • Fracture forces necessary are unpredictable	This process is used to break down ammunition into small enough pieces to be processed through an incineration destruction method. The liquid nitrogen changes the mechanical properties of the munition casing to a more brittle phase by cooling it to –130^{0}C. The munition can then be easily shattered using simple mechanical shear or press techniques.
Hydro-abrasive cutting	• Entrainment systems • Direct injection systems	• Lower staff requirements • Can be used for virtually all ammunition types • Safety	• High capital investment • Complex filtration systems for waste water required • Grit sensitivity of explosive after cutting	The use of water and abrasives at pressures from 240 to 1,000 Bar to cut open ammunition by an erosive process.
	Destruction operations			
Explosive removal	• Hot steam melt out	• Simplicity	• Low capital investment • Restricted to certain explosive types	
	• Microwave melt out	• Efficiency • Low secondary waste stream	• High capital investment • A developing technology	

Incineration	• Rotary kiln furnace	• Efficiency • Low staff requirements • High production rates	• Limited to small calibre ammunition, propellant, and pyrotechnics • Significant pre-processing required for larger calibres • Small arms ammunition lead residue and pyrotechnic effluent can pose considerable environmental problems	The kiln is made up of four 1.6 metre long, 1 metre outer diameter retort sections bolted together. The 6 to 8 cm thick walls of the kiln are designed to withstand small detonations. The kiln contains internal spiral flights, which move the waste in an auger-like fashion through the retort as the kiln rotates.
	• Car bottom furnace	• Ideal for explosive residue • Low staff requirements	• Medium levels of capital investment required • Cannot destroy most ammunition types • A system to support destruction rather than a system in its own right	Used to destroy small amounts of explosive or explosive residue left after flush-out pre-processing techniques. It can also be used to destroy explosively contaminated packing material, for instance.
Incineration	• Hearth kiln furnace	• Low staff requirements • Medium production rates	• Limited ammunition types possible	A static high temperature kiln.
	• Plasma arc furnace	• Low staff requirements • High production rates	• High capital investment • High power requirement • A developing technology • Pre-processing still required	A plasma torch, at temperatures in the region of 4,000^{0}C to 7,000^{0}C, is used to heat a container into which waste products are fed. The plasma is an ionized gas at extremely high temperature, which is used to initiate rapid chemical decomposition by the action of this extreme heat. The material is currently fed in a slurry form, although research is ongoing into the destruction of entire munitions.

Contained detonation		• Limited pre-processing requirements • Can deal with many ammunition types • Medium production rates	• Medium staff requirements • High donor explosive requirements • Medium levels of capital investment required • Explosive content limited	The destruction of ammunition and explosives by detonation in an enclosed chamber. The evolving gases are then processed by an integral pollution control system.
	Pollution control systems[33]			
Volatile Organic Compound (VOC) destruction	• Afterburner	• Proven technology • Very low staff requirements	• High fuel requirements	This oxidizes entrained organic compounds, ash, and metal fragments. In order to achieve this, it must operate above 850^{0}C for over 2 seconds to destroy VOC; the VOC then burn to CO_2, H_2O, and acid gas. All organic particulate is destroyed.
Acid gas neutralization	• Addition of Sodium Bicarbonate	• Operates over wide temperature range • Produces safe and inert solid waste • Reacts well with NOX[34] • Readily available	• Large supplies necessary	Produces safe and inert solids such as Sodium Chlorate (common salt), Sodium Sulphate, and Sodium Nitrate for disposal.

Particulate removal	• Baghouse	• Simple and cheap technology	• Prone to baghouse fires • Filtration efficiency • Medium capital investment	
	• Dry Ceramic Filtration	• Fire resistant • Filters down to one micron • Supports a bed of sorbent for improved gas adsorption	• Medium levels of capital investment required	Dry ceramic filtration is now regarded as one of the most efficient filtration systems currently available. It has the capacity to remove particulate matter down to one micron.
	• Liquid Filtration	• Filtration efficiency	• High capital investment • Liquid waste stream requires further processing	
	Scrap processing operations			
Scrap processing	• Crusher			System requirements depend on waste stream from destruction process. There are many systems available.
	• Shredder			
	• Compacter			
	• Cracker			

Annexe 2 The ammunition demilitarization cycle



Annexe 3 Ammunition destruction projects[35]

Date	Country	Agency	Donor(s)	Project	Details		Remarks
					Quantity	Cost (USD)	
Complete							
1999	Albania	UK DfID	UK	Feasibility study	N/A	60,000	Used to develop NATO PfP Albania Project (2003)
2001	Democratic Republic of Congo	UNDP	UNDP TTF	Destruction of grenades	2,587 grenades		
2002	Albania	NAMSA	CA, AU, BE, HU, NL, NO, SZ, UK	APM destruction	1,600,000 APM	790,000	Included infrastructure and equipment development
2002	Moldova	NAMSA	NL, CA, GE, HU, LU, PL, UK, US	APM destruction Rocket fuel	12,000 APM 325 tonnes	1,100,000	
2002	Ukraine	NAMSA	CA, NL, HU, PL	APM destruction	400,000 APM	800,000	Included infrastructure and equipment development
2003	Bulgaria	UNDP	UNDP TTF	5.54 mm small arms ammunition 100 mm HEAT	750,000 rounds 2,475 rounds	85,000	Costs also covered small arms and light weapons destruction, and included equipment development

2003	Paraguay	UNDP	UNDP TTF	Destruction of unsafe ammunition up to 100 mm	80 tonnes	80,000	Direct cost on-site and exclusive of two planning missions
2004	Georgia	NAMSA	LU, CA, CZ, DA, FN, NL, NO, SW, SZ, TU, UK	Missiles	525 missiles	1,089,000	Includes UXO clearance funding
2004	Serbia and Montenegro	UNDP	UNDP TTF	Small arms ammunition	0.6 tonnes	100	To support amnesty collection only
2005	Uganda	UNDP	UNDP TTF	Destruction of unsafe ammunition up to 100 mm	400 tonnes		
Ongoing							
2003	Albania	NAMSA	CA, CZ, ES, GR, HU, IR, LU, NL, NO, PL, SW, SZ, UK, US, EU	Small arms and light weapons ammunition	11,000 tonnes	6,400,000	Due for completion 2007
2004	Bosnia and Herzegovina	UNDP	NL, UK	Ammunition demilitarization facility	33,000 tonnes	10,000,000	USD 1,400,000 committed to date
2005	Paraguay	UNDP	UNDP TTF	Destruction of unsafe ammunition up to 100 mm	86 tonnes		

2005	Tajikistan	OSCE	FR (in kind)	Destruction of unsafe ammunition	20 tonnes	4,000	Part of larger stockpile security and small arms and light weapons destruction project
2005	Belarus	EU	EU	Destruction of PFM 1 Series APM	6,000,000 APM	7,000,000	
2005	Serbia and Montenegro	NAMSA	AU, BL, CA, CH, CZ, HU, IR, NL, NO, SW	APM destruction	1,300,000 APM	1,900,000	
2006	Belarus	NAMSA	CA, LI	APM destruction	600,000 APM		
2006	Ukraine	NAMSA	AU, BL, CH, EU, GE, LI, LU, NL, NO, SL, TU, UK, US	Ammunition	135,000 tonnes	90,000,000	Only partially funded
Proposed or under development							
?	Kazakhstan	NAMSA	NL, US	MANPADS	400 missiles	?	
?	Uzbekistan	NAMSA		Rocket fuel Ammunition	1,068 tonnes 5,400 tonnes	?	At pre-feasibility stage
?	Ukraine	OSCE		Rocket fuel (Oxidizer)	11,677 tonnes	?	

List of abbreviations

ANBP	Afghan New Beginnings Programme
APM	Anti-Personnel Mines
ASEAN	Association of South East Asian Nations
AUW	All Up Weight
BCPR	Bureau for Crisis Prevention and Recovery
CEE	Central and Eastern Europe
CSBM	Confidence and security building measure
DDA	Department for Disarmament Affairs (UN)
DDR	Disarmament, demobilization, and reintegration
DERA	Defence Evaluation and Research Agency
EOD	Explosive Ordnance Disposal
EODASST	Explosive Ordnance Disposal and Ammunition Support Training Team (NATO)
FSC	Forum for Security Cooperation (OSCE)
GICHD	Geneva International Center for Humanitarian Demining
HEAT	High Explosive Anti-Tank
IMAS	International Mine Action Standards
MANPADS	Man-Portable Air Defence Systems
MBT	Mine Ban Treaty
NAMSA	NATO Maintenance and Supply Agency
NATO	North Atlantic Treaty Organisation
OBOD	Open Burning and Open Detonation
OSCE	Organization for Security and Co-operation in Europe
PCS	Pollution Control System
PfP	Partnership for Peace (NATO)
PoA	*UN Programme of Action on Small Arms and Light Weapons*
RMDS/G	Regional Micro-Disarmament Standards and Guidelines (SEE)
RSP	Render Safe Procedures
SADC	Southern African Development Community
SADU	Small Arms and Demobilization Unit (UNDP)
SALW	Small arms and light weapons
SEE	South Eastern Europe

SEECI	South Eastern Europe Cooperation Initiative
SEESAC	South Eastern and Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons
SSR	Security sector reform
TTF	Thematic Trust Fund (UNDP)
UK DfID	United Kingdom Department for International Development
UK FCO	United Kingdom Foreign and Commonwealth Office
UNDP	United Nations Development Programme
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound

Endnotes

1 This chapter uses the term ammunition generically to include ammunition, explosives, and propellants.

2 The chapter draws on previous work contained in Greene, Holt, and Wilkinson (2005), Hughes-Wilson and Wilkinson (2001), SEESAC (2004; 2005), and Wilkinson (2004).

3 Render Safe Procedures (RSPs) are specialist techniques to make ammunition and UXO safe to move or handle.

4 Spin, set back, centripetal, and set forward forces.

5 Ammunition of 12.7 mm calibre and below.

6 The Alliant Techsystems programme in Ukraine during the early 1990s is one such example.

7 Yevgeny Marchuk, Ukraine Defence Minister, quoted in Rosbalt News Agency, 2004.

8 Anthony Cordesman, Centre for Strategic and International Studies, Washington, quoted in AP, 2004.

9 The United States, most of Western Europe, and some countries in South East Asia already have a developed industrial demilitarization capacity for the destruction of ammunition and explosives, which is why they were not included in this table.

10 The ammunition surplus for destruction being considered under the auspices of the NATO PfP is only a small proportion of the actual stockpile that will require destruction.

11 This represents only a proportion of the true extent of ammunition stockpiles in Afghanistan.

12 Ammunition demilitarization study conducted in Bosnia and Herzegovina for SEESAC by Threat Resolution Ltd. in 2004.

13 SEESAC estimate, 2005.

14 Some of the information in this section is summarized from SEESAC, 2006.

15 The Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, February 1972, and subsequent amendments; the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 29 December 1972,

and subsequent amendments; and the 1998 Convention for the Protection of the Marine Environment of the North-East Atlantic (also known as the 'OSPAR Convention').

16 This is covered in detail in SEESAC, 2004.

17 Extracted from SEESAC APD 50 Commercial in Confidence Report for the UK FCO (United Kingdom Foreign and Commonwealth Office), 30 July 2005 (confidential document).

18 UK Demilitarization Facility, DERA (Defence Evaluation and Research Agency), Shoeburyness, 2001 (author's information).

19 Extracted from SEESAC APD 50 Commercial in Confidence Report for the UK FCO (United Kingdom Foreign and Commonwealth Office), 30 July 2005 (confidential document).

20 Remi Vezina, Ammunition Technical Officer, UNDP, BCPR (Bureau for Crisis Prevention and Recovery), SADU (Small Arms and Demobilization Unit), 2005.

21 Presentation by NAMSA (NATO Maintenance and Supply Agency), Standing Committee to the Mine Ban Treaty, Geneva, 2002.

22 Some of the information in this section is summarized from Greene, Holt, and Wilkinson, 2005.

23 In this respect it should be noted that the 1997 report of the UN Panel of Governmental Experts defined the scope of categories of small arms and lights weapons as including ammunition and explosives (UNGA, 1997, Annexe, para. 26).

24 First Committee of the UN General Assembly, UN Doc. A/C.1/59/L.48, 14 October 2004, adopted without a vote.

25 Adopted at the 407th Plenary Meeting of the OSCE Forum for Security Cooperation (FSC).

26 See UNGA, 2001b, art. 14: 'Upon request, States and appropriate international or regional organizations in a position to do so should provide assistance in the destruction or other responsible disposal of surplus stocks. . . .'. See also UNGA, 1999, para. 111–12.

27 NATO PfP or SEECI (South Eastern Europe Cooperation Initiative) projects, implemented through NAMSA, in Albania, Moldova, and Ukraine.

28 Ammunition destruction projects have been conducted in Central and Latin America, Africa, and South Eastern Europe through UNDP Country Office projects.

29 Excluding the two major APM destruction projects (Albania and Ukraine), NAMSA has completed one project for ammunition destruction in Moldova. Significant projects are ongoing in Albania, Georgia, and Ukraine.

30 The US, for example, reports providing assistance to destroy over 44 million rounds of ammunition in Albania, Angola, Bulgaria, Serbia and Montenegro, Guinea, Lesotho, Mozambique, the Philippines, Romania, and Senegal, among other countries. It is reported that other projects are under way and/or under negotiation. See Greene, Holt, and Wilkinson, 2005, p. 24.

31 An external fire caused the detonation of an ammunition depot on the outskirts of Lagos, resulting in more than 1,500 fatalities.

32 Other technologies such as molten salt oxidation, biodegradation, etc. are developing, but production facilities are very limited and the technology is still at the experimental stage.

33 A PCS (Pollution Control System) that meets EU environmental emission limits requires a combination of the technologies shown.

34 Nitrogen Oxides.

35 Only those projects dealing purely with ammunition destruction are included. Those dealing with stockpile management can be found in Chapter 8.

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