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THE ARGUMENT FOR THERMAL TREATMENT: BOSNIA AND HERZEGOVINA

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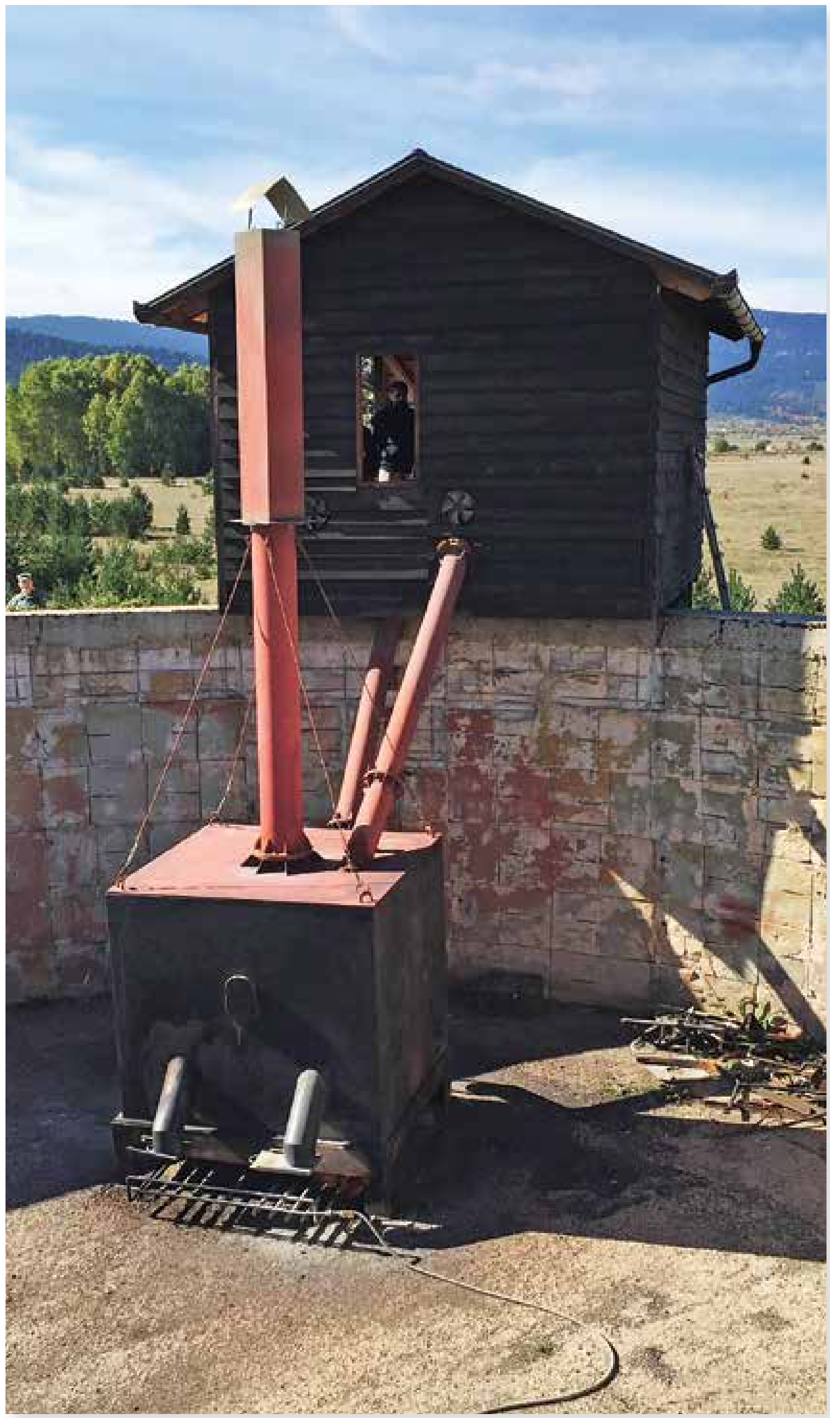
Historically, large, aging conventional weapons stockpiles in Bosnia and Herzegovina have been a challenge to regional security in Eastern Europe and potentially beyond. The International Trust Fund Enhancing Human Security (ITF), the Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA), and many other donors have funded stockpile reduction efforts in Bosnia and Herzegovina and in surrounding regions since 1999. Currently, PM/WRA funds U.S.-based contractor Sterling International Group, LLC (Sterling) to destroy weapons stockpiles under a bilateral technical agreement between the United States and the government of Bosnia and Herzegovina. Under this agreement, Sterling destroys approximately 500 tons of excess munitions yearly through open burning and open detonation at the military range facilities near Glamoč. This program is a continuation of an effort originally funded by PM/WRA in 2009 and implemented through ITF.



Thermal treatment furnace at Glamoč as seen from a protective concave wall.
All photos courtesy of Sterling International Group, LLC.

The destruction of these munitions occurs near the end of a long chain of activities conducted by the Armed Forces of Bosnia and Herzegovina to demilitarize or otherwise disassemble explosive items. Munitions that cannot be disassembled due to age, condition or other technical issues are sent to Sterling at Glamoč. A high priority for the governments of the United States and Bosnia and Herzegovina has been the destruction of 20 mm ammunition due to the age and condition of these stockpiles. This ammunition type, high-explosive incendiary (HEI) and HEI with tracers (HEI-T), was the cause of a major explosion at a facility performing manual large-scale disassembly in nearby Serbia. The Armed Forces of Bosnia and Herzegovina determined that it would take a disproportionate amount of time and resources to disassemble these munitions and then dispose of the primers, powder, warheads, tracers and cartridge cases. These munitions were therefore marked for destruction by open burning and open detonation.

Challenges With Destruction

Ammunition of this type presents a unique problem: it is too thick for traditional explosive destruction. The thickness of a 20 mm projectile casing and the relatively small explosive weight of each round make it expensive to destroy using military-grade explosives, such as C4 or Semtex, and nearly impossible to destroy using most commercially available explosives. For example, estimates indicate that 1 kg (2.2 lb) of plastic explosives would be required to detonate eight 20 mm rounds if conducting open detonation, which is a large consumption rate considering the cost of military-grade plastic explosives. At approximately US$17 per kilogram, they are difficult to procure and troublesome to transport. Destroying the 2 million 20mm rounds classified by Bosnia and Herzegovina for destruction would cost approximately $4.25 million in explosives alone—not including the cost of technicians, support staff and other project requirements.

The range at Glamoč allows a very small net explosive quantity of only 300 kg (660 lb), which allows approximately 1,200 20 mm rounds per shot and is very expensive in terms of personnel and time.

While too tough for efficient explosive destruction, 20 mm is often considered a bit too large for thermal treatment. Many programs conduct open burning of small arms ammunition where munitions are unpacked and loosely spread in an open pit containing wood or other flammables. The pit is then doused with fuel and ignited. The resulting flames ignite the propellant in each round, which launches the bullet a short distance and is generally contained within the pit. Steel furnaces replaced this type of open burning in which the combustible material and small arms munitions are placed within a large steel box, and the burn is conducted in a manner similar to the pit. However, unlike the pit, the furnace is safer and contains the small explosions from the propellant, trapping bullets as they fire. Many ammunition technicians refer to this arrangement as the popcorn treatment. Furnaces can also be outfitted with filters and ventilators to control the release of particulates into the atmosphere. Some furnace designs include a steel feed tube or chute, which allows operators to slowly add more ammunition into the furnace and maintain the heat level, thus maximizing the heat and effectiveness of the operation.

Sterling workers demonstrate destruction of 20 mm ammunition to U.S. and Bosnia and Herzegovina government observers.

Earth, concrete and steel containers form a concave barrier away from personnel in the chute structure.

Unfortunately, unlike conventional small arms ammunition, which contain a solid lead or metal alloy projectile, 20 mm cartridges contain a fuze and internal explosive material designed to detonate upon hitting the target. This type of explosion is much larger than the pop of the propellant and generally exceeds the safety limits of most locally constructed steel-box furnaces. Although a number of commercially manufactured furnaces could deal with 20 mm, these are expensive to build and operate, often approaching the cost of explosive treatment previously described.

This created a logistical and technical problem for the Armed Forces of Bosnia and Herzegovina as they addressed millions of unwanted 20 mm rounds in their inventory. Sterling responded by expanding upon existing designs for thermal treatment of ammunition and developed a 2-x-2-m (2.2-x-2.2-yd) furnace with inserts.

Solution to Large-caliber Munition Destruction

Made of 20 mm rolled steel, the Sterling furnace can safely contain the explosive force of 20 mm detonations. Likewise, Sterling increased the thickness of feed chutes, vents and chimneys to 10–15 mm to deal with increased heat and explosive force. Rather than use dunnage or other combustible material inside the furnace, it is heated from the outside using large, remotely controlled propane or oil-fired burners.

Once the furnace reaches a temperature of 250 C (482 F), operators feed a small amount of ammunition into the furnace core via a baffled feed chute. Operators are approximately 35 feet from the furnace while detonations occur. There is adequate steel and concrete between the operators and the ammunition. The furnace is designed to contain all of the hazardous effects from the blast. The chute contains a two-door system, which lets the operator load several rounds into the feed chamber, close the safety door and then open the release door, allowing new munitions to slide into the combustion chamber. The chute's height and angle is configured to allow operators to work at a safe distance from the low-level explosions occurring within the furnace. Operators feed ammunition at a steady rate while constantly monitoring the sounds of each explosion, thereby preventing a buildup of ammunition that might exceed the furnace's design.

The furnace routinely runs at its operational temperature for up to five hours, disposing 3,000 rounds of 20 mm ammunition per day. Smaller caliber ammunition, such as 12.7 mm, can be disposed at a rate of 10,500 rounds in a typical workday. This furnace configuration burns through approximately 35 L (9 gal) of propane gas per hour, varying slightly in relation to outside temperatures.

Sterling made a number of improvements to the furnace based on its experience with this method. The blast chamber was modified to incorporate removable inserts, allowing larger caliber ammunition such as 20 mm cartridges to detonate inside the furnace without damaging its interior. While the nature of the replacement process means the furnace will still need to cool down before damaged inserts can be replaced, the operation maintains spares to eliminate any additional

Personnel load items into the furnace via one of two chutes. Gas burners below furnace raise internal temperature above 250 degrees Celsius (482 degrees Farenheit).

downtime while damaged inserts are repaired at an off-site facility without halting operations. The cost of insert repairs is also lower than repairs to the furnace interior. The inserts also baffle the blast, reduce noise pollution and contain the blast fragments.

Since incorporating the thermal treatment furnace into operations in late 2013, Sterling destroyed more than 300,000 rounds of 20 mm ammunition along with more than 1.5 million rounds of other small arms ammunition. At this pace, more than 2 million unwanted 20 mm rounds in Bosnia and Herzegovina will be eliminated within two years at a fraction of the cost needed to dispose of these rounds by other means.

Drawbacks of Thermal Treatment

Although cost-effective, thermal treatment has its downsides. Even with a number of safety features, the design still incorporates operators working in fairly close proximity to the furnace, which could prove dangerous if an uncontrolled detonation were to occur. Therefore, strict control is required when feeding the munitions into the chute and in monitoring individual detonations. Moreover, furnaces remain hot for several hours after combustible material is introduced by design, preventing quick stoppage following a perceived incident. The furnace must cool down while operators remain at a safe distance. In 2014, operators overwhelmed the furnace, building up explosive material that ignited and damaged the furnace.

Emissions are also a concern during these operations. Particulates released from the chimney are constantly monitored, verifying that emissions meet environmental standards in Bosnia and Herzegovina. Environmental controls inherent in the design include but are not limited to the following: containment of hazardous materials, high burning temperatures that ensure complete burning of materials, a relatively tall chimney, and good air flow design. To protect the surrounding environment, nearby soil and water are closely monitored for possible contaminants. Operators on-site are required to wear respirators and protective clothing to shield against lead

Removable inserts isolate 20 mm ammunition and allow separate repairs and uninterrupted operations.

exposure. Operators are also physically examined to ensure they are not exposed to dangerous contaminants. These precautions also occur at demilitarization (DEMIL) facilities that disassemble or pull apart munitions.

Furnace designs may need alterations in some countries, as environmental regulations might require chimney scrubbers and other means of attaining emission levels consistent with national standards. Companies pursuing a thermal treatment operation must examine the standards of the country in question.

Conclusion

Conventional weapons and ammunition stockpiles jeopardize safety and security in a large number of countries. Given the global economic climate and location of conventional weapons destruction problems in many developing countries, an efficient, effective and reasonably priced solution is critically important. A thermal treatment furnace following a fairly low-technology design can be produced within local economies for under $50,000. This method can destroy ammunition stockpiles quickly and safely, especially 20 mm ammunition, without the need for expensive explosive material. The process requires fewer personnel, and the training requirement for operators is much lower than required for DEMIL or open burning and open detonation. Fuel costs are also low through use of locally available fuel oil or other standard heating fuel. Fuel costs average $0.02 per round. This figure is based on 35 L of fuel (at current exchange rate) to treat 3,000 rounds of 20 mm ammunition. The furnace is ultimately a safe option as well, with blasts contained and shrapnel potential eliminated. The furnace is certified using U.S. Department of Defense best practice methodology during research and development work (1.25 times the limit) and the shielding was tested well beyond this threshold. Thermal treatment is an excellent option for African, Eastern European and Southeast Asian countries with stockpile-reduction requirements. It is an appropriate solution that is effective, efficient, productive and safe.

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Chad Clifton is a conventional weapons destruction and humanitarian mine action professional with more than 12 years of project-management experience for the United States Government, the United Nations and commercial contracts. Clifton currently supports multiple projects in Eastern Europe, the Middle East, Asia and Africa for Sterling International Group. Prior to this, he worked as ERW project and finance manager for RONCO Consulting Corporation including programs in Sudan, South Sudan and the Kurdish Region of Iraq. He holds a Bachelor of Arts in international studies from the American University School of International Service in Washington, D.C. He is based in Washington, D.C., and frequently travels to the Balkans region.