



Libya. Source Threat Resolution Ltd.

## AMMUNITION SAFETY MANAGEMENT

### PREVENTING LOSS OF LIFE AND PROPERTY, AND DIVERSION FROM STOCKPILES

By Samuel Paunila, Advisor for Ammunition Operations, GICHD and Andrew Hoole, Ammunition Safety Management consultant, GICHD

The international community has been actively engaged in mine action for over 20 years. Clearance has been remarkably successful both in reclaiming land and making life safer for some of the most disadvantaged people in the world. As the number of casualties due to landmines has fallen, we have seen the number of deaths and injuries caused by explosions in ammunition storage areas rise<sup>1</sup> and an increasing diversion of ammunition away from state stockpiles and into the hands of non-state actors; the collapse of Libya in 2011 for instance saw the loss of almost an entire state stockpile.

Poorly managed stockpiles of ammunition present two distinct threats to the wider community: the risk of an explosion within the stockpile and the risk of diversion. Explosions in ammunition storage areas are being reported at 2 per month worldwide<sup>2</sup>. This figure is based on reported incidents and the real number may be significantly higher. The effects of explosions in ammunition storage areas can be truly devastating with damage to property and infrastructure running in to billions of dollars<sup>3</sup> and a human cost measured in shattered lives<sup>4</sup>.

Diversion could be described as a theft, or loss of ammunition that reduces the capability of the stockpile



Lapua ammunition factory accident aftermath, Finland 1976.

owner, usually the state, and allows military grade ammunition and explosives to be used by non-state actors. Military ammunition is in many countries the preferred main charge for use in improvised explosive devices (IEDs).

There are numerous issues to consider and procedures to follow when managing ammunition stockpiles, like any risk management strategies they are designed to reduce the likelihood of an accident and/or to reduce the consequences of such event. There are many factors that increase the risk of an explosion and they all need to be addressed. As a primary measure where ammunition is safe to move and where the situation allows, it should be moved away from people and vital infrastructure as soon as reasonably practicable. In the event of an ammunition storage explosion, this simple logistics activity will mitigate much of the potentially devastating effects.

Ammunition Safety Management is a broad subject and for brevity and readability we will focus on some of the major contributing factors to the explosive risk. The first three are broadly risk mitigation and the remaining four deal with accident prevention.

- Stockpiled ammunition in or near populated centres.
- Quantity Distances and SOPs.
- Segregation of ammunition in storage by Hazard Divisions and Compatibility Groups.
- Segregation between serviceable and unserviceable ammunition.
- Unsafe and shelf life expired ammunition within the stockpile.
- Untrained and unsupervised personnel.
- Poor inventory control measures and lack of basic management.

Each of these factors represents a significant management challenge, which is still poorly understood by many states. Some of these challenges tie together and can be improved significantly with small investments into human and technical resources. It is the planning and prioritisation of ammunition safety management that is key to improving the situation and managing the explosive risk. We will now briefly introduce the above factors.

#### **Stockpiled ammunition in populated areas.**

Moving the ammunition away from people, property



Libyan market for munitions. Source James Madison University.

and infrastructure is paramount. In order to accomplish this safely the ammunition must be inspected before transport and certified as 'safe to move'. Ammunition that is not 'safe to move' must be destroyed in accordance with EOD drills and principles.

**Quantity Distances.** One of the easiest, cheapest and most effective means of protecting public and property from the effects of an explosion is by the use of separation distances. Quantity Distance (QD) tables are available that give minimum acceptable separation distance from a given quantity and type of ammunition to areas where the public may live, congregate, work or transit. Within the storage areas there should also be separation between storage locations to reduce the risk of an explosion propagating from one store to another. The adoption of, and adherence to, these QD will ensure that if an explosion occurs it will be limited to one location and the risk to the public is reduced to a tolerable level.

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**Segregation of ammunition.** Ammunition can be classified generically into Hazard Divisions (HD) by the major hazard that it poses in the event of an accident, be it mass explosion, fragmentation or a fire hazard. Within each HD the ammunition is sub-divided into Compatibility Groups (CG) to determine which items can be stored and transported together. By adhering to HD, CG and approved mixing rules we can radically reduce the risk of an ammunition accident and lessen the effects should one occur.

**Separation of serviceable and unserviceable ammunition.** Unserviceable does not automatically mean unsafe. The term 'unserviceable' covers a broad spectrum of ammunition from an item so unsafe it has to be destroyed in situ, through to ammunition that is apparently perfect in all respects but fails to meet the specified performance parameters. Mixing the two categories will have implications such as decreasing war fighting capability





US Soldier in underground storage bunker near Tikrit, Iraq, 1st Sep 2003. Source NBC News.

and risking the safety of the entire stockpile, including all serviceable ammunition.

**Unsafe and life expired stocks being retained.**

The safety of ammunition is not always immediately apparent and as ammunition degrades over time it may become unstable, increasing the likelihood of initiation in storage or whilst being moved. If stored with serviceable ammunition there is an increased risk of losing strategic stocks.

**Untrained personnel.** Ammunition requires special handling and storage requirements. All personnel working with ammunition must be aware of the risks and the associated safety precautions and procedures. Addressing these factors will reduce the risk of an ammunition accident occurring and limit the amount of ammunition involved as well as minimising the impact on people and property.

**The other major risk posed by ammunition stockpiles is diversion.** Ammunition is a sought after commodity and in many countries the favoured

main charge in IEDs. Diversion may be small-scale and local, or large with national or even regional dimensions.

Small-scale diversion is characteristically carried out by individuals or small groups. It may be a member of the security forces or an authorised worker with access to ammunition taking directly from the stockpile. This kind of theft typically takes place where security is lax, accounting procedures are inadequate and where there is poor supervision over the site and workforce. To counter diversion at this level the ammunition must be physically secured, access restricted and monitored, and the ammunition subject to strict accounting, regular stock checks and a clear audit trail.

Examples of large-scale diversion include the former Soviet Union countries and more recently Iraq and Libya. Where accounting and accountability break down, diversion at grand scale may flourish. Without attempting to over-simplify the problem, the actions

required to address the diversion and proliferation of ammunition in grand scale are essentially the same in terms of restricting access, establishing accurate accounts and instilling accountability.

Further means of diversion include forced theft, mass looting or abandonment. At grassroots this might be an armed gang breaking in to an explosive store and stealing the ammunition; whilst at the larger scale, with a shifting frontline in a conflict area, the ammunition stockpile could be lost entirely. The need for physical security and an adequate security response at the lower level is a fundamental part of ammunition safety management. A secure building may not keep out well-equipped and determined attackers but it will slow them sufficiently for a co-ordinated security response to be mounted. Secure buildings, adequate monitoring through CCTV, regular patrols and a dedicated armed quick response force are the PS (Physical Security) component of appropriate PSSM. Whilst the loss of ammunition to wrong hands is more difficult to prevent in all settings, good management of the ammunition stockpile should ensure that only tactical, rather than strategic levels of stock are lost.

Improving ammunition safety and security requires a change in mindset and a political will. The case is pertinent in both emerging and developed countries. Finland makes a good example, having suffered a series of ammunition explosions in storage areas and factories in the 1960s and 1970s<sup>5</sup>. The accident investigations pointed out that most of the explosions could have been avoided and that their impact could have been reduced through implementation of relatively simple measures. This revelation prompted the Ministries of Defence and the Interior to reassess and redefine priorities. National standards for ammunition management were developed in the late 1970's and updated in the 1980's and 1990's; training of both military and civil personnel was carried out; and a staff screening and qualification regime was established. Good practice guidance was sought and learnt from other countries, introduced to the ammunition industry and armed forces, and then standardised and monitored. It worked. Since the 1970's and until early 2015 only two explosive incidents have been recorded



Albanian ammunition store. Source GICHD.

in Finland's manufacturing sites and none in storage locations, with no casualties or significant damage in either case.

In Finland today, large ammunition stockpiles have been reduced in size and explosive depots have been modernised and life cycle managed, with much capacity now situated underground, resulting in a safe and secure system for storing ammunition in significant quantities. With the project due for completion in 2018, the national effort will continue in neutralising the remaining explosive remnants (ERW) from World War II, inspecting and decommissioning expiring stocks, and procuring new ammunition to maintain the defence capability.

On the challenge of expired stocks, ammunition is never completely safe. Explosives are combinations of chemicals and these react with each other. Depending on the level of exposure to external conditions, these chemical processes slow down or



Ammunition Store in South Sudan, 2014. Source GICHD.

accelerate. Regardless of the design of conventional ammunition, the means of triggering and initiation are simple mechanical-chemical or electric-chemical systems. By neglecting the basic requirements for storekeeping, it is entirely probable, and this likelihood increases over time, that badly kept ammunition will accidentally initiate one day, will fail to function as designed or will be stolen or be traded away. In addition, as ammunition gets too old and unstable it will prove more expensive to destroy as increased care and safety measures have to be applied throughout the disposal operation.

It is also worth killing a myth in the notion of unpredictability of ammunition. While it is true, that it is difficult to know what is going on inside an old artillery shell by simply looking at it, there are ways to rapidly verify the type of explosive in ammunition and with some more effort and techniques, to determine the level of deterioration in its components, including the condition of fuze(s). There is no magic in these processes, only science. By studying the history of storage, ammunition shelf life can be

determined as well as the anticipated effects on a type of munition over time due to altered packaging, temperature and humidity in the store location.

All this said, in most cases the lead cause of an explosion in a storage area is remarkably less technical and subject to external disturbance. Examples are sub-standard and old electrical installations, smoking and other spark-inducing activities, burning rubbish and packaging material near ammunition, a fire that started elsewhere and spread to the ammunition storage area, and so forth.

To summarise, there are numerous instances of continued malpractice in storing ammunition. Ammunition is being stored alongside weapons, serviceable and unserviceable ammunition is being stored together and Hazard Classification Codes are being ignored. Abandoned and unexploded ordnance and quarrying explosives and accessories are in some places mixed in with the operational stock. Some armed forces continue to stockpile ammunition that has no corresponding, or functioning weapon system with which to fire it. These are not only bad practices, but, as history has shown us, they are also dangerous.

Safe routines, standard operating procedures, supervision and discipline are called for.

There is plenty of technical guidance available. United Nation's International Ammunition Technical Guidelines (2015) in French and English, UN Safeguard Web portal (UN ODA), OSCE's Handbook of Best Practices on Conventional Ammunition (2007), NATO's AASTPs<sup>6</sup> (2006), and British Joint Service Protocol publications<sup>7</sup> (e.g. JSP482) are examples of complementary international guidance on good practice. Professional advisory services and training are also available to bridge the gap between the

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current state of ammunition affairs, and the minimum level of acceptable stockpile safety and security.

A properly managed ammunition stockpile has virtually no obsolete, unserviceable or surplus stock. It is kept safely away from people, accounted for correctly with a clear audit trail and stored in a secure location with regular inspections and stock checks. It requires trained, qualified and dedicated staff and a commitment to safety and accountability. With these people and procedures in place the risks and impact of ammunition accidents or diversion can be reduced to a negligible level that should be the goal of everyone involved in ammunition management. ■

## REFERENCES

- 1 Unplanned Explosions at Munitions Sites, Small Arms Survey, update 4 March 2015.
- 2 Ibid.
- 3 On 13 February 2009 an explosion aboard a Russian cargo ship (Monchegorsk) in Cyprus was estimated by Credit Suisse to have caused EUR 2.4billion damage, equal to 13% of Cyprus' GDP.
- 4 An explosion in an army barracks in Brazzaville (4 March 2012) killed 282 people and injured 2300.
- 5 1963 Oulu explosive depot (10 dead), 1965 Uusikylä ammunition depot (4 dead, 69 injured), 1966 Vihtavuori dynamite factory (4 dead), 1976 Lapua Ammo Factory (40 dead, 60 injured, 90% women).
- 6 Allied Ammunition Storage and Transport Publication 1-2: Manual of NATO Safety Principles for the Storage of Military Ammunition and Explosives.
- 7 IATG were mainly developed from the British instruction on ammunition stockpile management.

## ABOUT THE AUTHORS



**Mr Samuel Paunila** is an Advisor for Ammunition Operations at the GICHD. He assists national authorities in issues related to security and safety of ammunition, management of stockpiles, and in the development of state policies and practices to effectively address

the risks from explosive remnants of war. He is currently leading a research project to characterise explosive weapons based on their effects in populated areas. For a decade prior to joining the GICHD, Mr Paunila directed mine action and armed violence reduction programmes with Danish Demining Group in Asia and Africa, and before that he was engaged in explosive ordnance disposal and stockpile management as an officer in the Finnish Defence Force. Ammunition work has taken him to 20+ countries, with longest field postings in Afghanistan, the Balkans, Sri Lanka and Uganda. Mr Paunila's education is a combination of academic and practical disciplines with degrees in weapon systems, automation engineering, and resilience.



**Mr Andrew Hoole** is an Ammunition Safety Management consultant at the GICHD providing specialist advice and support within GICHD and to NGOs and other partner organisations.

He is a former EOD/IEDD operator, instructor and specialist and spent 28 years as a British ATO (Ammunition Technical Officer) working at all levels of Ammunition Safety Management in field storage, temporary storage, operational storage and permanent storage locations in theatres across the world from Asia to Africa and the Americas.

As a Senior ATO he was responsible for the management and technical compliance of the largest ammunition storage areas in Western Europe. Since leaving the military in 2010 he has served as a technical advisor in Africa, Afghanistan and the USA.