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Alternatives for the Demilitarization of Conventional Munitions

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Alternatives for the Demilitarization of Conventional Munitions

Public Release Webinar
December 6, 2018

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Statement of Task (SOT)

As Set Out in Section 1421 National Defense Authorization Act 2017

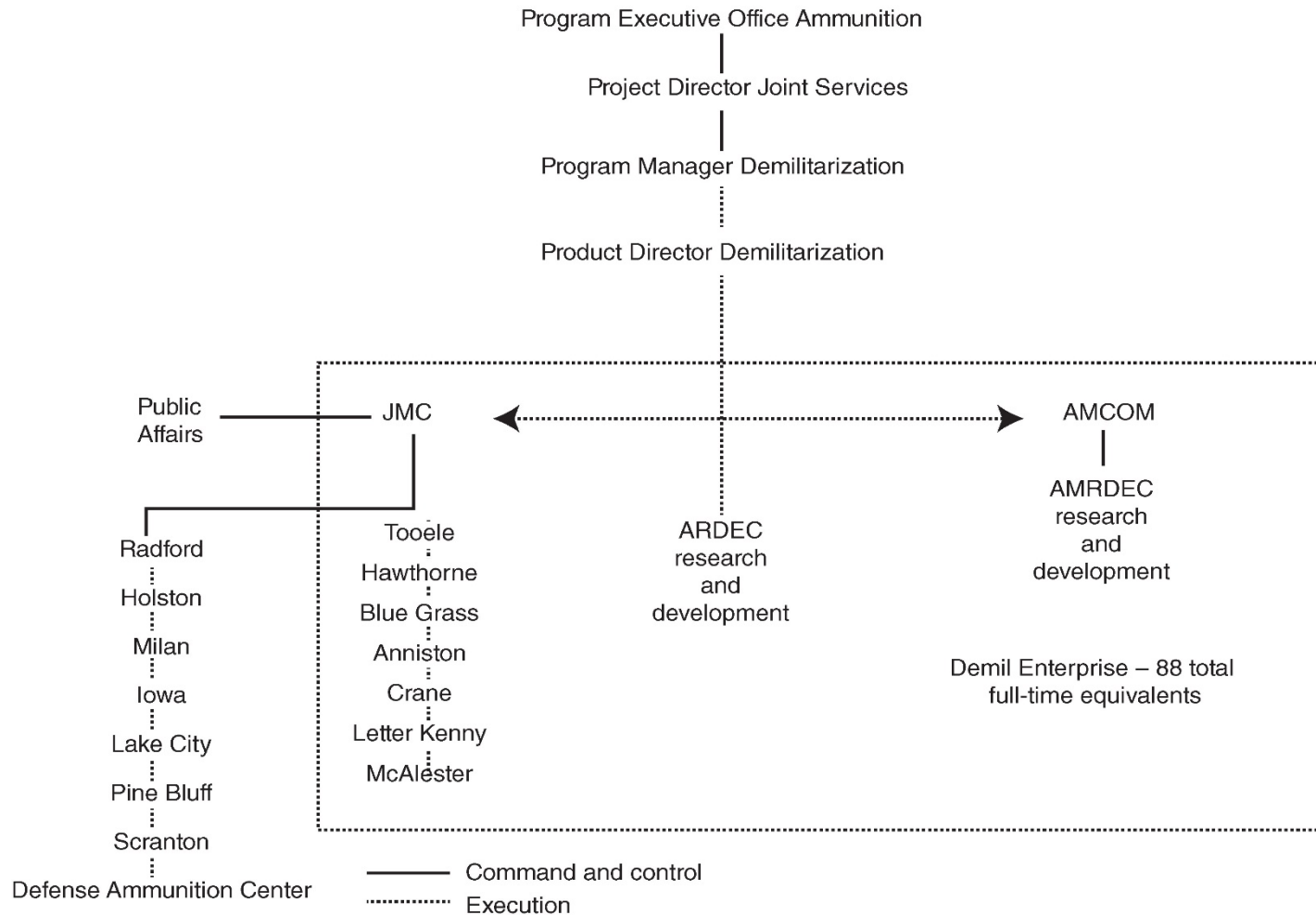
- A review of the current conventional munitions demilitarization stockpile, including types of munitions and types of materials contaminated with propellants or energetics, and the disposal technologies used.
- An analysis of disposal, treatment, and reuse technologies, including technologies currently used by the Department and emerging technologies used or being developed by private or other governmental agencies, including a comparison of cost, throughput capacity, personnel safety, and environmental impacts.
- An identification of munitions types for which alternatives to open burning, open detonation, or non-closed loop incineration/combustion are not used.
- An identification and evaluation of any barriers to full-scale deployment of alternatives to open burning, open detonation, or non-closed loop incineration/combustion, and recommendations to overcome such barriers.
- An evaluation of whether the maturation and deployment of governmental or private technologies currently in research and development would enhance the conventional munitions demilitarization capabilities of the Department.

Scope of Work

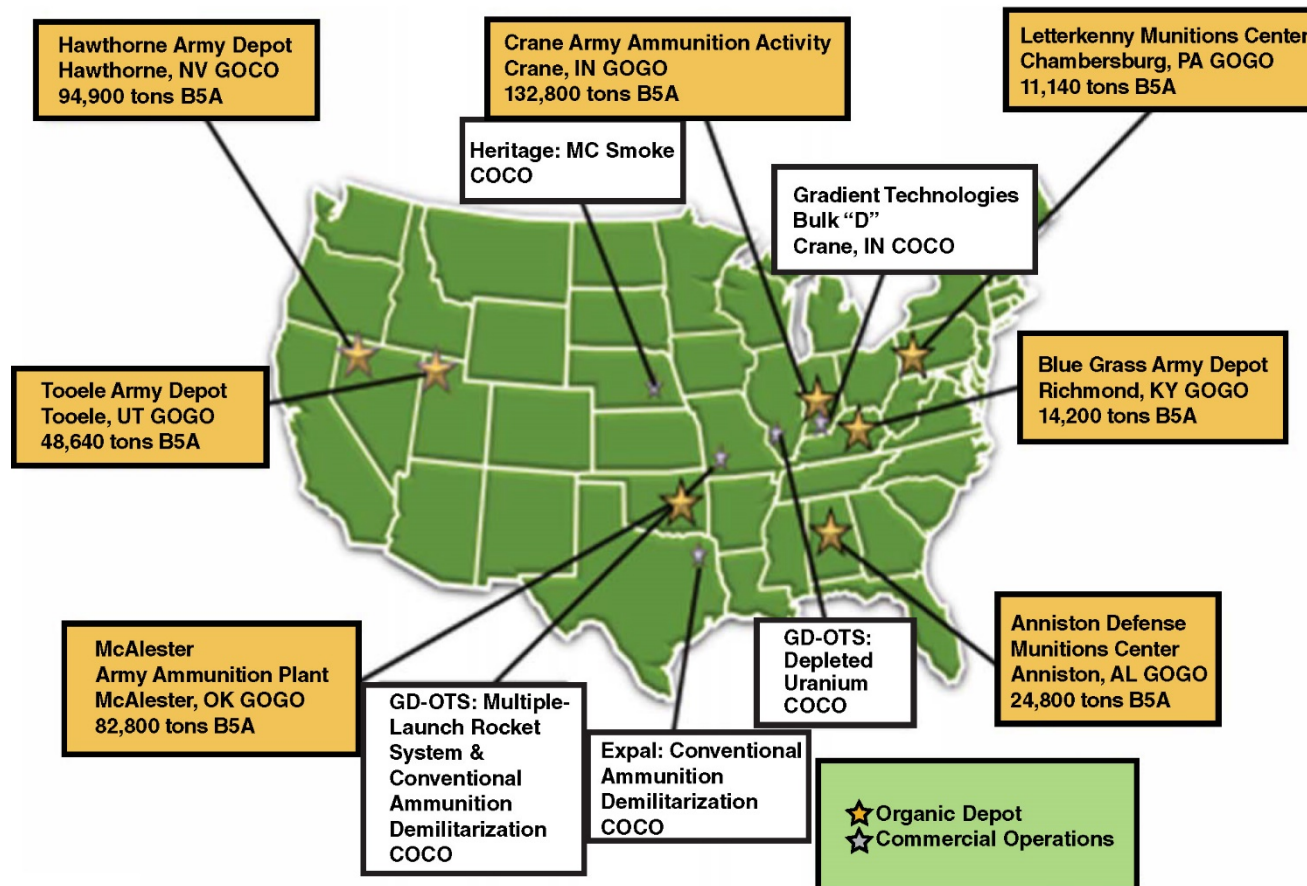
- The SOT directed that the committee address the seven sites that manage the conventional munitions demilitarization stockpile.
- The scope also included contractor owned contractor operated (COCO) operations that demilitarize the conventional munitions demilitarization stockpile.
- The committee did not address other open burning or open detonation operations (e.g., ammunition plants, other military, Department of Energy sites).
- However, the committee's findings and recommendations will have implications for and applicability to sites outside of the seven stockpile sites.

Demilitarization Enterprise

ARMY CONVENTIONAL MUNITIONS DEMIL MANAGEMENT



Sites Included in Report



Committee Activities

- 5 full meetings
 - 3 data gathering meetings (webcast, 775 unique log-ins across 3 meetings)
 - 2 closed working meetings
 - Numerous closed committee teleconferences
- Site visit to Letterkenny Munitions Center
- 4 teleconferences with PD Demil
- 2 teleconferences with JMC PAO
- Teleconference with Strategic Environmental Research and Development Program (SERDP)
- 3 teleconferences with representatives of public interest groups
 - California Communities Against Toxics
 - Cease Fire! Campaign
 - Environmental Patriots of the New River Valley
- Extensive outreach to alternative technology vendors
- Public comment email inbox open throughout data gathering, 39 emails and numerous documents received

Timeline

- Contract award July 14, 2017
- First meeting August 22-24, 2017
- Final (5th) meeting June 11-13, 2018
- Concurrence July 9, 2018
- Report out to peer review August 16, 2018
- Response to review approved October 22, 2018
- Final Academies approval November 12, 2018
- Prepub delivered December 5, 2018
- Contract end January 13, 2019

Organizations Providing Information to the Committee

Technology Vendors

- Dynasafe
- El Dorado Engineering
- Expal USA
- General Atomics
- General Dynamics
- Gradient Technology
- MuniRem
- US Demil

Department of Defense

- Department of Defense Explosives Safety Board
- Joint Munitions Command

- Office of the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health
- Non-Stockpile Chemical Materiel Disposal Program
- Product Director for Demilitarization
- Program Executive Office for Assembled Chemical Weapons Alternatives
- Strategic Environmental Research and Development Program
- U.S. Army Aviation and Missile Life Cycle Management Command

Organizations Providing Information to the Committee, *continued*

Other U.S. Government

- U.S. Environmental Protection Agency

State Regulators

- Alabama Department of Environmental Management
- Pennsylvania Department of Environmental Protection

Public Interest Groups

- California Communities Against Toxics
- Cease Fire! Campaign
- Center for Public and Environmental Oversight
- Environmental Patriots of the New River Valley

Demilitarization Overview

(Numbers are approximate; the stockpile fluctuates, disposal is affected by budget, cost varies by situation)

- Approximately 431,000 tons of stockpiled conventional munitions to be demilitarized
- Approximately 23,000 tons/year destroyed by OB/OD (30% of total)
- Approximately 52,000 tons/year destroyed by other means (70% of total)
- Average demilitarization cost, all technologies: \$2,890/ton
- Average demilitarization cost, OB/OD: \$750/ton
- Range of demilitarization costs, alternative technologies: \$2,000-\$20,000/ton

Source: Data provided by PD Demil, as of September 30, 2017.

Munitions Being Treated by Open Burning, Static Firing, or Open Detonation

- Rocket assisted projectiles containing grenades
- Dispensers containing submunitions with shaped charges (projectiles and bombs)
- High explosive projectiles containing grenades and shaped charges
- Rocket and missile motors with double-based propellant
- High explosive incendiary cartridges
- Propellant charges
- Bombs
- High explosives
- Fuzes and initiators

Example Alternative Technologies Used by Product Director for Demilitarization

- Incineration (e.g. APE-1236 rotary kiln)
- Autoclave meltout of energetics
- High-pressure washout
- Cryofracture (in testing for size reduction)
- Pull Apart machines (for grenades and small arms ammunition)
- Explosive detonation chambers
- Contained rocket and missile motor firing (in testing)
- Contractor facilities (automated disassembly lines, incinerators)
- Other technologies include hydrolysis, white phosphorus conversion, and several forms of munitions down-sizing (shredding, cutting, submunition removal).

Technologies and Capabilities Reviewed by the Committee

- Munitions Preparation and Size Reduction
 - Mechanical cutting (band saws)
 - Water jet and slurry jet cutting
 - Cryofracture
 - Automated disassembly
 - Wash-out and melt-out of energetics
- Explosive Detonation Chambers
 - Controlled Detonation Chamber (CDC)
 - Detonation of Ammunition in a Vacuum Integrated Chamber (DAVINCH)
 - Explosive Destruction System (EDS)
- Contained Burn Chambers
 - Thermal treatment chambers
 - Flashing furnaces
- Contained Rocket and Missile Motor Firing Chambers
 - Ammonium Perchlorate Rocket Motor Destruction (ARMD) Facility
- Static Detonation Chamber (contained burn/deflagration and contained detonation)

Technologies and Capabilities Reviewed by the Committee, *continued*

- Deactivation furnaces/rotary kilns
 - APE-1236, Explosive Waste Incinerator, Rotary Kiln Incinerator, Decineration
- Non-Incineration Energetics Destruction
 - Industrial supercritical water oxidation (iSCWO)
 - Hydrolysis oxidation
 - Sulfur reduction chemistry

Examples of Technologies in Research and Development

- Liquid/vapor jet cutting (CO_2 , ammonia)
- Supercritical fluid extraction
- Photocatalytic degradation of energetics
- Acoustic energy propagation (sonication) to degrade energetics
- Biodegradation of energetics

Findings and Recommendations

- The report contains a total of
 - 30 Findings
 - 8 Recommendations
- These roll up into 6 main messages identified in the report by the committee.

Main Message 1

The Office of the Product Director for Demilitarization (PD Demil) 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 of the stockpile and contractor locations.

Finding 2-4. According to data provided to the committee by PD Demil, the use of OB/OD as demilitarization treatment methods has declined from an estimated 80 percent of demilitarized munitions in the mid-1980s to an average of about 30 percent in recent years.

Main Message 2

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.

Finding 7-1. Alternatives to OB and OD are not being used for some munitions because the munitions have become unstable and are too hazardous for the handling and transportation required for demilitarization using alternative technologies. A determination by the PD Demil that a munition is unstable and potentially shock sensitive is a valid reason for performing demilitarization via OB/OD to minimize transportation and handling and, therefore, the exposure of technicians to the explosive hazard. The capability for OB/OD will always be needed.

Main Message 3

Viable alternative technologies exist within the demilitarization enterprise, either stand-alone or as part of a treatment train, for almost all munitions currently being treated within the DoD conventional munitions demilitarization stockpile via OB/OD.

Finding 8-3. Most of the alternative technologies that could replace open burning and open detonation are mature and many have already been permitted.

Finding 4-1. Contained burn chambers with associated pollution abatement systems designed to treat propellants and other energetics are available commercially and can be designed to meet the needs of PD Demil stockpile demilitarization as a substitute for open burning.

Main Message 3, *continued*

Finding 7-2. The configuration of some munitions will require handling and processing steps prior to munitions demilitarization using alternative technologies. This adds complexity to the process, may increase the cost of demilitarization, and may increase risks to workers. These factors will have to be considered when evaluating the use of alternative technologies.

Finding 7-3. The organic capabilities of the PD Demil and the contractor community have the technical capability—or could develop the capability—to demilitarize nearly all of the munitions in the stockpile using alternative technologies. There will, however, always be some munitions that need to be treated by open burn or open detonation for safety reasons.

Main Message 4

Alternative technologies have both pros and cons. Implementing alternative treatment technologies for munitions that are currently treated via OB/OD will result in reduced emissions but will be associated with increased capital and operating costs, although with lower closure costs. The alternative technologies treating the same munitions as OB/OD will have varying throughput capacities compared to OB/OD, depending on the capabilities of the technologies, munitions being treated, and other factors, including permit restrictions (e.g., net explosive weight limits and weather restrictions).

Finding 8-1. Each of the alternative technologies that the committee evaluated as potential replacements for OB and OD would have lower emissions and less of an environmental and public health impact, would be monitorable, and would likely be more acceptable to the public.

Main Message 4, *continued*

Finding 4-2. Contained detonation chambers that can demilitarize some conventional munitions and munition components exist; however, limited explosion containment capabilities and the need to prepare and/or pre-process munitions can limit the applicability of these chambers.

Finding 8-2. Throughput capacity for open burning and open detonation and alternative technologies is dependent on many factors, some of which may offset each other. These factors include the capability of the treatment technology, the characteristics of the munition or munition component being treated, and permit restrictions.

Main Message 4, *continued*

Finding 8-4. The alternative technologies that could replace OB and OD could pose either more or less risk to personnel depending on the munition and on the extent to which munitions handling is required. The safety approvals currently required by the DDESB for both OB/OD and CB and CD and their associated demilitarization processes are adequate to minimize explosive accidents and injuries.

Finding 8-6. The committee requested but was unable to obtain sufficient data to draw general conclusions regarding the relative life cycle costs of OB and OD and the alternative technologies, although the capital (startup) costs of the alternatives will likely be higher while the costs of environmental monitoring and closure will likely be lower. Operating costs of the alternatives appear to vary widely and in some cases may be competitive with OB/OD.

Main Message 5

Public interests groups are expected to generally favor alternative technologies over OB/OD. Further progress in implementing alternatives will be facilitated by proactive engagement with federal and state regulators and the affected public, featuring increased two-way communication and transparency in decision making.

Finding 9-9. The public's acceptance of technologies that they view as being risky may be fostered if the Army adopts more effective public involvement activities. Without proactive attention by PD Demil to the ways that the perception of technology and management are intertwined, public support may be undermined, resulting in delays in full-scale deployment of alternative technologies to replace OB/OD.

Main Message 6

There is only one barrier to the full-scale deployment of alternative technologies in lieu of OB/OD—namely, funding. In addition, there are two other considerations that could significantly impact the transition away from OB/OD: (1) The PD Demil's lack of a detailed implementation plan to institutionalize the 2018 Demilitarization Strategic Plan, and (2) the potential for public opposition to specific alternative technologies at the individual stockpile depots.

Finding 9-2. The implementation and use of alternative technologies is a function of how much funding is requested by the Army and how much funding is appropriated, however, both the DoD and the Army have placed a relatively low priority on funding the demilitarization program, including the implementation of additional alternative technologies to replace OB/OD, as reflected in their past budget requests.

Main Message 6, *continued*

Finding 9-3. Uncertainty in the current and future funding levels for demilitarization of conventional munitions is a barrier to the development and increased use of alternatives to OB/OD.

Finding 9-4. Absent a clear directive from Congress, accompanied by sufficient funding, it will not be possible for the Army to implement full-scale deployment of alternative technologies in lieu of OB/OD.

Recommendations: Current Picture

Recommendation 2-1. The Army should include the potential to reduce the use of open burning and open detonation as a criterion used to evaluate candidate projects in Office of the Product Director for Demilitarization's research, development, test, and evaluation program.

Recommendation 2-2. The Office of the Product Director for Demilitarization should investigate the use of alternative treatment or disposal methods, including commercial treatment, storage, and disposal facilities, for positively identified pyrotechnic, explosive, or propellant-contaminated nonmunitions wastes.

Recommendations: Regulatory

Recommendation 6-1. The Army should investigate whether permits for existing alternative technology units at Army munition demilitarization depots can be amended to be more flexible regarding the types, frequency, and amounts of munitions that can be treated.

Recommendation 6-2. The Army should identify issues that could affect the Resource Conservation and Recovery Act permitting process for alternative technologies, including public concerns, and work with regulators in the states with jurisdiction over the seven demilitarization depots to establish requirements for Subpart X applications (e.g., developing scientific and technical analysis documents, emission modeling and estimates, and efficiency documentation for similar units) so as to address issues and questions before they become a problem that could significantly delay permitting alternative technologies.

Recommendations: Current Demil

Recommendation 7-1. In keeping with stated strategic goal to increase the use of contained disposal, resource recovery, and recycling consistent with continuing to ensure minimal exposure of personnel to explosive safety risks, the Office of the Product Director for Demilitarization should perform a detailed technical and engineering evaluation of the munitions in the inventory currently demilitarized by open burning or open detonation and evaluate appropriate alternative demilitarization technologies for each munition along with an implementation schedule and budget requirements. This detailed evaluation should include the option of shipping munitions and munitions components to other organic or contractor facilities for demilitarization.

Recommendations: Barriers and Other Considerations

Recommendation 9-1. To enable the Department of Defense and Congress to decide what level of resources should be devoted to increasing the use of alternative technologies in lieu of open burning (OB) and open detonation (OD), the Office of the Product Director for Demilitarization should prepare an analysis of the full life cycle costs of demilitarization of the munitions in the stockpile using alternative technologies and OB/OD to determine the funding necessary to increase the use of alternative technologies over various periods of time and the impact of that increase on the demilitarization enterprise.

Recommendation 9-2. The Office of the Product Director for Demilitarization should develop a detailed implementation plan for transitioning from open burning and open detonation to alternative technologies, with appropriate performance metrics, and institutionalize it throughout the Demilitarization Enterprise.

Recommendations: Barriers and Other Considerations, *continued*

Recommendation 9-3. The Office of the Product Director for Demilitarization should, in coordination with the Joint Munitions Command Public and Congressional Affairs Office, include in its implementation plans proactive public affairs activities that build on the experience of other successful programs in resolving public concerns.

Conclusion

There are no significant technical, safety, or regulatory barriers to the full-scale deployment of alternative technologies for the demilitarization of the vast majority of the conventional waste munitions, bulk energetics, and associated wastes.

Indeed, alternative technologies to mostly replace OB/OD currently exist.

The primary barrier is cost—replacing OB/OD with alternative technologies will require significant and stable funding and the concomitant policy commitment.

Complicating any push to fund replacement of OB/OD with alternative technologies is the fact that EPA and the states maintain that permitted OB/OD operations are safe for human health and the environment.

The report will be available for complimentary download in PDF format at:

<https://www.nap.edu/catalog/25140>

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The prepublication version will be available on December 6, 2018, at 1:30 PM EST.

The final version will be available in January 2019.

ANY
QUESTIONS
?

Full Listing of Findings and Recommendations

The full context for these findings and recommendations can be found in the report.

Findings and Recommendations: Chapter 2, Current Picture

Finding 2-1. According to PD Demil, the primary factor determining the quantity of munitions demilitarized in a given year is the budget, not technological capacity or availability.

Finding 2-2. Despite the Army's stated strategic goal of replacing OB/OD with alternative contained treatment technologies, reducing the use of OB/OD is not an explicit criterion used to evaluate projects in PD Demil's RDT&E program.

Recommendation 2-1. The Army should include the potential to reduce the use of open burning and open detonation as a criterion used to evaluate candidate projects in Office of the Product Director for Demilitarization's research, development, test, and evaluation program.

Finding 2-3. The Army demilitarization program appears to have instituted an effective safety management program.

Findings and Recommendations: Chapter 2, Current Picture

Finding 2-4. According to data provided to the committee by PD Demil, the use of OB/OD as demilitarization treatment methods has declined from an estimated 80 percent of demilitarized munitions in the mid-1980s to an average of about 30 percent in recent years.

Finding 2-5. Nonmunitions waste materials, including solvents and other organic liquids, positively identified as pyrotechnic, explosive, or propellant-contaminated are treated via OB at some of the stockpile demilitarization sites.

Recommendation 2-2. The Office of the Product Director for Demilitarization should investigate the use of alternative treatment or disposal methods, including commercial treatment, storage, and disposal facilities, for positively identified pyrotechnic, explosive, or propellant-contaminated nonmunitions wastes.

Findings and Recommendations: Chapter 4, Alternative Technologies

Finding 4-1. Contained burn chambers with associated pollution abatement systems designed to treat propellants and other energetics are available commercially and can be designed to meet the needs of PD Demil stockpile demilitarization as a substitute for open burning.

Finding 4-2. Contained detonation chambers that can demilitarize some conventional munitions and munition components exist; however, limited explosion containment capabilities and the need to prepare or preprocess munitions can limit the applicability of these chambers.

Finding 4-3. For some munitions, combinations of processing steps will be required to prepare munitions for treatment in a CB or CD chamber. Although this increases complexity and handling risks, if not conducted remotely using automated equipment, these steps enable the munitions to be demilitarized without using OB or OD.

Findings and Recommendations: Chapter 4, Alternative Technologies

Finding 4-4. Several of the emerging technologies are in early stages of research and development and have not been demonstrated under full-scale operating conditions. None of those examined by the committee are expected to make a significant contribution to demilitarizing munitions in the near future.

Findings and Recommendations: Chapter 6, Regulatory Aspects

Finding 6-1. There is no formal Environmental Protection Agency guidance for permit applicants or authorized state agencies to determine the requirements for applications or permit conditions (e.g., risk goals, treatment efficiencies, or waste and operational limitations) for alternative technology units that would be permitted as Subpart X units.

Finding 6-2. Provisions contained in permits for existing alternative technologies at Army demilitarization depots may limit the types of waste munitions that can be treated or the throughput of the units. Some of these limitations are based on the technology or regulatory limitations, but some may be the result of (1) how the original Resource Conservation and Recovery Act (RCRA) application was worded or (2) availability of RCRA waste characterizations for a variety of munitions.

Findings and Recommendations: Chapter 6, Regulatory Aspects

Finding 6-3. Public interest group representatives express the need to consider community preferences and site-specific conditions when selecting an alternative technology to implement, install and permit at any of the seven demilitarization depots.

Recommendation 6-1. The Army should investigate whether permits for existing alternative technology units at Army munition demilitarization depots can be amended to be more flexible regarding the types, frequency, and amounts of munitions that can be treated.

Findings and Recommendations: Chapter 6, Regulatory Aspects

Recommendation 6-2. The Army should identify issues that could affect the Resource Conservation and Recovery Act permitting process for alternative technologies, including public concerns, and work with regulators in the states with jurisdiction over the seven demilitarization depots to establish requirements for Subpart X applications (e.g., developing scientific and technical analysis documents, emission modeling and estimates, and efficiency documentation for similar units) so as to address issues and questions before they become a problem that could significantly delay permitting alternative technologies.

Findings and Recommendations: Chapter 7, Applicability of Treatment Types to Munitions

Finding 7-1. Alternatives to open burning (OB) and open detonation (OD) are not being used for some munitions because the munitions have become unstable and are too hazardous for the handling and transportation required for demilitarization using alternative technologies. A determination by the PD Demil that a munition is unstable and potentially shock sensitive is a valid reason for performing demilitarization via OB/OD to minimize transportation and handling and, therefore, the exposure of technicians to the explosive hazard. The capability for OB/OD will always be needed.

Finding 7-2. The configuration of some munitions will require handling and processing steps prior to munitions demilitarization using alternative technologies. This adds complexity to the process, may increase the cost of demilitarization, and may increase risks to workers. These factors will have to be considered when evaluating the use of alternative technologies.

Findings and Recommendations: Chapter 7, Applicability of Treatment Types to Munitions

Finding 7-3. The organic capabilities of the PD Demil and the contractor community have the technical capability—or could develop the capability—to demilitarize nearly all of the munitions in the stockpile using alternative technologies. There will, however, always be some munitions that need to be treated by open burn or open detonation for safety reasons.

Recommendation 7-1. In keeping with stated strategic goal to increase the use of contained disposal, resource recovery, and recycling consistent with continuing to ensure minimal exposure of personnel to explosive safety risks, the Office of the Product Director for Demilitarization should perform a detailed technical and engineering evaluation of the munitions in the inventory currently demilitarized by open burning or open detonation and evaluate appropriate alternative demilitarization technologies for each munition along with an implementation schedule and budget requirements. This detailed evaluation should include the option of shipping munitions and munitions components to other organic or contractor facilities for demilitarization.

Findings and Recommendations: Chapter 8, Technology Assessments

Finding 8-1. Each of the alternative technologies that the committee evaluated as potential replacements for OB and OD would have lower emissions and less of an environmental and public health impact, would be monitorable, and would likely be more acceptable to the public.

Finding 8-2. Throughput capacity for open burning and open detonation and alternative technologies is dependent on many factors, some of which may offset each other. These factors include the capability of the treatment technology, the characteristics of the munition or munition component being treated, and permit restrictions.

Finding 8-3. Most of the alternative technologies that could replace open burning and open detonation are mature and many have already been permitted.

Findings and Recommendations: Chapter 8, Technology Assessments

Finding 8-4. The alternative technologies that could replace open burning (OB) and open detonation (OD) could pose either more or less risk to personnel depending on the munition and on the extent to which munitions handling is required. The safety approvals currently required by the DDESB for both OB/OD and CB and CD and their associated demilitarization processes are adequate to minimize explosive accidents and injuries.

Finding 8-5. Hold-test-release capability is neither necessary nor appropriate for technologies treating conventional munitions and associated wastes because of the difference in acute toxicity between chemical warfare agents and the components of conventional munitions.

Findings and Recommendations: Chapter 8, Technology Assessments

Finding 8-6. The committee requested but was unable to obtain sufficient data to draw general conclusions regarding the relative life cycle costs of OB and OD and the alternative technologies, although the capital (startup) costs of the alternatives will likely be higher while the costs of environmental monitoring and closure will likely be lower. Operating costs of the alternatives appear to vary widely and in some cases may be competitive with OB/OD.

TABLE 8.2: Comparison of OB and Technology Alternatives to OB (Does Not Include Treatment Trains)^a

Technology	Throughput Capacity	Environmental and Public Health Impacts ^c	Personnel Safety ^d	Cost ^e	Maturity and Permitability ^f	Monitorability ^g	Public Confidence in Technology ^h
OB	0	0	0	0	0	0	0
Energetic materials CB	D ^b	+	0	-	0	+	+
Rocket and missile motor CB	D	+	0	-	0	+	+
Bulk Energetics Disposal System CB	D	+	0	-	0	+	+
iSCWO	D	+	0	-	-	+	+
MuniRem	D	+	0	-	-	+	+
Alkaline hydrolysis	D	+	0	-	-	+	+
SDC	D	+	0	-	0	+	+
Rotary kiln incinerators	D	+	0	-	0	+	+ ⁱ
Flashing furnaces	D	+	0	-	0	+	+

Notes are explained after Table 8.3



Table 8.3: Comparison of OD and Technology Alternatives to OD (Does Not Include Treatment Trains)^a

Technology	Throughput Capacity	Environmental and Public Health Impacts ^c	Personnel Safety ^d	Cost ^e	Maturity and Permitability ^f	Monitorability ^g	Public Confidence in Technology ^h
OD	0	0	0	0	0	0	0
CDC	D ^b	+	0	-	0	+	+
DAVINCH	D	+	0	-	0	+	+
SDC	D	+	0	-	0	+	+
Rotary kiln incinerators	D	+	0	-	0	+	+ ⁱ
Decineration furnace	D	+	0	-	0	+	+

Notes are explained after this table

Notes for Tables 8.2 and 8.3

- ^a OB/OD serves as the baseline for comparison with a “0” rating for each criterion, “–” indicates that the alternative technology performs less effectively than OB/OD, “+” indicates that the technology performs better than OB/OD, and “0” indicates the technology is about the same as OB/OD in terms of each criterion.
- ^b D, depends on treatment technology capability, munitions characteristics, and permit restrictions.
- ^c All alternative technologies are enclosed and have lower emissions than OB/OD, so perform better in terms of environmental and public health impacts.
- ^d All alternative technologies are assumed to have been reviewed by the DDESB, so are equivalent in terms of safety.
- ^e Alternative technologies are considered more expensive than the relatively low-tech OB/OD, based solely on the need to site, design, install, and operate new facilities.

Notes for Tables 8.2 and 8.3, *continued*

- ^f Alternative technologies that have been permitted are assumed to be mature and as easy to permit as OB/OD.
- ^g Unlike OB/OD, alternative technologies can be engineered with a PAS, so are more easily monitorable.
- ^h Public confidence is a function of technologies' characteristics and potential risks, as well as people's assessments of their management and related decision-making processes, which are site-specific and difficult to predict, but the committee believes that, in general, alternative technologies may be more acceptable to the public than OB/OD.
- ⁱ Despite the long history of public opposition to incineration, that opposition may no longer apply in specific instances to incinerators with newer state-of-the-art pollution abatement technologies.

Findings and Recommendations: Chapter 9, Barriers and Other Factors

Finding 9-1. There are no significant technical, safety, or regulatory barriers to the full-scale deployment of alternative technologies for the demilitarization of the vast majority of the conventional waste munitions, bulk energetics, and associated wastes.

Finding 9-2. The implementation and use of alternative technologies is a function of how much funding is requested by the Army and how much funding is appropriated, however, both the DoD and the Army have placed a relatively low priority on funding the demilitarization program, including the implementation of additional alternative technologies to replace OB/OD, as reflected in their past budget requests.

Finding 9-3. Uncertainty in the current and future funding levels for demilitarization of conventional munitions is a barrier to the development and increased use of alternatives to OB/OD.

Findings and Recommendations: Chapter 9, Barriers and Other Factors

Finding 9-4. Absent a clear directive from Congress, accompanied by sufficient funding, it will not be possible for the Army to implement full-scale deployment of alternative technologies in lieu of OB/OD.

Recommendation 9-1. To enable the Department of Defense and Congress to decide what level of resources should be devoted to increasing the use of alternative technologies in lieu of open burning (OB) and open detonation (OD), the Office of the Product Director for Demilitarization should prepare an analysis of the full life cycle costs of demilitarization of the munitions in the stockpile using alternative technologies and OB/OD to determine the funding necessary to increase the use of alternative technologies over various periods of time and the impact of that increase on the demilitarization enterprise.

Findings and Recommendations: Chapter 9, Barriers and Other Factors

Finding 9-5. The goals and metrics in the 2018 Demilitarization Strategic Plan are focused on determining whether the program is meeting or exceeding its planned reduction in OB/OD and increase in R3, but they do not set quantitative end points or time tables.

Finding 9-6. PD Demil's stated goal is to increase the use of contained disposal technologies. In addition, the Environmental Protection Agency staff and state staff presentations to the committee indicated an evolving preference to move away from OB/OD. Public interest groups also support the adoption of alternative technologies.

Findings and Recommendations: Chapter 9, Barriers and Other Factors

Finding 9-7. PD Demil has no implementation plan or process for increasing the use of alternative technologies and transitioning away from OB/OD.

Recommendation 9-2. The Office of the Product Director for Demilitarization should develop a detailed implementation plan for transitioning from open burning and open detonation to alternative technologies, with appropriate performance metrics, and institutionalize it throughout the Demilitarization Enterprise.

Finding 9-8. There is a potential that proposals for alternative technologies to replace OB/OD at the stockpile sites could be contested by the public.

Findings and Recommendations: Chapter 9, Barriers and Other Factors

Finding 9-9. The public's acceptance of technologies that they view as being risky may be fostered if the Army adopts more effective public involvement activities. Without proactive attention by PD Demil to the ways that the perception of technology and management are intertwined, public support may be undermined, resulting in delays in full-scale deployment of alternative technologies to replace OB/OD.

Recommendation 9-3. The Office of the Product Director for Demilitarization should, in coordination with the Joint Munitions Command Public and Congressional Affairs Office, include in its implementation plans proactive public affairs activities that build on the experience of other successful programs in resolving public concerns.