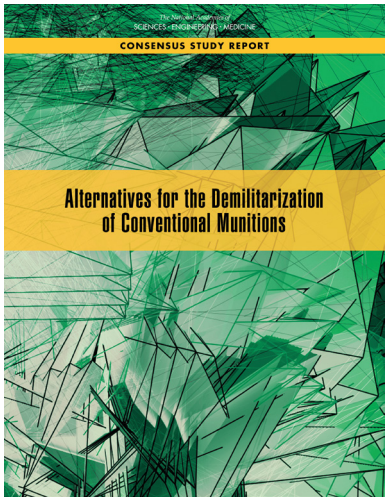
Consensus Study Report
HIGHLIGHTS
December 2018

Alternatives for the Demilitarization of Conventional Munitions

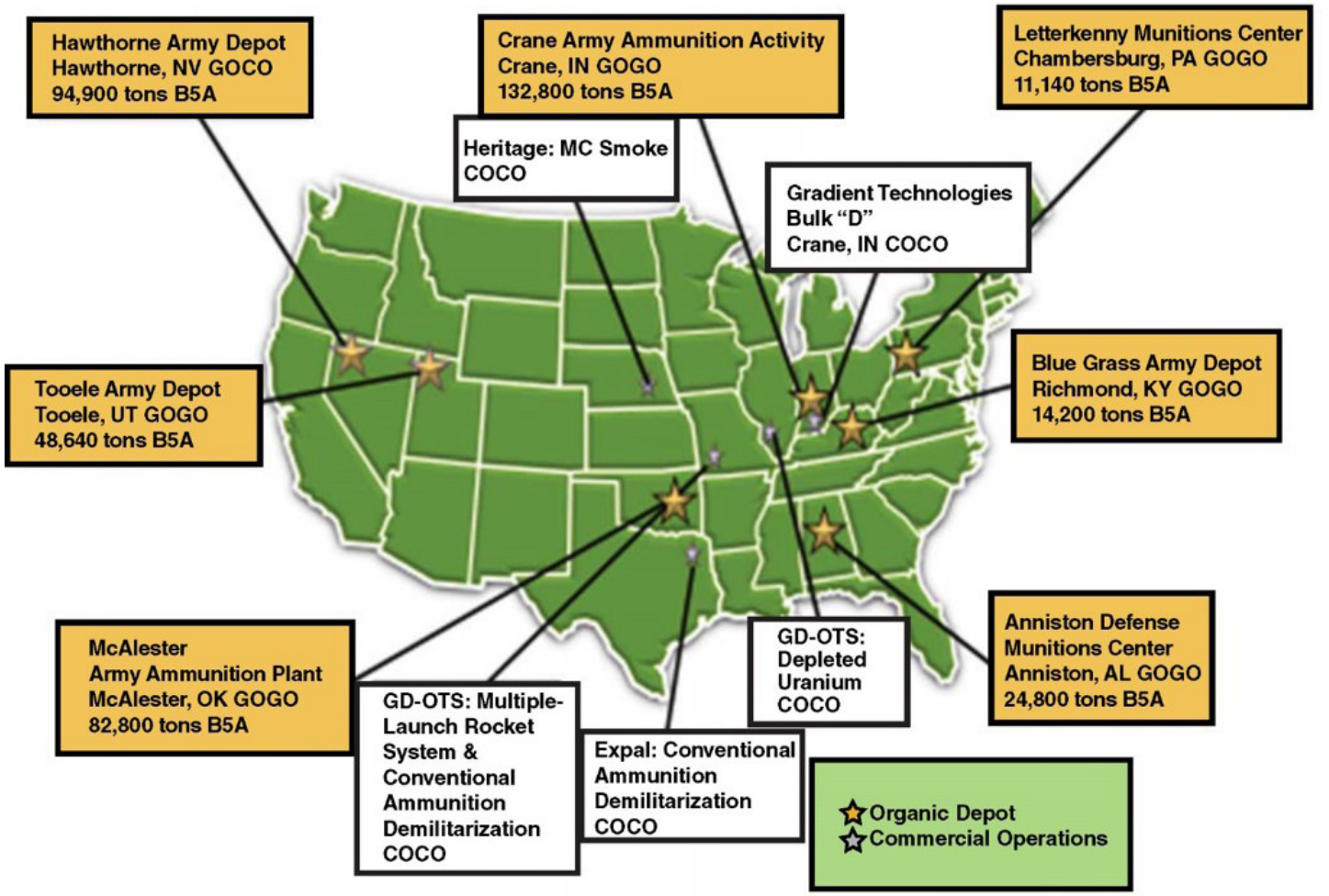


From fiscal year 2011 to 2017, the U.S. military stockpile of excess, obsolete, or unserviceable munitions decreased from just under 600,000 tons to about 400,000 tons. Approximately 60,000 tons are added to the stockpile with an even larger quantity demilitarized every year. These munitions include projectiles, bombs, rockets, landmines, and missiles. Open burning/open detonation (OB/OD) of these munitions is conducted at numerous installations across the United States. Although the use of OB/OD has decreased significantly since 2011, the emissions from these facilities and their potential health and environmental effects continue to cause concern for public interest and community groups. In response to these concerns, the U.S. Congress directed the Secretary of the Army to enter into an arrangement with the National Academies of Sciences, Engineering, and Medicine to conduct an assessment of alternative technologies for the demilitarization of conventional munitions in lieu of OB/OD. The resulting report, Alternatives for the Demilitarization of Conventional Munitions, reviews the current conventional munitions demilitarization stockpile, assesses disposal technologies, and identifies barriers to full-scale deployment of alternatives to OB/OD.

OPEN BURNING AND OPEN DETONATION

Open burning (OB) typically involves either burning bulk propellants and energetics in burn pans or other structures, or static firing rocket and missile motors to use up their fuels. Static firing involves securing the motors on stands and igniting them. Open detonation (OD) typically involves placing munitions and donor charges into pits, covering them with earth, and activat-

The National Academies of
SCIENCES • ENGINEERING • MEDICINE



Army conventional stockpile and demilitarization locations in the continental United States. *The Army Demilitarization Enterprise includes the 7 U.S. Army depot installations (larger gold stars) where the conventional munitions stockpile (B5A account) is stored, along with a small number of industrial sites that demilitarize munitions by alternative technologies to OB/OD (smaller silver stars), as of February 2018. GOGO: government owned, government operated; GOCO: government owned, contractor operated; COCO: contractor owned, contractor operated; GD-OTS: General Dynamics Ordnance and Tactical Systems. SOURCE: J. McFassel, Product Director for Demilitarization, PEO AMMO.*

ing the donor charges. Current OB and OD operations are conducted under Resource Conservation and Recovery Act (RCRA) permits, which are only granted if the operation can demonstrate that it is protective of human health and the environment. While there have been safety incidents, OB/OD is considered by the Army to be a generally safe technology for workers, and the committee finds that the Army safety program appears to be effective. The downside of OB and OD is that they release contaminants from the operation directly into the environment. During OB/OD operations, thick plumes of smoke are quite often visible, and this has generated significant concern on the part of public interest groups. These groups have been opposed to OB/OD operations for years, claiming a lack of adequate monitoring of emissions and potentially cumulative negative impacts on human health and the environment.

ALTERNATIVES TO OPEN BURNING AND OPEN DETONATION

Over time, a number of technology alternatives to OB/OD have become available, with additional technologies in development. These alternative technologies generally involve some type of contained destruction of the energetic materials,

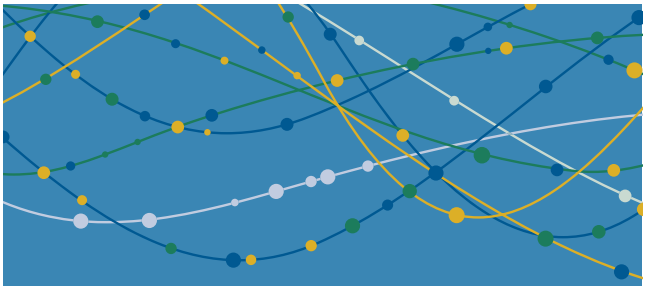
including contained burning (CB) or contained detonation (CD) as well as contained methods that forego combustion or detonation. Emissions from CB and CD operations are captured, and gaseous emissions are treated in pollution abatement systems before release to the environment. The recycling, recovery, and reuse of munition components are often employed as well. These alternative technologies, by their nature, release far fewer emissions into the environment, and thus are generally perceived by the public as more environmentally friendly and acceptable. There is the possibility of an increased safety risk to workers owing to additional handling requirements associated with preparing munitions for disposal by many of the alternative technologies. However, some demilitarization facilities use automation to minimize handling, and thus worker risk.

The primary downsides of most of the available CB/CD technologies are cost and throughput. CB/CD technologies will have higher capital and operating costs than OB/OD because of the need to design a plant; procure and install equipment; construct the facility; and pay for utilities, maintenance, and personnel. However, alternative technology facilities will likely be less expensive to close and clean up than OB/OD facilities, as repeated OB/OD operations can contaminate the surrounding environment and require extensive mitigation. CB/CD throughput depends on the specific munition and technology employed, but throughput is generally lower with CB/CD as compared to OB/OD.

KEY MESSAGES

The full report includes 30 findings and 8 recommendations, which can be consolidated into these key messages:

- The Office of the Product Director for Demilitarization has a stated strategic goal to increase the use of alternative technologies in lieu of OB/OD. The Army has made progress in implementing alternatives at many stockpile and contractor locations.
- Some shock-sensitive or unstable munitions may not be safe to handle or transport for treatment by alternative technologies; thus, the capability for OB/OD will always be needed.
- Viable alternative technologies exist within the demilitarization enterprise for almost all stockpile munitions currently being treated via OB/OD.
- Alternative technologies have both pros and cons. Implementing alternative treatment technologies will result in reduced emissions and lower closure costs, but will be associated with increased capital and operating costs. Alternative technologies will have varying throughput capacities compared to OB/OD.
- Public interest groups are expected to generally favor alternative technologies over OB/OD. Proactive engagement with regulators and the affected public, as well as increased two-way communication and transparency in decision making, will help further progress.
- Funding is the main barrier to the full-scale deployment of alternative technologies in lieu of OB/OD. A detailed implementation plan with public involvement is needed to transition away from OB/OD.



Learn more by downloading the full report, briefing slides, and other report resources at: **nap.edu/25140.**

COMMITTEE ON ALTERNATIVES FOR THE DEMILITARIZATION OF CONVENTIONAL MUNITIONS: TODD A. KIMMELL, Argonne National Laboratory, Washington, D.C., Chair; DOUGLAS M. MEDVILLE, Independent Consultant, Highlands Ranch, Colorado, Vice Chair; JUDITH A. BRADBURY, Independent Consultant, Knoxville, Tennessee; GAIL CHARNLEY, HealthRisk Strategies, LLC, Washington, D.C.; HEREK L. CLACK, University of Michigan, Ann Arbor; DEBORAH L. GRUBBE, Operations and Safety, LLC, Chadds Ford, Pennsylvania; REBECCA A. HAFFENDEN, Global Empire, Santa Fe, New Mexico; PETER R. JAFFE, Princeton University, New Jersey; RICHARD S. MAGEE, New Jersey Corporation for Advanced Technology (NJCAT), Hoboken; JAMES P. PASTORICK, Independent Consultant, Alexandria, Virginia; SETH P. TULER, Worcester Polytechnic Institute, Massachusetts; WILLIAM J. WALSH, Clark Hill, PLC, Washington, D.C.; LAWRENCE J. WASHINGTON, Independent Consultant, Midland, Michigan

STAFF: BRUCE BRAUN, Director, Board on Army Science and Technology; JAMES C. MYSKA, Study Director; NIA D. JOHNSON, Senior Research Associate; DEANNA SPARGER, Program Administrative Coordinator

This Consensus Study Report Highlights was prepared by the Board on Army Science and Technology (BAST) based on the report *Alternatives for the Demilitarization of Conventional Munitions* (2018). The study was sponsored by the Department of Defense. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of the sponsors. Download the report at **nap.edu**.

Division on Engineering and Physical Sciences

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

The nation turns to the National Academies of Sciences, Engineering, and Medicine for independent, objective advice on issues that affect people's lives worldwide.
www.national-academies.org