

THE HENRY L. STIMSON CENTER

**The U.S. Chemical Weapons
Destruction Program:
Views, Analysis,
and Recommendations**

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Pragmatic steps toward ideal objectives



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Executive Summary

For well over a decade, the U.S. Army has been assembling, testing, and refining a program to destroy the U.S. chemical weapons stockpile, which consists of some 30,000 tons of nerve and blister agents located at eight storage sites in the continental United States. The Army selected high-temperature incineration to do the job. When compared with other alternatives available at the time this decision was made, incineration ranked highest for effective and safe disposal, as well as the ability to complete the task under the deadlines stipulated by Congress to destroy these deteriorating munitions. Since that time, environmentalists have launched a campaign to halt incineration as a method of disposing of hazardous wastes. Therefore, on the eve of inaugurating operations at its first facility in the continental United States, the Army found itself facing strong opposition to its chemical weapons destruction program.

In addition to conducting pilot-scale tests of its incineration technology, known as the "baseline" system, the Army has completed a series of tests at a larger prototype baseline facility on Johnston Atoll in the Pacific Ocean, where a small percentage of the U.S. chemical arsenal is being destroyed. Conducted under the scrutiny of federal regulatory authorities, these tests show the Johnston Atoll baseline facility to have met or exceeded federal pollution control standards. Furthermore, the National Academy of Sciences convened panels of experts to review the Army's baseline program and the feasibility of alternative technologies. Reports from the National Research Council recommended several improvements to the baseline system as well as the pursuit of alternative technologies. The National Research Council advised going ahead with the baseline program based on the conclusion that the increased health and environmental risks of maintaining the stockpile over the extended period of time needed to develop alternative technologies far outweighed the risks of destruction via incineration. Meanwhile, officials from the Army, federal regulatory agencies, and the Council all acknowledge that there have been problems with the baseline system.

Incineration opponents have honed in on those problems, subjecting the Army's efforts to withering scrutiny. Depicting incinerators as "landfills in the sky," the opposition has emphasized its claim that the Army and federal regulatory authorities will allow chemical agents and other toxic by-products of incineration to emerge from the smokestacks of baseline facilities in quantities that will endanger the environment and the health of local populations. Several reports detail the opposition's accusations against incineration in general and the Army's program in particular. Circulation of these reports and other opposition charges have heightened resistance to the Army's program in communities near munitions storage sites.

The opposition has probed virtually every aspect of the baseline program, but the technical underpinnings of its accusations have not received the same degree of examination. Recent peer reviews of the science contained in some of the opposition's reports reveal it to be poor, biased, and lacking in the standards that normally discipline scientific research. In short, incineration opponents appear to be presenting a distorted picture of incineration and the baseline program.

The author recommends that citizens and legislators regard existing scientific claims against the baseline program compiled by advocacy groups with a healthy degree of skepticism. At the same time, citizens and legislators need to continue to press the Army to maintain the highest possible standards of public health and safety while carrying out the baseline program. The author also makes the following recommendations:

- The Army should initiate a more thorough and aggressive effort to state its case and to provide clear and concise information about the baseline system.
- The size and responsibilities of Citizens Advisory Commissions could be increased so that they become meaningful channels of communication between the Army and local communities.
- The Army might consider taking additional steps to enhance public confidence that baseline facilities in fact have only the low level of emissions advertised, including hiring a separate contractor to run the monitoring system at each destruction facility and making funds available to local Citizens Advisory Commissions to retain an independent emissions monitoring consultant.
- Outside of a decision by local communities to allow future uses of baseline facilities, responsible national officials should regularly reaffirm their commitment to destroy these facilities upon completion of their primary task.
- The Army must revitalize and properly administrate the Chemical Stockpile Emergency Preparedness Program to create the viable emergency response capability upon which the decision to destroy the stockpile *in situ* was predicated.

This report is intended to serve multiple purposes. Views of proponents and opponents to the baseline program are presented and an independent analysis of the situation is provided, along with references on the evolution of the destruction program and a bibliography for further reading. The report covers the confusion and controversies over the risk assessment supporting the Army's program; the emergency preparedness programs at the stockpile storage sites; the possible use of baseline facilities for purposes other than stockpile destruction; and the long-running, scientific and technical debate about the desirability of incineration as a method for destroying the stockpile.

While executing the baseline program is an enormously complicated and difficult task, the Army is making unprecedented efforts to build and operate these facilities safely, at considerable cost.

- Baseline incinerators are the only ones in the country to monitor continuously for particulate emissions, in this case for chemical agent emissions. The Army's monitoring levels for nerve agents are roughly 21,000 times stricter than what would be required federally and about 210 times stricter than the tougher emissions standards requested by some states. For mustard agent, the Army's monitoring levels are approximately 415 times stricter than the federal requirement and four times stricter than the more rigorous state emissions standard.
- Baseline incinerators have hundreds more operational checkpoints and safeguards than federal regulations require. A case in point is the Johnston Atoll facility's

deactivation furnace, which destroys explosives and propellants from munitions. The fourteen alarms that federal authorities require for cutting off the waste feed into the incinerator in the event of operational irregularities have been supplemented by another 186 alarms for the Army's own monitoring purposes. These extra alarms give the Army ample information about the incinerator's operation to enable appropriate adjustments to be made to maintain the highest possible level of combustion efficiency.

- Baseline incinerators have other unique features. For instance, after artillery shells and ton containers are processed through the metal parts furnace, they enter an airlock where the air is sampled twice for the presence of residual agent. If agent is detected, the item(s) concerned go back into the furnace for additional treatment. No other incinerator in the country possesses this post-treatment screening safeguard.

Thus, while the Army's baseline program shares some characteristics with other incinerators, it clearly has some uncommon attributes that set it apart from the common stereotype of incinerators.

Citizens and legislators should take this into consideration when making decisions about the chemical weapons destruction program. In addition, they need to give serious thought to the increased risk to local populations that would accrue from long-term storage of the stockpile and the possibility that alternative technologies may offer only marginal safety improvements over baseline. No method used to destroy the stockpile will be inherently risk-free, nor can any method be executed with an absolute guarantee of foolproof operations. Therefore, continuous local and national oversight for the Army's destruction program will be needed.

This report is a product of the Chemical Weapons Convention Implementation Project, which is funded by the Carnegie Corporation of New York. The project's objectives are to serve as an information clearinghouse about the Convention and issues associated with it, as a watchdog over national and international preparations to implement the Convention, and as an advocate for the strongest possible chemical weapons nonproliferation regime.

Preface and Acknowledgements

More than 155 nations, including the United States, have signed the Chemical Weapons Convention, which will prohibit the development, production, stockpiling, and use of chemical weapons. While entry into force of this treaty, which is expected sometime in 1995, would require the elimination of the U.S. chemical weapons stockpile, the U.S. Army has since the mid-1980s been under a congressional mandate to do the same. After studying various disposal options, the Army decided to destroy the stockpile using high-temperature incineration, a process known as the "baseline" system. This decision has sparked vigorous debate and the intense opposition of some national environmental organizations and local citizens in the eight U.S. communities where the stockpile is stored.

As the debate has progressed, local citizens and national legislators have been hit with a barrage of conflicting and confusing information from the baseline system's critics and advocates. This report attempts to clarify the issues surrounding the chemical weapons destruction program, thereby allowing for more informed decision-making.

This report is a product of the Henry L. Stimson Center's Chemical Weapons Convention Implementation Project, funded by the Carnegie Corporation of New York. The Convention is the most significant agreement to stem the proliferation of weapons of mass destruction since the 1968 Nuclear Nonproliferation Treaty. The Stimson Center established this project to monitor the preparations for implementing the treaty and to serve as a watchdog, information clearinghouse, and advocate for the most effective chemical weapons nonproliferation regime possible.

The author wishes to express appreciation to the many individuals who assisted with this study by granting interviews or providing documents. Interviews were conducted with officials of the U.S. Army Chemical Materiel Destruction Agency at the headquarters building at Aberdeen, Maryland, including the Agency's Commander and Director, General Walter L. Busbee; Charles Baronian, who recently retired but was the Program Manager for Chemical Demilitarization at the time of the interview; Public Affairs Chief Marilyn Tischbin; Mark Evans, Special Assistant to the Program Manager; and Edwin Muniz, Task Manager in the Agency's Environmental and Monitoring Division.

The Chairman of the National Research Council's Stockpile Review Committee, Dr. Carl Peterson, and Donald Siebenaler of the Council's staff spoke with the author in Washington. From the Environmental Protection Agency's Office of Solid Waste, the author interviewed Jim Michael and Sonya Sasseville of the Assistance Branch, Permits and State Programs Division. The former is the Chief of the Disposal Technology Section, the latter the Chief of the Alternative Technologies Section. Victoria van Roden, Chief of the Permit Policy and Review Section in the Permits Branch of the Office of Solid Waste was also interviewed in Crystal City, Virginia. A telephone interview was conducted with Y.J. Kim, National Incineration Expert, and Cathy Massimino, Senior Resource Conservation and Recovery Act/Superfund Technical Specialist. These two individuals have been integrally involved in the Environmental Protection Agency's

regulatory oversight of baseline operations at the Johnston Atoll facility. James Everett, Executive Director of Kentucky Disaster and Emergency Services, and DePaul University Law Professor Barry Kellman also granted interviews.

Sebia Hawkins, Greenpeace's Pacific Campaign Director, and Craig Williams, Founder and President of the Kentucky Environmental Foundation, were interviewed in Washington, D.C. Williams graciously extended the author an invitation to attend a meeting of the Chemical Weapons Working Group in Washington, D.C. Likewise, John Nunn, Chairman of the Aberdeen, Maryland, Citizens Advisory Commission invited the author to attend a meeting. Both of these experiences provided valuable insight into the concerns of local citizens. The author conducted telephone interviews with James Harmon of the Anniston, Alabama, Citizens Advisory Commission and The Families Concerned About Nerve Gas Incineration, as well as with Ross Vincent, Chairman of the Sierra Club's National Hazardous Materials Committee and member of the Pueblo, Colorado, Citizens Advisory Commission. The author wishes to thank all of these individuals for patiently sharing their time, views, and expertise.

Harvey Rogers of the Centers for Disease Control and Prevention, James Cudahy, President of Focus Environmental Inc., and Georgetown University Law Professor David A. Koplow all provided the author with early access to documents they were preparing. Tim Dixon, a contractor working for the Public Affairs Office of the Program Manager for Chemical Demilitarization, was extremely helpful in providing access to information and documents about the Army's program.

The author would also like to thank others who contributed to the preparation of this report. As always, Stimson Center President Michael Krepon provided key substantive guidance and a critical reviewer's eye. Vicky Plunkett of Congressman Glen Browder's (D-AL) staff and John Parachini, Executive Director of the Lawyers Alliance for World Security, reviewed two sections of the report, furnishing constructive suggestions. Maureen Lenihan supplied stalwart research assistance, stepping in when Keir Lieber, an equally able aide, concluded his tenure with the Stimson Center. Lenihan quickly grasped the subject matter and made tangible contributions that are reflected most prominently in the report's appendixes. Jane Dorsey joined the effort in its final stages, giving the document its final polish.

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Contents

Executive Summary	<i>iii</i>
Preface and Acknowledgements	<i>vii</i>
List of Tables	<i>xi</i>
List of Figures	<i>xi</i>
List of Abbreviations.....	<i>xii</i>
Introduction	1
Rationale and Structure of the Report	2
The U.S. Chemical Weapons Stockpile and the Baseline Technology	3
Sources of Confusion Regarding the U.S. Chemical Weapons Destruction Program	9
Comparative Risks of One Course of Action Versus Another	10
Risk Assessments: The Army and the Opposition	11
The Chemical Stockpile Emergency Preparedness Program	21
Future Use of the Baseline Facilities	25
Polar Views Concerning Baseline Incineration.....	28
Observations and Recommendations	43
Introduction	43
How It Came To This	43
A Word About Advocacy Science.....	47
Putting Baseline Emissions in Context	53
Legal Storm Clouds on the Horizon	55
Recommendations.....	57
Appendix A: The Baseline Program and Opposition To It:	
An Overview of Charges and Responses	63
Destruction Program Management and Ethics	64
The Operation of the Johnston Atoll Baseline Facility	69
The Risk Assessment Supporting the Army's Decisions	78
Alternatives to the Current Destruction Program	80
The National Academy of Science's Role	88
Appendix B: U.S. Chemical Demilitarization Chronology	95
Sources	103
Appendix C: Selected Bibliography	105
Army, Contractor Documents About JACADS	105
Other Army Documents	107
Congressional Documents	109
Documents From Environmental Groups, Baseline Opponents, and Local Citizens' Groups	110
National Research Council Documents	112
Newsletters and Status Reports	113
Videos	114
Miscellaneous Documents	114

List of Tables

1. Summary of Major Federal Environmental Laws Impacting the Chemical Stockpile Disposal Program.	13
2. Brief Description of Some Suggested Alternative Technologies.	34
3. Monitoring for Just the Destruction and Removal Efficiency versus the Army's Actual Monitoring Standard.	39
4. Products of Incomplete Combustion Screened for in Army Sampling.	42
5. Scientific Peer Reviews of Greenpeace's <i>Playing With Fire</i>	49
6. Destruction and Decontamination Capabilities and Availability of Alternative Technologies.	82

List of Figures

1. The U.S. Chemical Weapons Stockpile Storage Sites.	4
2. A Chemical Munitions Transport Container.	5
3. A Schematic of the Baseline Disassembly and High-Temperature Incineration Process.	6-7
4. Chemical Weapons Storage Igloos.	16
5. The Inside of a Chemical Weapons Storage Igloo.	16
6. A Diagram of the M55 Rocket.	18
7. Risks of Stockpile Storage and Disposal.	19
8. Potential Consequences of Delayed Disposal.	19
9. Storage Locations and Population within 6.2 Miles of Incineration Plants.	22
10. An Aerial View of the Baseline Facility on Johnston Atoll.	31
11. The Tooele Chemical Disposal Facility.	58
12. The Automatic Continuous Air Monitoring System.	75
13. The Role of the National Academy of Sciences in Reviewing the Army's Program.	90
14. The Carbon Filter System for Ventilation at Johnston Atoll.	93

List Of Abbreviations

ACAMS	Automatic Continuous Air Monitoring System
CAC	Citizens Advisory Commission
CAMDS	Chemical Agent Munitions Disposal System
CSEPP	Chemical Stockpile Emergency Preparedness Program
CDC	Centers for Disease Control and Prevention
CWC	Chemical Weapons Convention
DOD	Department of Defense
DRE	Destruction and Removal Efficiency
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAO	General Accounting Office
HHS	Department of Health and Human Services
JACADS	Johnston Atoll Chemical Agent Disposal System
LIC	Liquid Incinerator
MPF	Metal Parts Furnace
NRC	National Research Council
OTA	Office of Technology Assessment
OVT	Operational Verification Test
PCB	Polychlorinated Biphenyls
PICs	Products of Incomplete Combustion
RCRA	Resource Conservation and Recovery Act
TEQ	Toxicity Equivalents

Introduction

How the United States is to destroy safely its Cold War cache of chemical weapons is now a subject of national and international importance. The U.S. Army presently plans to destroy these weapons irreversibly using high-temperature incineration, which is known as the "baseline" program. The Army tested, refined, and retested this technology in hopes of being able to implement the destruction program without strenuous public opposition at the eight different sites in the United States where the weapons are stored. Instead, it ran head-long into staunch opposition to incineration. Having opted to burn the weapons long before a reform-minded environmental movement gave incineration a bad name, the Army was caught off guard. Efforts to explain and defend the baseline program have floundered, and the Army has lost ground to an increasingly vocal opposition. From the onset of the baseline battle, citizens, legislators, and regulators have been caught in a conflicting barrage of information: Nary a statement can be made about the baseline program without challenge.

Two impulses appear to be on a collision course: the need to dispose of the deteriorating chemical weapons stockpile and the need to address concerns raised by those who fear incineration. While technical facts should be the basis for decisions made regarding the baseline program, these circumstances denote the probability that political and emotional elements will also influence decisions at a local and national level. As a staffer working for Senator Orrin Hatch (R-UT) acknowledged, although incineration may be safe, "There's a practical level to this and there's an emotional level. A lot of people react emotionally to incineration, and we have to be concerned with that."¹ As if these circumstances were not complicated enough, the congressional mandate to destroy the weapons may soon be reaffirmed by an international treaty commitment to do the same, putting new stiffness into a completion deadline that has slipped a decade thus far.² The potential for a clash between a national objective and local concerns clearly frames the debate over the chemical weapons destruction program.

As one analyst observed, these circumstances make a difficult environment for decision-making.

This situation presents what might be a classic formula for making a poor social decision, as we have: 1) a clash of scientific

1. This staffer claimed, "There are no politics to this. The senator only wants to do what's right." These remarks were made when Hatch initiated an effort to try to block incineration at Utah's Tooele Army Depot in favor of using alternative technologies, such as electrochemical oxidation. "Senator Pushes Mandate for Army Review of Incineration Alternative," *Defense Environment Alert*, 27 July 1994, 16.

2. The treaty in question is the Chemical Weapons Convention, which is expected to enter into force in the later half of 1995. The Convention, which prohibits the development, production, stockpiling, and use of chemical weapons, carries a ten-year deadline for completing destruction of the chemical weapons stockpiles, but a five-year extension may be requested. The Convention is the culmination of a decades-long effort by the United States and other nations to take constructive steps to ban these weapons and stem their proliferation.

experts, who disagree profoundly on the maturity and risks of incineration technology; 2) a dearth of tested data regarding the feasibility of alternative technologies; 3) powerful, mobilized, and indignant social groups pressing their separate agendas on both sides of the political spectrum; 4) not much time available to make a decision (given the lengthy lead times associated with testing, licensing, and constructing any demolition facilities); 5) international pressures to set a viable precedent for other countries to follow; and 6) elements of law (treaty and statute) weighing on both sides of the scale. Where uncertainty, urgency, and importance lurk together, there may be little elbow room for compromise or wisdom.³

This report has been written to promote more informed decision-making about the U.S. effort to destroy its chemical weapons stockpile.

Rationale and Structure of the Report

Most of those involved in the struggle to either affirm or redirect the course of the U.S. chemical weapons destruction program have a with-'em-or-again-'em attitude. Since there is no middle ground, one runs the risk of being quickly labelled an incineration apologist and an advocate of having federal programs trample local rights or an opponent of incineration, arms control, or government programs in general.⁴ Therefore, this report was designed to function on several levels—as an overview of the problem as perceived by those involved, as a reference document, and as a source of recommendations. These recommendations appear at the end of the report, in chapter three. Throughout the rest of the report, the cases mounted by the contending parties have been presented so that they can either stand or fall based on their own merits.

The second chapter of the report presents a discussion of the reasons for confusion about the chemical weapons destruction program: 1) the comparative risks in keeping the stockpile or in destroying it; 2) the timing and purposes of the Chemical Stockpile Emergency Preparedness Program; 3) the mixed signals from Washington regarding the possibility that baseline's incinerators will be used to destroy materials other than chemical weapons; and 4) the debates over destruction technology that pit experts against experts. The first appendix elaborates some of the issues raised in this chapter, as well as others. This appendix consists of a side-by-side presentation of the arguments made by opponents to the baseline program and the counter-arguments made by the Army, National Research Council, and the Environmental Protection Agency, which operate and oversee it.⁵

3. David A. Koplow, "How Do We Get Rid of These Things?: Dismantling Excess Weapons Under Arms Control Treaties," forthcoming, *Northwestern University Journal of International Law*, 89 (1994).

4. "Combustion apologists" are described by the Sierra Club as "always" referring "to incineration as 'acceptable,' or 'effective,' or 'safe'—even as 'the best' method for dealing with virtually all combustible wastes." Ross Vincent, "The Sierra Club and the Combustion Strategy," *EI Digest Industrial and Hazardous Waste Management*, March 1994, 2.

5. The author is admittedly an advocate of the Chemical Weapons Convention, but has tried to present

The author's opinions are reserved for the third and concluding chapter, which contains observations about the evolution of the controversy, the science being used by incineration opponents to promote their arguments, the context for baseline emissions, and possible legal challenges to the baseline program. This chapter concludes with recommendations for addressing an impasse that may be in the making.

The second appendix presents a chronology of major events in the evolution of the U.S. chemical weapons destruction program. The third appendix is an annotated bibliography of sources, including both supportive and opposing points of view. The remainder of this chapter will be devoted to an overview of the U.S. chemical weapons stockpile and the baseline technology.

The U.S. Chemical Weapons Stockpile and the Baseline Technology

The U.S. chemical weapons stockpile consists of approximately 30,000 tons of nerve and blister agents. Nerve agents, which are particularly lethal, disrupt the nervous system. Exposure to the nerve agents GB or VX can cause a variety of symptoms including drooling, sweating, vomiting, loss of bladder control, headache, confusion, blindness, convulsions, coma, and death. Blister agents, such as mustard gas, attack the skin, respiratory system, and eyes, and cause blistering, blindness, and death.⁶

The stockpile is currently stored at eight continental U.S. sites, as well as at Johnston Atoll in the Pacific. The low-volume sites, or sites with 5 percent or less of the chemical weapons stockpile, are Lexington-Blue Grass Army Depot, Kentucky; Aberdeen Proving Ground, Maryland; Newport Army Ammunition Plant, Indiana; and Johnston Atoll. The sites that store between 5 and 12 percent of the stockpile include: Umatilla Army Depot, Oregon; Pueblo Army Depot, Colorado; Anniston Army Depot, Alabama; and Pine Bluff Arsenal, Arkansas. Tooele Army Depot in Utah is the largest storage site, housing 42 percent of the stockpile.⁷ Figure 1 shows the location of the stockpile sites and the types of agents and munitions at each.

Approximately 60 percent of the chemical agents are kept in non-explosive bulk or ton containers. However, the remainder of the chemical agents are stored in projectiles, rockets, cartridges, bombs, mines, and spray tanks. Fully assembled M55 rockets are the most dangerous items in the stockpile due to the degradation of stabilizers that were incorporated into the rocket propellant to prevent auto-ignition.⁸ The composition of the stockpile is not identical at each site. For instance, the Newport and Aberdeen sites

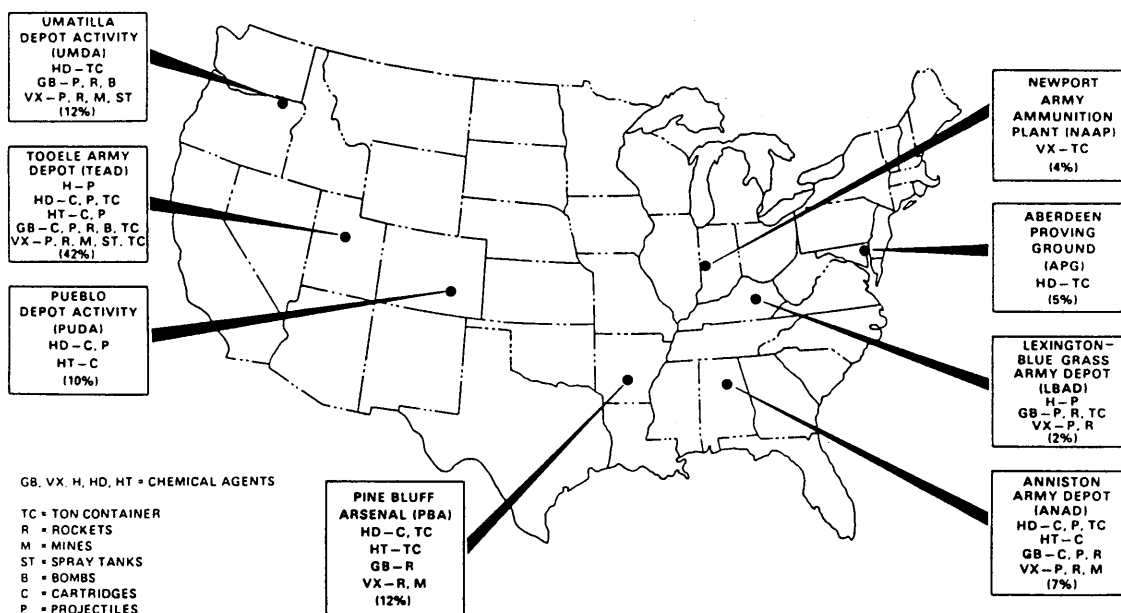
this material in an unbiased fashion. Two individuals who are well acquainted with the U.S. destruction program reviewed chapter two and appendix one for accuracy and absence of the author's bias. The author wishes to thank Vicky Plunkett of Congressman Glen Browder's (D-AL) staff and John Parachini, executive director of the Lawyers Alliance for World Security, for their assistance in this regard.

6. Rodney McElroy, *Briefing Book On Chemical Weapons* (Boston: Council For a Livable World Education Fund, 1989) 3-4.

7. "Chemical Weapons Fact Sheet No. 1" (Washington, D.C.: Committee for National Security, 1994) 2.

8. See pages 15-17 in chapter 2 for more on the M55 instability problem.

Figure 1: The U.S. Chemical Weapons Stockpile Storage Sites.



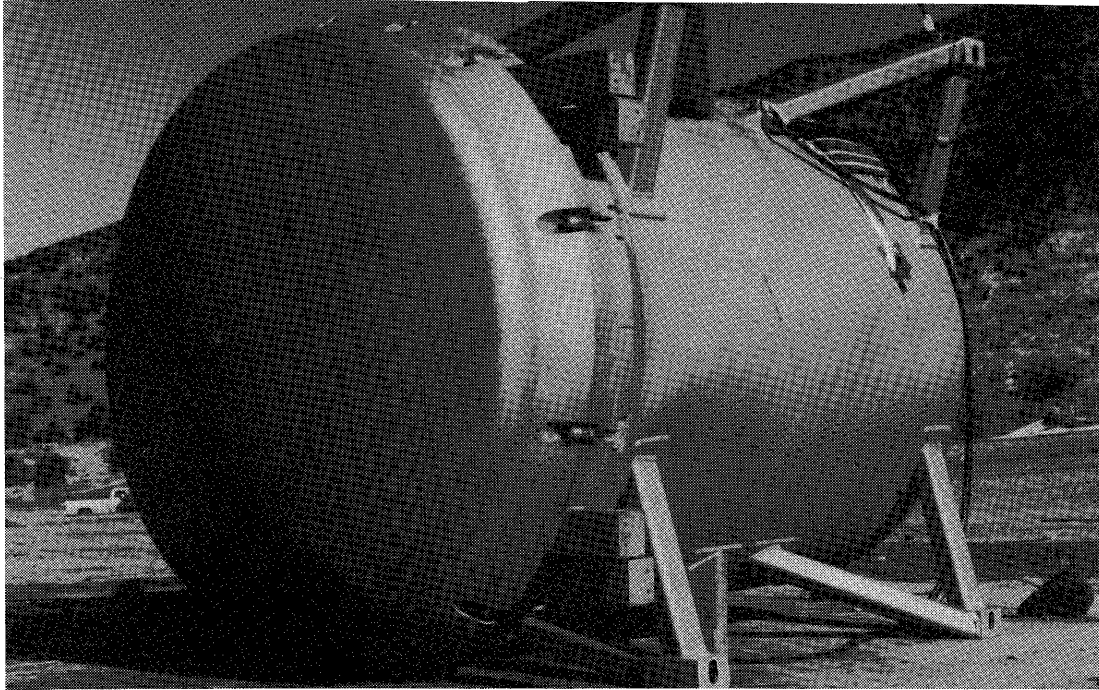
Source: *Final Programmatic Environmental Impact Statement* (Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, January 1988) p. A-5.

have only bulk containers of one chemical agent, but Tooele stores everything from bulk containers to M55 rockets. Accordingly, storage facility requirements differ from site to site.

The baseline incineration system irreversibly transforms chemical weapons into gases and solid residues through exposure to high temperatures. Unlike other disposal alternatives, incineration is capable of destroying an entire chemical weapon inclusive of the chemical agents, explosives, and metal parts. A baseline facility has been built at Tooele and is slated to be constructed at the seven other storage sites.⁹

The destruction process begins with the transportation of the chemical weapons from either storage sheds or earth-covered protective igloos to the baseline facility. The weapons are transported in special containers, which are huge multi-legged barrels. Figure 2 shows one of these transport containers, which are fire-proof, explosion-proof,

9. Descriptions of the baseline process can be found in numerous documents, for example *Johnston Atoll Chemical Agent Disposal System* (U.S. Army Chemical Materiel Destruction Agency, 3 September 1993); *Summary Evaluation of the Johnston Atoll Chemical Agent Disposal System: Operational Verification Testing*, MTR-930000036 (McLean, VA: Mitre, May 1993); *RCRA Trial Burn Report for HD Mustard Ton Containers, Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System* (United Engineers and Constructors, 16 December 1990).

Figure 2: A Chemical Munitions Transport Container.

Photograph courtesy of the U.S. Army Chemical Materiel Destruction Agency.

Note: The transport container can hold a pallet of munitions. Wires are protruding from the rear portion of the container because the photo was taken during testing.

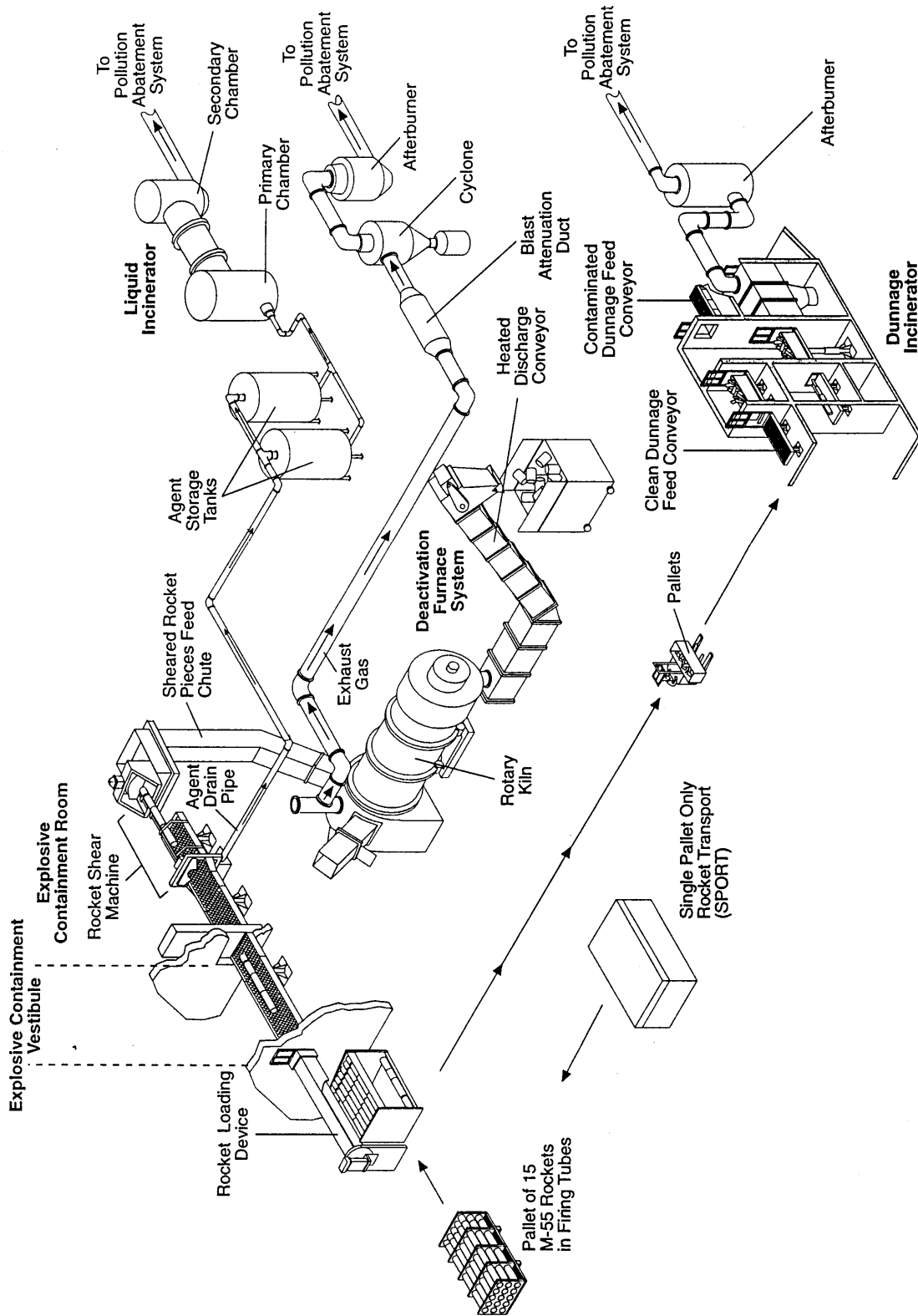
leak-proof, and resistant to force and pressure. In addition, the eight-legged structure ensures that the barrel will always remain standing.

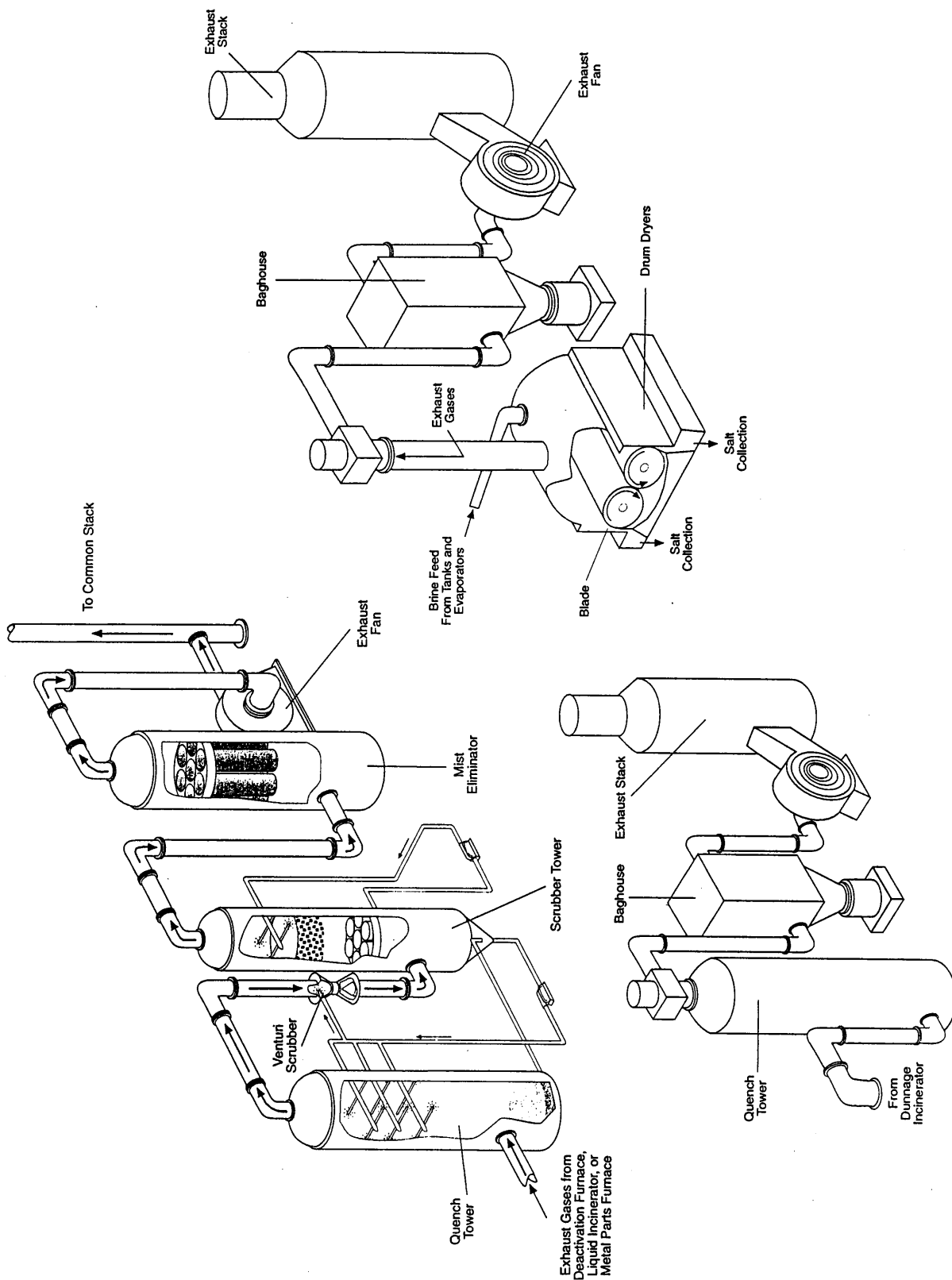
Upon arrival at the destruction facility, the weapons or bulk containers are stored in a holding area until they are ready to be unpacked. Figure 3 presents a diagram of how a pallet of M55 rockets would make its way through the destruction process at a baseline facility. First, if no leaking agent is detected upon unloading the weapons, they are carefully loaded onto a conveyor and sent to a special thick-walled room to be drained of chemical agent and disassembled in an automated process. Since disassembly of the munitions is considered to be an especially dangerous step in the overall destruction process, this room is specifically designed to contain an explosion. A rocket shear machine punches the weapon and drains the agent. The agent is then pumped into storage tanks, while the munition is cut into pieces. Drained agent, munitions pieces, explosives, and packing materials are then incinerated separately in four specialized incinerators.

The agent incinerator burns the drained chemical agent, as well as solutions used for decontamination at the facility. The agent is exposed to 2,700 degrees Fahrenheit in the first combustion chamber and the remaining gases are then sent to a second combustion chamber, known as an afterburner. Exhaust gases then pass through a pollution control system.

The deactivation furnace destroys solid materials such as explosives, rockets, mines and agent-contaminated material. These items are incinerated in a rotary kiln for six

Figure 3: A Schematic of the Baseline Disassembly and High-Temperature Incineration Process.





Source: Process Report for the Johnson Atoll Chemical Agent Disposal System (Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, 3 September 1993) 7, 9.

minutes. Scrap metals and leftover residue receive additional treatment on a heated discharge conveyor belt. The residue from the conveyor belt is emptied into a residue bin, and the exhaust from the kiln goes through a cyclone chamber where any remaining large solid particles are removed. The gases are incinerated in an afterburner before going through the pollution control system.

The metal parts furnace decontaminates bulk containers and munition shells by burning away residual chemical agent. These items are first incinerated in the primary combustion chamber. The scrap metal then enters an airlock where it is tested for any remaining agent before being released for scrap handling. Gases pass through an afterburner before being processed through a pollution control system.

The waste or dunnage furnace destroys wooden pallets used in shipment and other miscellaneous solid wastes. These wastes are treated in the primary incineration chamber. The resulting scrap metal and residual ashes are discharged to an ash hopper. An afterburner processes gases from the primary chamber before they are sent to a pollution control system, where a quench tower cools the gases to 350 degrees Fahrenheit. These gases are then sent to the baghouse where solid particles are filtered through a dry fabric filter.

Exhaust gases for the agent, deactivation, and metal parts incinerators pass through a joint pollution control system. Gases are first cooled to approximately 180 degrees Fahrenheit by a quench tower before entering a venturi scrubber designed to remove 95 percent of all particles measuring larger than 0.5 micron. The gases are then neutralized in a packed bed scrubber and, finally, run through a mist eliminator. As recommended by the National Research Council, a bed of charcoal filters will also be added to the pollution control systems at baseline facilities at continental U.S. sites. The venturi scrubber produces brine, or salt in a water solution, which is removed to the brine reduction area. There, the water is evaporated by a steam heat exchanger and drum dryers, leaving only dried salt. The remaining salt is packed in containers and prepared for disposal at licensed hazardous waste disposal sites.

Sources of Confusion Regarding the U.S. Chemical Weapons Destruction Program

The complexity of the nation's chemical weapons destruction program can lead to confusion regarding one aspect or another of it. For example, those who are unfamiliar with the provisions of the Chemical Weapons Convention may be under the impression that this arms control treaty has dictated the timetable or the methods by which the U.S. stockpile must be destroyed. To the contrary, the Convention, which will ban the development, production, stockpiling, and use of chemical weapons, has yet to enter into force. When it does, all states that join will be required to destroy their chemical weapons stockpiles within a ten-year time frame.¹ A maximum five-year extension can be requested from international authorities if a state is unable to meet the original deadline.² If the treaty enters into force in the latter half of 1995, its time line for the destruction of the U.S. stockpile will coincide roughly with the deadline that Congress has already set for the Army to complete this task. In that case, the treaty deadline would actually fall after the congressional deadline of 31 December 2004.

In addition, the Convention's provisions do not stipulate the exact method of destruction that states must use. The Convention states only that whatever technology is chosen must result in "irreversible" destruction of the agent, be safe for the population, and protect the environment. To that end, the Convention prohibits ocean dumping, burial on land, or open pit burning as methods of destruction.³ To date, therefore, the Convention has not been the driving force behind the time lines or the technologies of the U.S. chemical weapons destruction program.

Uncertainty over the implications of a new arms control treaty is just one of the factors generating confusion about the U.S. destruction program. The remainder of this chapter will address four principal sources of confusion. Several subsidiary issues are

1. The Convention provides an international legal framework whereby chemical weapons will be destroyed and their production banned. States that do not possess chemical weapons will be required to report data and accept inspections that will allow international authorities to monitor whether a nation is trying to evade its treaty obligations. For basic information about the Convention, which has been signed by over 155 countries, see Amy E. Smithson, ed., *The Chemical Weapons Convention Handbook*, 2nd ed. (Washington, D.C.: The Henry L. Stimson Center, September 1993).

2. The impression that the Convention is an obstacle to safe disposal of the U.S. stockpile is not universally held. For instance, baseline critic James Harmon of Anniston, Alabama, noted that the United States can request this five-year extension to give the Army enough time to bring alternative technologies on-line to destroy the U.S. stockpile. Harmon is a member of the Anniston Citizens Advisory Commission and The Families Concerned About Nerve Gas Incineration. Telephone interview with author, 9 August 1994.

3. See *The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction* (Washington, D.C.: U.S. Arms Control and Disarmament Agency, October 1993), Article IV and Part IV (A) of the Annex on Implementation and Verification. See also David A. Koplow, *Some Disassembly Required: Eliminating Chemical Weapons While Protecting the Environment* (Washington, D.C.: Lawyers Alliance for World Security, Committee for National Security, July 1994) 9.

touched upon under each subheading, but the intent of this chapter is to give the reader a feel for the overall issue rather than to provide an exhaustive discussion of all of the subsidiary issues. More detail about the issues broached in this chapter can be found in appendix one. Confusion stems from the discussion of: 1) the comparative risks of the Army's high-temperature "baseline" program versus other courses of action; 2) the emergency preparedness programs at the stockpile storage sites; 3) the potential future use of the baseline facilities; and 4) the long-running, scientific debate about the baseline program.

Comparative Risks of One Course of Action Versus Another

Countless Army reports and concurring National Research Council (NRC) assessments cite pending problems with the safety of the chemical weapons stockpile as a principal reason for proceeding with destruction as soon as possible. At the same time, the Army asserts that it can maintain the stockpile safely until destruction is completed, assuming the baseline program proceeds as planned. The general public also hears from opponents of the Army's baseline program that incineration carries significant risks. Thus, confusion arises as to whether the real risks lie in keeping the stockpile or in destroying it via incineration.

Non-experts have additional difficulties discerning the real level of risk because risks are discussed in terms of probabilities. Webster's defines probability as "the ratio of the number of outcomes in an exhaustive set of equally likely outcomes that produce a given event to the total number of possible outcomes." Those who calculate risks attach caveats, or ranges of uncertainty, to the resulting numbers to atone for unknown factors in the data or weaknesses in the analytical technique. Therefore, a risk calculation expressed numerically as 1:10 might actually be as small as 1:1 or as large as 1:100.⁴

On the topic of uncertainties, one of the Army's reports states: "Although the estimation of uncertainties, itself, is subject to uncertainty, attempts have been made to ensure that the uncertainties and potential for error are consistent and systematic throughout the analysis."⁵ While this assertion does not strike scientists as unusual, it encourages misgivings among the general public. Furthermore, a risk assessment begins with a series of assumptions about the factors likely to cause risk, and since those assumptions are open to dispute, no risk assessment is inviolable.⁶ For those who are

4. Another way to think of this mathematic expression is that if the risk calculation were stated as a dime, it might actually be as great as a dollar or as small as a penny.

5. *Chemical Stockpile Disposal Program: Final Programmatic Environmental Impact Statement*, vol. 3 (Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, January 1988) p. M-14.

6. The Sierra Club, for instance, does not think highly of the risk assessment supporting the baseline program. Risk assessments "attempt with only limited success to estimate the probability of certain specific, clearly definable adverse outcomes—for example, deaths from acute exposure to chemical weapons agent as a result of a major accidental agent release, where some specific amount of agent is assumed to be released, as a result of some specific accident scenario, with the wind blowing in an assumed direction at an assumed speed. The estimates and the models that generate them are often controversial." "Sierra Club Analysis of Dr. Carl Peterson's Recommendations for the Disposal of Chemical Agents and Munitions" (Pueblo, CO: Sierra Club, 26 May 1994) 1.

uncomfortable with statistics or in search of hard facts as the basis for their decision about which course of action is best, risk assessments offer little refuge. Hard facts are elusive, while paradoxical statements abound.

Risk Assessments: The Army and the Opposition

The Army's risk assessment focused on the potential for major accidents to occur while keeping the stockpile, moving it to regional or national destruction centers, or destroying it in place with the baseline technology. The Army classifies risks in two main categories, the first of which is the acute risk of high-level exposure to a chemical agent resulting from an accident, whether during storage, transportation, or destruction operations. Such an accident could result from the explosion of an old rocket, an airplane crash into a storage depot, human error in handling the munitions, or another catastrophic event, such as an earthquake. Secondly, a chronic risk could result from long-term, low-level exposure to agent from routine storage or disposal operations. Also factored into this second category is the risk of exposure to the products of incomplete combustion from the incineration of the agents, munitions, propellants, and other items. The Army's studies conclude that the risk of simply continuing to store the stockpile exceeds the risk of all other alternatives, including destroying it on site with incineration.⁷

One thought that occurs to most people living near the stockpile sites is to move the weapons elsewhere to be destroyed. Many originally pin their hopes on shipping the weapons out of their neighborhoods because it is common knowledge that the Army has transported chemical weapons in the past without a major incident, most recently out of West Germany in July 1990.⁸

The Army considered several transport alternatives, including railroad shipment of all stocks to Tooele, Utah; rail shipment of eastern stocks to Anniston, Alabama, and western stocks to Tooele; and air shipment of the Lexington, Kentucky, and Aberdeen, Maryland, stocks to Tooele.⁹ Although the destruction-on-site alternative consistently

7. The risk of continuing to store the weapons significantly outweighed the risk of destroying them for all stockpile sites except Kentucky, where the risk of continued storage was greater than, but not statistically significant from, the risk of other alternatives considered. Those alternatives were: 1) disposal at a national destruction site (Tooele, Utah); 2) disposal at two regional sites (Tooele and Anniston, Alabama); 3) partial relocation (Lexington-Blue Grass, Kentucky, and Aberdeen, Maryland stocks to Tooele); 4) disposal at the site (risk assumed to come from handling, on-site transport, and plant operations); and 5) "no action" or continued storage for at least twenty-five years (risk from storage and low probability, catastrophic events).

8. *Chemical Warfare: DOD's Successful Effort to Remove U.S. Chemical Weapons From Germany*, GAO/NSIAD-91-105 [Washington, D.C.: General Accounting Office (GAO), February 1991]. For an idea of how local citizens express their concerns and views in this regard, see *Citizen Attitudes on the Destruction and Disposal of Chemical Weapons Stockpiles: A Report from a Series of Community Dialogue Forums on Chemical Weapons* (Washington D.C.: Lawyers Alliance for World Security, the Committee for National Security, July 1994).

9. Railroad shipment of all stocks to Tooele and Anniston would require between 730 to 1,800 miles of transit across five to eleven states. Moving all continental U.S. stocks to Tooele by rail would involve crossing as many as twenty states and along 730 to 2,670 miles of railroad tracks. Airlifting the Lexington and Aberdeen stocks to Tooele would require between 2,100 to 2,700 flights of over 1,500 to 2,060

ranked lower in risk than other options, aspects in the evaluation of human health effects and ecosystem and environmental impacts for the different transport and destruction-on-site options were a statistical wash, given the uncertainty factor of one hundred that was used. Therefore, the Army based its decision to destroy the stocks on site on its confidence that a more viable emergency response capability could be created at eight fixed sites rather than along the entire length of the transportation corridors that may have been used.¹⁰

During the course of its evaluation, the Army crunched numbers for several hundred scenarios depicting what could happen during the course of executing these different alternatives. For example, two scenarios evaluated were “forklift collision accident at storage area leads to detonation” and “a train accident involving a munitions rail car occurs and impact forces fail the agent containment.”¹¹ To address the risks of major agent releases, the Army extrapolated data from laboratory tests with animals, as well as from human exposures during munitions production and on the battlefield. The Army did not conduct an in-depth study of the other risks of incineration, deciding instead to meet the federal and state standards set for operating incinerators.¹² The federal pollution control standards that safeguard public health and the environment, including the Resource Conservation and Recovery Act, the Clean Air Act, the Toxic Substances Control Act, and the Clean Water Act, are summarized in Table 1. This approach did not satisfy the Army’s critics, who characterize the Army’s risk assessment as fundamentally flawed.

Baseline opponents assert that a comprehensive risk assessment would compare the risks of incineration to other destruction methods. Furthermore, it would take into account the long-term effects of the stockpile’s incineration on the environment and the human population through direct exposure or through such avenues as ingestion via the food chain. Such an assessment would address the impact of agent releases and the by-products of incineration.¹³ According to the Sierra Club, “clearly the weapons are

miles. See *Chemical Weapons Disposal: Alternative Technologies* [Washington, D.C.: Office of Technology Assessment (OTA), June 1992] 29.

10. Former Program Manager for Chemical Demilitarization Charles Baronian, interview with author, Aberdeen Proving Ground, 10 May 1994. See *Final Programmatic Environmental Impact Statement*, section 2, vol. 1, and appendices J and M, vol. 3; see also “Record of Decision: Chemical Stockpile Disposal Program,” which states that for the national and regional destruction options, the munitions would have to be shipped through twenty and sixteen states, respectively. James R. Ambrose, Under Secretary of the Army, U.S. Department of the Army, 23 February 1988, 4-5; *Transportation of Chemical Agents and Munitions: A Concept Plan*, SAPEO-CDE-IS-87003 (Aberdeen Proving Ground, MD: Chemical Stockpile Disposal Program, 30 June 1987); *Chemical Weapons Movement History Compilation*, SAPEO-CDE-IS-870 (Aberdeen Proving Ground: Office of the Program Manager for Chemical Munitions, 12 June 1987).

11. See Program Manager for Chemical Demilitarization, *Final Programmatic Environmental Impact Statement*, table J.5, 120-126 of appendix J.

12. *Ibid.*, 4-3, 1-18 to 1-21, appendices B and O.

13. This synopsis of the opposition viewpoint contains only a few of the main criticisms made of the Army’s risk analysis. For more critiques, see appendix one of this report and “Some Flaws of Risk Assessment in the *Final Programmatic Environmental Impact Statement*,” separate critiques by Robert Menefee and Robert Tussey in *The Citizens’ Viewpoint: Citizen Perspectives on The Army’s Plan*

Table 1: Summary of Major Federal Environmental Laws Impacting the Chemical Stockpile Disposal Program.

Date	Law	Provisions
1980	Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. §§ 9601 et seq.)	Addresses hazardous substance releases into the soil, air, surface water and groundwater and regulates the cleanup of these releases.
1977	Clean Water Act (PL 95-217) Amended 1987	Governs potential sources of water pollution and specifically prohibits the discharge of any chemical agent into navigable waters of the U.S.
1976	Resource Conservation and Recovery Act (PL 94-580) Amended 1984; 1986	Regulates the treatment, storage, and disposal of hazardous waste. The chemical agents are either listed or characteristic hazardous wastes at each of the applicable sites.
1976	Toxic Substances Control Act (PL 94-469) Amended 1986; 1988	Regulates the incineration of polychlorinated biphenols (PCBs). The fiberglass matrices of some of the shipping and firing tubes for M55 rockets have been contaminated with PCBs. Toxic Substances Control Act regulations apply during the disposal of these items.
1974	Hazardous Materials Transportation Act (PL 93-63)	Regulates the packaging, marking, loading, and transporting of hazardous materials by road or by rail.
1972	Marine Protection, Search, and Sanctuaries Act (PL 92-532)	Prohibits ocean dumping of chemical weapons.
1970	Clean Air Act (Public Law 91-604 and 95-95) Amended 1977	Governs potential sources of air pollutants and sets emission standards for various pollutants.
1969	National Environmental Policy Act	Requires environmental impact studies for proposed projects that could have a damaging effect on the environment.

Source: *Final Programmatic Environmental Impact Statement* (Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, January 1988) p. 1-15.

safer in their igloos than they are on the surface being handled, disassembled and burned.”¹⁴ The reason is that the process of burning any item—whether it be diesel fuel in a truck, wood in a fireplace, or a drained artillery shell in a baseline incinerator—forms new chemicals, known as “products of incomplete combustion,” or PICs.¹⁵ A report from the environmental watchdog group Greenpeace states that “incineration emissions contain many pollutants that are toxic, persistent, and bioaccumulative. Over months and years, even trace emissions of these substances can reach concentrations in local ecosystems that are acutely and/or chronically harmful to humans as well as many other species.”¹⁶ Governmental and nongovernmental experts alike have only positively identified about 100 PICs, but many more are believed to exist.¹⁷

However, enough is understood about the most well-known PICs, dioxins and furans, to make this a major issue of concern for U.S. Government regulators and independent observers and critics. Dioxins and furans can be produced when chlorinated organic compounds are burned. Dioxins and furans have been linked to cancer, birth defects, and other diseases. One incineration opponent calls the formation of dioxins and furans an “inevitable” result of baseline incineration because of the presence of chlorine or chlorinated compounds in mustard gas, decontamination solutions, and packaging materials.¹⁸ Given the unavoidable presence of PICs, critics of the baseline program argue that the risks of incinerating the chemical weapons stockpile are so significant that other methods of destruction must be found. Baseline opponents suggest a number of candidate technologies that are in varying stages of development, but which they contend could be used to destroy the stockpile more safely.¹⁹

Mitigating the Risks in the Interim

The Army has pledged to try to maintain the safety of the stockpile while destruction is underway. The bedrock of the maintenance program is surveillance and monitoring of the weapons. Soldiers enter storage areas frequently to monitor for leaks and inspect the condition of munitions, containers, and facilities. Any “leakers” are placed in airtight containers. In some instances, soldiers will change mechanical components

To Build A Nerve Agent Incinerator in Madison County, Kentucky (Berea, KY: Kentucky Environmental Foundation, Common Ground, and Concerned Citizens of Madison County, August 1991) 12–15.

14. Sierra Club, “Analysis of Dr. Carl Peterson’s Recommendations,” 3.

15. Causes of incomplete combustion include insufficient temperature, inadequate mixing of the materials, or failure to leave the materials in the incinerator long enough.

16. Pat Costner and Joe Thornton, *Playing With Fire: Hazardous Waste Incineration* (Washington, D.C.: Greenpeace, 1990) 35.

17. Sonya Sasseville of the Environmental Protection Agency (EPA) noted that there could indeed be hundreds or thousands of PICs. “We do not expect to really identify all of them,” she says, just those that are present in the highest concentrations and are the most toxic. Sasseville is chief of the Alternative Technologies Section, Office of Solid Waste. Interview with author, Crystal City, VA, 10 August 1994.

18. Lenny Siegel, *Chemical Weapons Disposal: The Threat at Home* (Boston: National Toxics Campaign Fund, June 1991) 5–6.

19. For a discussion of alternatives to incineration, see Alfred Picardi et al., *Alternative Technologies for the Detoxification of Chemical Weapons: An Information Document* (Washington, D.C.: Greenpeace International, 24 May 1991).

or other items to prevent further corrosion. They also test the rocket and projectile propellants.²⁰ With this effort, Army officials are confident they can keep the situation well in hand. Nonetheless, in the last decade the Army has had to contain over 1800 leaking munitions.²¹ Figures 4 and 5 show typical storage conditions for the chemical weapons stockpile.

The Army stated in 1992 that all of the chemical agents stored in bulk containers, projectiles, cartridges, bombs, spray tanks, and mines were stable and could be safely stored for the next fifteen to twenty years.²² A year later, the Army certified the stockpile's safety only until 2004.²³ Some people may be perturbed by these changing estimates, but the Army is trying to deal with what is, by most accounts, a deteriorating situation.

The main source of concern *within* the stockpile is the M55 rocket, which is stored at five of the eight sites—Lexington, Tooele, Anniston, Umatilla, and Pine Bluff. The M55, which is diagramed in Figure 6, is a fused weapon that contains a burster designed to disperse its ten-pound load of the nerve agents VX or sarin.²⁴ One of the elements in the M55 propellant, nitrocellulose, is unstable and can degrade to the extent that it ignites on its own. When the weapon was manufactured, a stabilizer was added to inhibit the decay of the propellant, but the amount of stabilizer will eventually decline, reviving the threat of auto-ignition. This pending problem is at the root of the entire stockpile disposal program, which began with the intent of destroying the M55s and expanded to incorporate the other munitions as well.²⁵ The M55, which accounts for 65 percent of stockpile leakers, is tested annually to determine the propellant's stability and degree of deterioration.²⁶ Estimates of just when the amount of stabilizer in the M55 will reach unsafe levels have ranged from 1986 to 2010. The Army's analysis points out that the stabilizer used in the M55s might not be as effective as presumed in some studies.²⁷

20. *Annual Status Report on the Disposal of the Lethal Chemical Stockpile* (U.S. Army Chemical Materiel Destruction Agency, Department of the Army, 15 December 1992) 20–23.

21. *Annual Status Report on the Disposal of the Lethal Chemical Stockpile* (U.S. Army Chemical Materiel Destruction Agency, 15 December 1993) 32.

22. U.S. Army Chemical Materiel Destruction Agency, *1992 Annual Status Report*, 23.

23. U.S. Army Chemical Materiel Destruction Agency, *1993 Annual Status Report*, 30.

24. Ten pounds may not sound like much, but a quart jar can hold one million lethal doses of nerve agent. Gordon M. Burck and Charles C. Flowerree, *International Handbook on Chemical Weapons Proliferation* (New York: Greenwood Press, 1991) 6. Thus, the explosion of an M55 round, while an event that the Army characterizes as extremely low probability, could have catastrophic consequences for unprotected civilians.

25. For more on the condition of the M55s, see OTA, *Alternative Technologies*, 7–8; and National Research Council (NRC), *Recommendations for the Disposal of Chemical Agents and Munitions* (Washington, D.C.: National Academy Press, 1994) 46–47.

26. U.S. Army Chemical Materiel Destruction Agency, *1993 Annual Status Report*, 32; *1992 Annual Status Report*, 23.

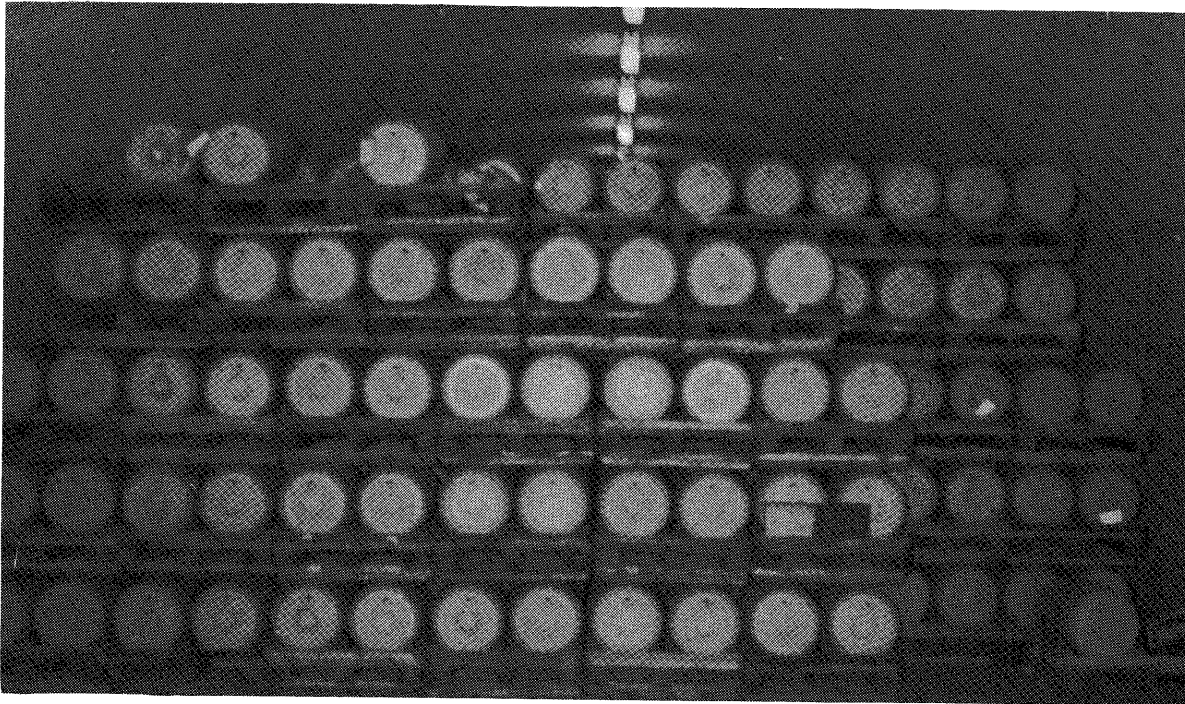
27. In addition to the Army, the OTA, Mitre, and Science Applications International Corporation have tried to estimate the status of the M55s. The NRC requested a new and more definitive study of the M55 rocket propellant problem. NRC, *Recommendations for the Disposal*, 48–51.

Figure 4: Chemical Weapons Storage Igloos.



Photograph courtesy of the U.S. Army Chemical Materiel Destruction Agency.

Figure 5: The Inside of a Chemical Weapons Storage Igloo.



Photograph courtesy of the U.S. Army Chemical Materiel Destruction Agency.

The M55 problem has led both the Army and the NRC to urge in their latest reports that there be no postponements in the destruction program. According to the NRC, "Delays in disposal operations can only increase the already much larger cumulative risk of accidental release from storage; they will extend the chronic risk from storage; and they can add to the risks of disposal as agents and munitions continue to deteriorate."²⁸ Oddly, the instability of the M55s and other problems associated with the stockpile's deterioration were not included in the Army's risk assessment, which concluded, nonetheless, that incinerating the stockpile was safer than keeping it.

Obstacles to the Public's Understanding of Risks

The Army has not really publicized the instability of the M55s. According to General Walter Busbee, commander and director of the U.S. Army Chemical Materiel Destruction Agency:

That is a fine line and we have to walk it carefully. We do not want to scare the bejesus out of every community where these are located, yet we want to be frank and honest with them. Probably over the years, we have not really explained to them the fact that even though their friends and neighbors who work at the depots have not come home with exposure to agent and symptoms, that the potential is there. Every day that goes past that we do not begin reducing that hazard there is a hazard for possible exposure beyond the fence line. The hazard within the fence line is greater than we probably have admitted. The potential for exposure outside the fence line is greater. We have not wanted to go around like Chicken Little screaming, 'The sky is falling.'²⁹

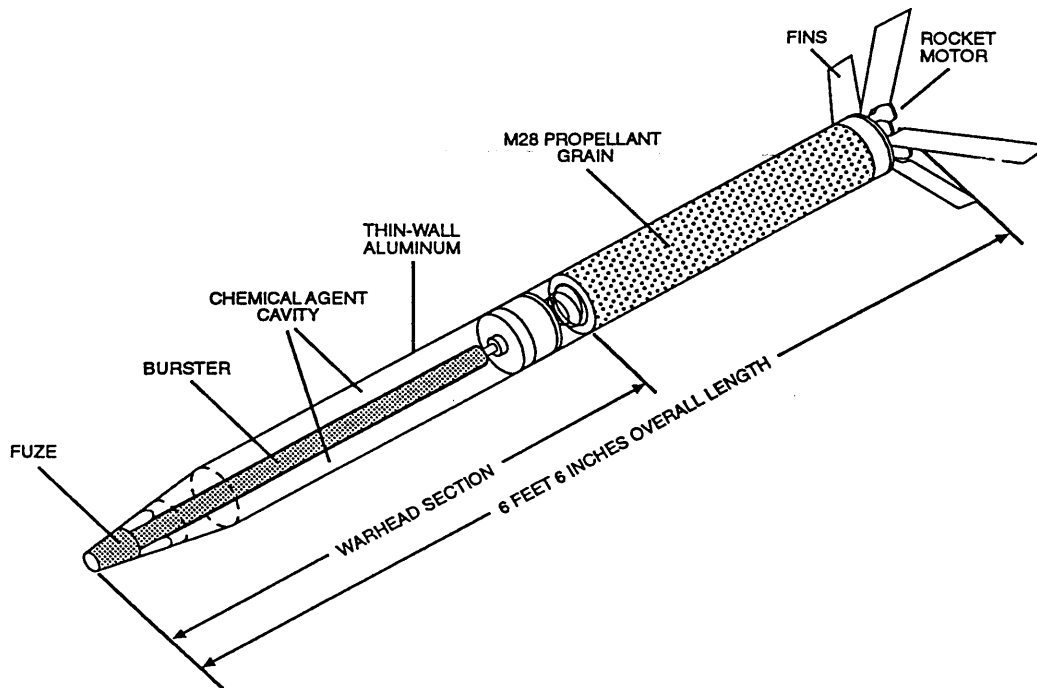
This strategy of understatement may well have been justified in the Army's view. The Army had a program under way to destroy the M55s and was also taking extra precautions to contain the problem in the interim.³⁰ One consequence of the Army's desire not to cause undue public concern, however, is a lack of public appreciation about the relative immediacy and possible catastrophic consequences of long-term storage of

28. Ibid., 11; The Army concurred with the NRC's conclusion that "any reduction in disposal risk afforded by alternative technology will be more than offset by the larger cumulative risk from extended storage." *U.S. Army's Alternative Technology Report for Congress: Executive Summary* (Program Manager for Chemical Demilitarization, Department of the Army, 11 April 1994) 8.

29. Interview with author, Aberdeen Proving Ground, MD, 5 May 1994.

30. All M55 storage areas are air monitored on a weekly basis, and M55 production lots where more than one percent of the production lot have shown some sign of leaking are air monitored daily with extremely sensitive detectors. These monitors can detect agent in concentrations unharmed to an unmasked worker. U.S. Army Chemical Materiel Destruction Agency, *1992 Annual Status Report*, 21, 23. The Army recently announced an even more intensive surveillance program for the M55s and for ton containers containing mustard gas, which may develop more severe leakage problems in warm weather months. *U.S. Army Alternative Technology Report for Congress* (Program Manager for Chemical Demilitarization, 11 April 1994) 3-28.

Figure 6: A Diagram of the M55 Rocket.



Source: *Safety Report for the Johnston Atoll Chemical Agent Disposal System* (Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, 3 September 1993) 5.

the M55s. Stockpile safety—along with concerns about the possible dangers of baseline incinerators and its alternatives—must be the key elements for citizens' decisions regarding the destruction program.

Furthermore, the NRC firmly agrees with the Army's assessment that the risk of indefinite storage—not counting the M55 problem—is forty-five times greater on a daily basis than the risks of incineration. Figures 7 and 8 depict the risk of stockpile storage versus incineration, as well as the additional risks that would accrue if disposal were delayed. On the other hand, the NRC, the nation's most esteemed scientific body, states: "There is certainly no clear indication of increased incidence of cancer, neurological disruptions, or other negative health effects that can be associated with low level, non-symptomatic exposure or long-term proximity to hazardous waste incinerators. Likewise, there is no unequivocal evidence that the risk can be ignored."³¹ Such scientific assessments do not help clarify the risk picture for undecided citizens and legislators.

Despite controversies over incineration, baseline opponents and proponents mostly agree on the top risks associated with destroying the chemical weapons stockpile. For example, Craig Williams, founder and president of the Kentucky Environmental Foundation, gave the following ranking for risks associated with stockpile destruction:

31. NRC, *Recommendations for the Disposal*, 71-72.

- 1) movement of the munitions from storage igloos to any type of treatment facility;
- 2) continued storage of M55 rockets;
- 3) a major, uncontrollable event, such as from a tornado, even though such an event is unlikely;
- 4) low-level exposure to agent over time resulting from the incineration process;
- 5) "fugitive" emissions, or agent leaks that result from storage and handling, and other toxic PICs.³²

The Army's studies show continued storage to be more risky than incineration. These studies also conclude that movement of the munitions from the storage areas to the destruction facility to be the most dangerous aspect of the destruction process. Opponents to the baseline program usually argue their case with such vigor as to give the impression that they believe the risks of incineration outweigh all other risks, when that does not appear to be the case. Evidently, baseline critics and advocates agree on the top two risks, neither of which has anything to do with incineration.

Figure 7: Risks of Stockpile Storage and Disposal.

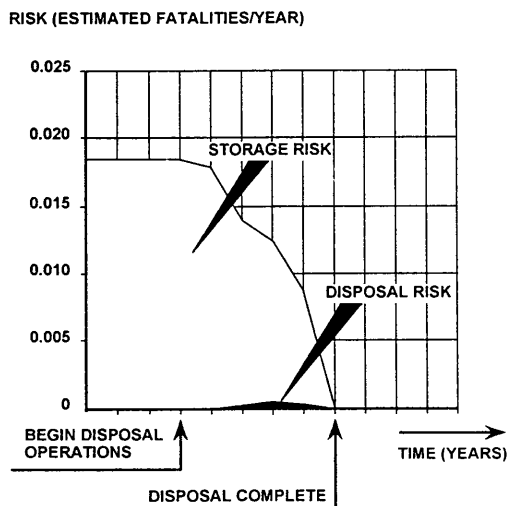
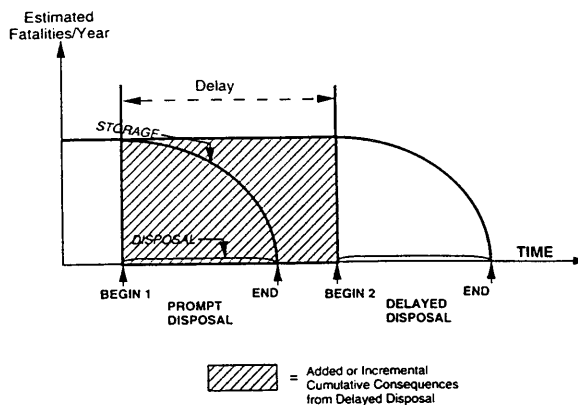


Figure 8: Potential Consequences of Delayed Disposal.



Source: *Recommendations for the Disposal of Chemical Agents and Munitions* (Washington, D.C.: NRC, 1994) 74, 76.

32. Interview with author, Washington, D.C., 19 May 1994.

However, as Greenpeace's Sebia Hawkins noted, local communities favor drilling and draining the munitions on site, which is a decidedly dangerous aspect of the entire operation. According to Hawkins, this situation reveals two things. First, local citizens do not understand the risks as portrayed in Army and NRC reports. Second, the Army does not understand which risks the local communities are willing to tolerate and which ones they will not countenance.³³

Furthermore, answers to the questions posed by baseline opponents will be a long time in coming. First, it could take more than thirty years to complete an exhaustive, authoritative study of the long-term public health effects of a baseline-type incinerator.³⁴ The NRC asked for additional analysis of the latent risks of storage, handling, and disposal activities, but "is confident that site-specific risk analysis will confirm the wisdom of proceeding promptly" with the baseline program.³⁵ Second, the safety of baseline operations cannot be pitted against an unknown. Alternative technologies are not sufficiently mature for a comparative analysis of which would pose a greater health and safety risk.³⁶ The U.S. General Accounting Office (GAO) estimates that the suggested alternative technologies would not be available for full-scale operations until at least 2007.³⁷

In the meantime, federal regulators, as well as state and local officials, are closely watching the Army's performance to see that its plans and operations conform to regulatory standards for human and environmental safety. To that effect, the Environmental Protection Agency (EPA) has publicly stated that the emissions from the Johnston Atoll agent incinerator are the cleanest of any U.S. incinerator.³⁸ The opposition, which tends to find fault with the oversight of the EPA, challenges whether the other three incinerators at each baseline facility can meet similar standards.

As this brief survey suggests, the complexity and competing claims about the chemical weapons destruction program have most citizens ill at ease with making an

33. Hawkins is Greenpeace's Pacific campaign manager. Interview with author, Washington, D.C., 2 March 1994.

34. NRC, *Recommendations for the Disposal*, 69.

35. The NRC recommends that current plans not be delayed until these new risk assessments, which the Army has underway, are completed. NRC, *Recommendations for the Disposal*, 13. See also Program Manager for Chemical Demilitarization, *Executive Summary*, 11.

36. The NRC recommends that as research on alternative technologies progresses, such risk assessments should be made. NRC, *Recommendations for the Disposal*, 13, 71.

37. Moreover, more than one alternative technology may be needed to destroy or decontaminate the various items in the stockpile. *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration*, GAO/NSIAD-94-123 (Washington, D.C.: GAO, March 1994) 5-8. The NRC estimated that nine to twelve years would be needed to develop and demonstrate alternative technologies. See NRC, *Alternative Technologies for the Destruction of Chemical Agents and Munitions* (Washington, D.C.: National Academy Press, 1993) 89-93.

38. The Chief of the EPA's Disposal Technology Section, Permits and State Programs Division of the Office of Solid Waste, Jim Michael, stated that the trial burns show that each of the Johnston Atoll incinerators have met and in most cases surpassed federal standards, achieving destruction removal efficiency ratings of 99.9999 to 99.9999999. Interview with author, Crystal City, VA, 10 August 1994. See also GAO, *Advantages and Disadvantages of Alternatives*, 9.

independent judgment about the course to pursue.³⁹ Intuitive judgments are therefore likely to be as important as any other factors, including the credibility of the experts put forth by the contending sides.

The Chemical Stockpile Emergency Preparedness Program

The Army's Chemical Stockpile Emergency Preparedness Program (CSEPP) is designed to enhance the ability of the Army and local communities to respond to a chemical emergency. Should an accident occur, it could affect the approximately 100,000 people that live or work within a six-mile radius of the stockpile sites.⁴⁰ Figure 9 shows the population concentrations near each storage site. The program would beef up local emergency response capabilities by setting in place plans and personnel tailored to handle the consequences of a chemical agent release. Stores of equipment—everything from communications gear to medical antidotes—would be situated at each site, and specialized training programs would be initiated.⁴¹ CSEPP was envisioned as a prudent initiative to supplement the Army's program to monitor the stockpile closely and thereby contain any problems.

CSEPP was established in 1988 as an offshoot of the Army's Final Programmatic Environmental Impact Statement, a document that essentially explains and justifies the reasons for pursuing destruction at each storage site via the baseline method of high-temperature incineration.⁴² As former Program Manager for Chemical Demilitarization Charles Baronian recalled,

When we wrote the Environmental Impact Statement for this program, we studied the emergency response capabilities in existence at that time. The Army concluded that they were

39. The toll that information barrage has taken on the general public is all too evident. After a Citizens Advisory Commission meeting in Lexington, two women approached Dr. Carl Peterson, chairman of the Stockpile Committee, to argue that they supported "anything but incineration, even if the alternative has more risk." This discussion was witnessed and described by Public Affairs Chief Marilyn Tischbin of the U.S. Army Chemical Materiel Destruction Agency. Interview with author, Aberdeen Proving Ground, MD, 21 July 1994.

40. *Chemical Weapon Stockpile: Army's Emergency Preparedness Program Has Been Slow to Achieve Results*, GAO/NSIAD-94-91 (Washington, D.C.: GAO, February 1994) 2.

41. A CSEPP brochure describes this "vigorous" program and lists its responsibilities as improving emergency preparedness and response plans; providing accurate risk information; educating the public about what to do in the event of a chemical accident; training emergency response personnel; upgrading public alert and warning systems; and conducting emergency exercises. Chemical Stockpile Emergency Preparedness Program, FEMA-211 (Washington, D.C.: Federal Emergency Management Agency, July 1991) 1, 7. See also S.A. Carnes, *Site-Specific Emergency Response Concept Plans for the Chemical Stockpile Disposal Program: A Comparative Summary*, ORNL/TM-11357 (Oak Ridge, TN: Oak Ridge National Laboratory, December 1989).

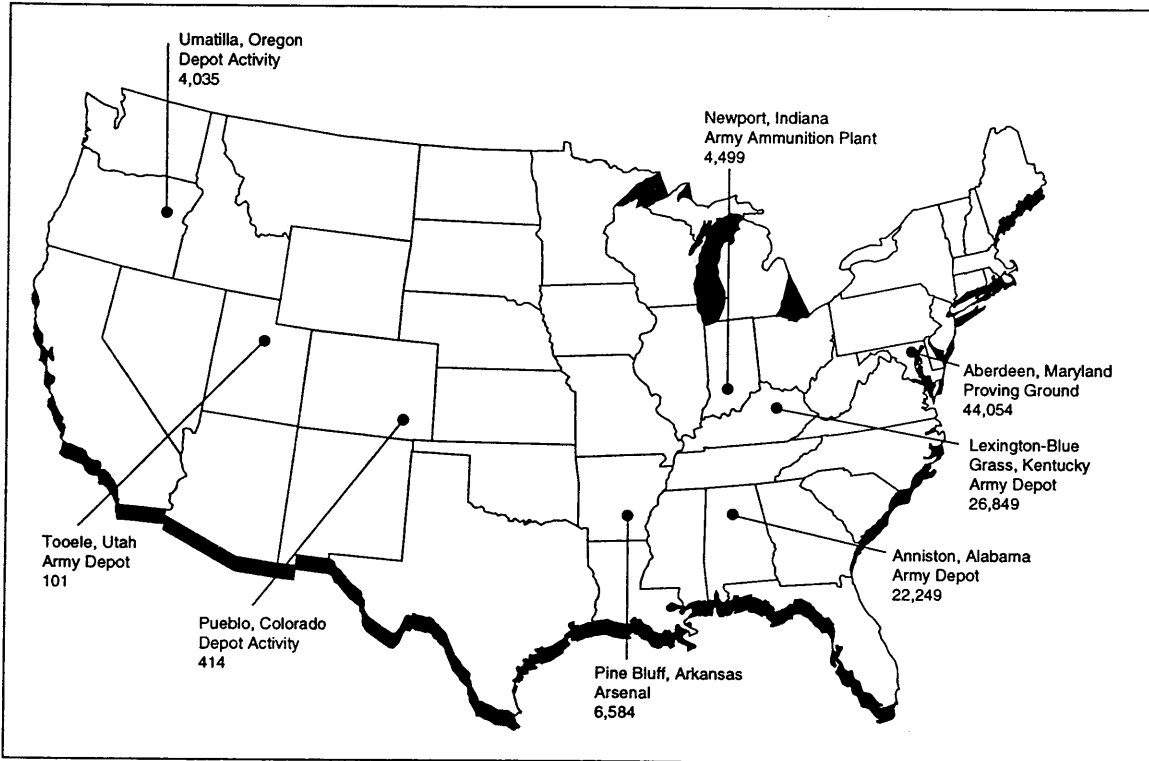
42. The GAO lists three reasons for CSEPP's creation: 1) to upgrade emergency preparedness to mitigate the potential environmental impacts of the destruction program, as required by the National Environmental Policy Act; 2) Congressional direction via Public Law 99-145 requires maximum protection for the public and the environment; and 3) public concerns about emergency preparedness. For an early history of CSEPP, see *Obstacles to the Army's Plan to Destroy the Obsolete U.S. Stockpile*, GAO/NSIAD-90-155 (Washington, D.C.: GAO, May 1990) 29-31.

woefully inadequate. Therefore, the Army decided—not because we were going to incinerate, but because the stockpile existed—to do more and created an emergency response program that would mitigate injuries or fatalities in the event of a stockpile incident.⁴³

Nonetheless, to skeptical local citizens not inclined to accept the Army's explanations at face value, CSEPP looked like a quid pro quo—an emergency response program in exchange for their acceptance of baseline's incinerators.⁴⁴

Lack of progress in achieving CSEPP's goals and high cost overruns have not burnished the program's image. The GAO has heavily criticized the program, which has

Figure 9: Storage Locations and Population within 6.2 miles of Incineration Plants.



Source: *Chemical Weapon Stockpile: Army's Emergency Preparedness Program Has Been Slow to Achieve Results* (Washington, D.C.: GAO, February 1994) 9.

Note: The 6.2 miles roughly corresponds to the area having less than one hour to respond to a chemical agent release. This area, called an immediate response zone, varies by site.

43. Interview with author, 10 May 1994. See also Program Manager for Chemical Demilitarization, *Final Programmatic Environmental Impact Statement*, appendix L, "Generic Emergency Response Concept Plan," L1-L29; U.S. Department of the Army, "Record of Decision," 6-7.

44. Several baseline opponents with whom the author has spoken have expressed this view, as well as their disappointment over the way the CSEPP program has been implemented.

been jointly administered by the Army and the Federal Emergency Management Agency (FEMA). Many of CSEPP's problems stem from this bifurcated management arrangement, according to the GAO. A 3 August 1988 agreement between the two organizations gave the Army the lead in developing integrated emergency response plans and FEMA responsibilities for administering CSEPP funds and working with the states and localities.

GAO criticized CSEPP for being poorly managed, both fiscally and otherwise. FEMA has administered 70 percent of CSEPP funds but according to a FEMA Inspector General report, the agency cannot account accurately for how these monies were spent. FEMA officials claim to "make no decisions in the program," yet CSEPP pays the salaries and benefits of forty-one FEMA oversight personnel.⁴⁵

Costs for the program, which is due to finish in 2003, have risen from a 1988 estimate of \$114 million to \$696 million in 1994.⁴⁶ Another management failure is the tardiness of a key study intended to guide important decisions on emergency response guidance and equipment, causing deadlines for many other important tasks to slip.⁴⁷

The result was that even though CSEPP had consumed about \$200 million by February 1994, "communities near the eight chemical warfare agent storage sites are not yet prepared to respond to a chemical emergency."⁴⁸ Among the unfinished tasks were installation of adequate emergency notification systems, creation of a capacity to evacuate or shelter-in-place the residents in the immediate area, purchase of protective equipment for those responding to the emergency, and establishment of the medical capacity to handle and treat chemical casualties.⁴⁹ Citizens' awareness of the disarray within the CSEPP program may vary from site to site and house to house. However, those who study the situation carefully can paint a disturbing picture.

In the event of a chemical emergency at a stockpile site, local citizens would have to be notified and receive appropriate instructions. In nine counties that the GAO surveyed in Oregon, Washington, Arkansas, Utah, Colorado, and Alabama, sirens and tone alert radios had yet to be installed and tested as of March 1993.⁵⁰ Those living closest to the base will probably have to take shelter in their homes or work places because there will not be enough time to evacuate them. Yet, according to the GAO, the Army has spent comparatively little time working on the shelter-in-place requirements.⁵¹ To the extent that those responding to the emergency are not appropriately protected and well-trained, the quality of the assistance that they can provide will

45. *Chemical Weapons Storage: Communities Are Not Prepared to Respond to Emergencies*, GAO/T-NSIAD-93-18 (Washington, D.C.: GAO, 16 July 1993). Statement of David R. Warren, Testimony before the Subcommittee on Environment, Energy, and Natural Resources Committee on Government Operations of the House, 10.

46. GAO, *Slow to Achieve Results*, 2.

47. GAO, *Communities Not Prepared*, 2, 10.

48. GAO, *Slow to Achieve Results*, 2.

49. GAO, *Communities Not Prepared*, 2.

50. *Ibid.*, 5.

51. *Ibid.*, 6

degrade proportionately. Equipment purchases have been delayed and response procedures have not been completed due to the lack of guidance.⁵² Finally, civilians exposed to agent would need antidotes, but during a full-scale exercise at Tooele, the depot's supply was found to be outdated and supplies at some other sites were inadequate for an accident of any consequence.⁵³

In addition to national FEMA and Army managers, individuals from ten states and thirty-eight counties feed into the CSEPP decision-making process.⁵⁴ Bureaucratic top-heaviness and mismanagement at the national level may account for some of the program's woes, but attitudes and activities at the local levels may be the source of others. Most of the equipment—computers, sirens, medicine—needed to respond to a chemical emergency would be useful for grappling with other man-made or natural disasters. Therefore, according to one congressional staffer, CSEPP represented “a potential wind-fall for these communities.” Local officials, this staffer noted, felt the “need to get as much as they can while the pickin's good.”⁵⁵ While many of the requests from local officials have been predictable and reasonable, others have bordered on the outlandish. For example, the governor of one of the stockpile states reportedly requested a sixteen-wheel, hermetically sealed, mobile command post.⁵⁶

This grim portrait does not apply to all locations, noted James Everett, an emergency disaster official from Kentucky. Had the GAO spoken with any Kentucky officials involved in CSEPP, Everett argued, they would have found a response plan that is tested annually. Nor would fiscal accountability have been a problem. As for another of the Achilles heels identified by the GAO—lack of medical preparedness—Kentucky has hired a CSEPP medical program director to oversee response planning, specialized training, and purchasing of supplies.⁵⁷

While Kentucky may be well on the road to chemical emergency preparedness, the CSEPP program as a whole is undoubtedly in need of tighter managerial controls. However, despite a genesis that roughly coincided with the Army's baseline program, the suspicions that CSEPP is a bribe for accepting incineration are misguided. The Army funds both the CSEPP and baseline programs, but the former is not there to lobby for the latter, said Everett. “Madison County has to be prepared regardless of what destruction technology is used.”⁵⁸ Baronian, formerly the top civilian official for the chemical demilitarization program, heartily concurred with this view. “If I were living in that community—whether incineration, neutralization, or sending it on a rocket to the sun was the method chosen—I would say that emergency preparedness was needed. The

52. GAO, *Slow to Achieve Results*, 14–16.

53. GAO, *Communities Not Prepared*, 8–9.

54. GAO, *Slow to Achieve Results*, 2.

55. Interview with author, Washington, D.C., 26 May 1994.

56. Interview with author, Washington, D.C., 29 April 1994.

57. Everett is executive director of Kentucky's Disaster and Emergency Services. Telephone interview with author, 25 May 1994.

58. Ibid.

major risk to the community is from storage.”⁵⁹ A congressional staffer also agreed. “Whether there is a destruction program or not, 95 percent of CSEPP should be in place because of the existence of the stockpile.”⁶⁰

Future Use of the Baseline Facilities

In 1985, Congress mandated that the Army develop a plan to destroy the nation’s chemical weapons stockpile by 20 September 1994.⁶¹ In 1986, when Congress approved the Army’s recommendation that high-temperature incineration be used to do the job, it added a provision to the law that stipulates that baseline facilities be destroyed upon completion of this task.⁶² This provision was incorporated into the law to reassure those living near these sites that the Army’s facilities would be used to destroy *only* the chemical weapons stockpile.

However, with the price tag per facility estimated at \$160 to \$250 million, there is general skepticism that the baseline facilities will be torn down.⁶³ The Kentucky Environmental Foundation’s Williams said, “It’s very difficult for these people to understand, comprehend, or believe” the Army will tear down state-of-the-art, hardly used, multi-million dollar incinerators. Such an act would be fiscally “insane.”⁶⁴ Ross Vincent, chairman of the Sierra Club’s National Hazardous Materials Committee and a member of the Pueblo, Colorado, Citizens Advisory Commission, concurred that the

59. Interview with the author, 10 May 1994.

60. Interview with author, 26 May 1994.

61. Public Law 99-145 dealt with so-called unitary chemical weapons—those that contain chemical agents that are highly toxic and lethal. Once the Chemical Weapons Convention enters into force, a second category of weapons, binaries, will also be destroyed because the treaty requires the destruction of the entire stockpile. As the term implies, binary weapons consist of two non-lethal chemicals that are separated to enable safer storage and handling. When mixed during the flight to its target, the two chemicals combine to make a highly toxic or lethal agent. The U.S. binary systems are the multiple launch rocket system, the bigeye bomb, and the M687 155 binary projectile. The Army is considering sending some binary chemicals to approved hazardous waste treatment facilities, selling some for industrial use, neutralizing some chemicals, and incinerating others. Final plans have not yet been articulated. See *Non-Stockpile Chemical Materiel Program: Interim Survey and Analysis Report* (Aberdeen Proving Ground, MD: Program Manager for Non-Stockpile Chemical Materiel, U.S. Army Chemical Materiel Destruction Agency, April 1993) 19-21.

62. Public Law 99-145, Title XIV, Part B, Section 1412 (50 USC 1521), (c)(2), 8 November 1985 (Department of Defense Authorization Act, 1986) states: “Facilities constructed to carry out this section may not be used for any purpose other than the destruction of lethal chemical weapons and munitions, and when no longer needed to carry out this section, such facilities shall be cleaned, dismantled, and disposed of in accordance with applicable laws and regulations.”

63. After the issue of the health and environmental hazards posed by incineration, the future use of these facilities was the second most important issue for Greenpeace’s Sebia Hawkins. Interview with author, 2 March 1994. Costs for the construction of baseline facilities were provided by Marilyn Tischbin of the U.S. Army Chemical Materiel Destruction Agency. Interview with author, 21 July 1994. Tischbin noted that construction costs vary from site to site.

64. Interview with author, 19 May 1994. The first several questions in a 31 March 1992 community discussion about the destruction program at Aberdeen Proving Ground pertained to citizens’ worries about the future use of the baseline incinerators. See Lawyers Alliance for World Security, *Citizen Attitudes*, 4-5, 7.

baseline program is the “back door” to permanent waste disposal facilities, adding that the notion that the nation’s largest polluter, the Pentagon, would dismantle these facilities when the Defense Department has such need for them is “not credible.”⁶⁵ James Harmon of Anniston observed that the baseline incinerators would be the equivalent of the Pentagon’s infamous “\$300 toilet seat” and predicted that the American public in general and Congress “will never allow these incinerators to be torn down.”⁶⁶ When asked about future use by an Aberdeen resident, Marilyn Tischbin, speaking on behalf of the U.S. Army Chemical Materiel Destruction Agency, said, “Yes, the law could be changed, there is no doubt about that.”⁶⁷ Local citizens therefore worry that the Army’s chemical weapons destruction program could leave them with permanent hazardous waste disposal facilities, making their communities dumping grounds for other governmental or municipal wastes.

Congress breathed new life into these fears when it later ordered the Army to “investigate and report on the feasibility and desirability of using chemical weapons disposal facilities for other purposes” after the stockpile was destroyed. This November 1989 request came from the Conference Committee of the House and Senate Appropriations Committees, which was searching for ways to hold down federal spending.⁶⁸ Representative Mike Synar (D-OK) typifies the cost-effectiveness sentiment of a congressional overseer who does not have one of the stockpile sites in his home district. During one hearing, he asked, “If the incineration process which they are going to use is so environmentally benign, why would you have to destroy the plant after the weapons are destroyed? Isn’t that an awful waste of money?”⁶⁹ Taxpayers outside of the eight stockpile sites are likely to applaud such congressional cost consciousness, but those fearing a permanent hazardous waste disposal facility as their neighbor react with alarm. Was this study of future uses, they wondered, the first step toward changing the law? This study and other suggestions by reviewers of the Army’s program that future use would be efficient fuelled suspicions that Washington would go back on its word.⁷⁰

65. Vincent added that if alternative technology facilities are built and not torn down after the stockpile is destroyed, such facilities by their very nature are considerably safer than the incinerators and would be far less of a risk to the local communities over the long run. Telephone interview with author, 11 August 1994.

66. Telephone interview with author, 9 August 1994.

67. Lawyers Alliance for World Security, *Citizen Attitudes*, 5.

68. U.S. Congress, House, *1990 Defense Appropriations Conference Report*, 101st Congress, session 1, 101-345, Title VI, 128-129 states: “Under existing law, the Army is required to dismantle and destroy all of the facilities which will be built to destroy chemical weapons and to return the sites to their original condition. The Committee believes that it may be possible or desirable to continue to use these facilities for disposal of other wastes or conventional munitions...The Committee directs the Army to investigate and report on the feasibility and desirability of using chemical weapon disposal facilities for other purposes after the primary mission is completed.”

69. *The Department of Defense’s Chemical Weapons Destruction Program*. Hearing Before the Environment, Energy, and Natural Resources Subcommittee of the Committee on Government Operations, U.S. House of Representatives, 102nd Congress, 2nd Session, 16 June 1992 (Washington, D.C.: U.S. Government Printing Office, 1993) 28.

70. A 1984 NRC report noted the Defense Department’s need to address its hazardous waste problems and suggested that the “life-cycle” of the baseline facilities could be extended if modified to handle these

An independent contractor, Mitre Corporation, was hired to conduct the requested evaluation of possible future use of baseline facilities. Factors considered in the study were the technical capability of the baseline facility to do proposed tasks and the desirability of using a baseline facility for such purposes. Several aspects were included in the desirability analysis: the military or public need for the activity; alternative methods of disposal; regulatory requirements; economic implications (e.g., efficiency, and capital, operating, maintenance, and permit costs); amount of potential feed material; transportation issues; public sentiment, for or against; and uncertainties associated with these elements of the analysis. An evaluation was done for each of the eight sites.

Mitre's January 1991 report concluded that, from a technical standpoint, baseline facilities could also dispose of or decontaminate other Defense Department items, namely the equipment, items, or buildings contaminated with chemical agent; non-stockpile chemical materiel; conventional munitions; contaminated soils; hazardous wastes from hospitals; and other military toxic wastes. Conventional municipal trash could also be processed.⁷¹ However, the desirability analysis pointed toward contrary conclusions. For example, "while it is technically feasible to process most of the feedstocks considered in the demilitarization facilities, in a majority of cases, it is undesirable to do so." Furthermore, the study concluded that future use was "not economically attractive when compared with existing and potential alternative methods...due to the relatively small size of the [baseline] incinerators" and their specialized nature.⁷²

Opponents to the baseline program seized this report, emphasizing the possibility that the desirability portion of Mitre's analysis would be overridden by the technical feasibility factors. The Mitre report, according to the Kentucky Environmental Foundation's Williams, is nothing more than a detailed map on how to bring about future use. He, like other baseline opponents, warned that "laws can be changed."⁷³ Similarly, Harmon of Anniston believed that "the reason for the baseline program is to build the incinerators, but not necessarily for them to destroy chemical weapons. It is to deal with the other military wastes that the Pentagon needs to get rid of." Having said that, Harmon reeled off a list of military bases near Anniston that are saddled with fifty years

wastes. See NRC, *Recommendations for the Disposal*, 68. A 1990 GAO review also said that the baseline facilities "have greater potential uses than current legislation allows. Efficiency would dictate that this expanded use be encouraged" since the Army was planning to build other incinerators to destroy these other wastes. The GAO recommended that the Secretary of Defense seek modification of the legislation if studies proved that baseline facilities could safely and efficiently destroy other hazardous wastes. GAO, *Obstacles to the Army's Plan*, 35.

71. The items in the second category—non-stockpile chemical materiel—must also be disposed of, but are not located at the eight main stockpile sites. These items include buried chemical materiel, recovered chemical weapons, former chemical weapon production facilities, binary chemical weapons, and miscellaneous chemical warfare materiel. The Army documented the locations, types, and quantities of non-stockpile materiel in an April 1993 report. See Program Manager for Non-Stockpile Chemical Materiel, *Interim Survey and Analysis Report*.

72. A.S. Goldfarb et al., *Engineering Analysis for Future Use of Chemical Agent Demilitarization Plants: Feasibility and Desirability*, MTR-91W00010 (McLean, VA: The Mitre Corporation, January 1991) xlii, xlvi. See also Program Manager for Chemical Demilitarization, *Executive Summary*, xv-xlix.

73. Interview with author, 19 May 1994.

of the Cold War's wastes—Fort McClellan, Redstone Arsenal, Fort Benning, Maxwell Air Force Base. Destroying such materials at a baseline facility would be the easy solution, he observed.⁷⁴ Dr. Peter Montague of the Environmental Research Foundation observed that as of mid-June 1992 the Pentagon had identified 14,400 Superfund-type chemically-contaminated sites in need of clean-up operations.⁷⁵

Apprehension that a chemical weapons destruction facility will turn into a permanent, unwanted neighbor was also evident in Canada. People living near the chemical weapons storage facility at Suffield, Alberta, were gravely concerned about the future-use factor. The regulations governing Canada's destruction program, known as Operation Swiftsure, stipulated removal of the incinerator that would be brought in to destroy portions of Canada's stockpile. Nonetheless, anxious members of the local citizens advisory committee requested and received additional written reassurance from Canada's Defence Minister that the incinerator would, indeed, be removed. The incinerator was sold to private industry and taken from the site in June 1992, approximately half a year after destruction was completed.⁷⁶

Polar Views Concerning Baseline Incineration

Underlying the educational campaigns for and against the baseline program are expert views. When experts differ, decades can pass before the scientific community comes to consensus on some issues. For example, prominent scientific debates have recently taken place about ozone depletion, nuclear winter, the Acquired-Immune Deficiency Syndrome, and the greenhouse effect. When scientific debate goes outside a discipline's journals, citizens can be inundated with statistics and data to prove diametrically opposing points.

The Opposition's Viewpoint

Incineration opponents say that incineration worsens and perpetuates mankind's hazardous waste disposal problems. Incinerator operators, they say, are guided by a "dilute and disperse" philosophy.⁷⁷ Translated, this phrase means that incineration breaks down a solid or liquid hazardous waste material and spreads it over the country-

74. Telephone interview with author, 9 August 1994.

75. Lawyers Alliance for World Security, *Citizen Attitudes*, 16.

76. Canadian Department of National Defence, *Project Swiftsure: Citizens' Environmental Protection Committee Report* (Alberta, Canada: Canadian Department of National Defence, July 1992)3-4. Canada's stockpile—12 tons of mustard, 2.5 tons of lewisite, and 0.3 tons of nerve agents—was small in comparison to the U.S. stockpile. The nerve agent and lewisite were neutralized in 1989 and 1991, respectively. The mustard gas, waste from the nerve agent neutralization, and scrap products were incinerated by November 1991 with a transportable incinerator operated by Chem-Security Ltd., a hazardous waste disposal firm from Calgary. See John M. McAndless, "Project Swiftsure Destruction of Chemical Agent Waste at Defence Research Establishment Suffield," Technical Paper 92-74.01 (Presentation at the 85th Annual Meeting & Exhibition of the Air & Waste Management Association, Kansas City, MO, 21-26 June 1992). As for selling or using baseline incinerators for any purposes after the stockpile was destroyed, U.S. Army Chemical Materiel Destruction Agency spokesperson Tischbin noted that "before we, private industry, or anyone could operate a facility, they would have to obtain a permit from the state and go back through the environmental process." Lawyers Alliance for World Security, *Citizen Attitudes*, 7.

77. This phrase was used in Alfred Picardi, et al., *Alternative Technologies*, 1.

side via smokestack emissions.⁷⁸ Regarding the baseline program, a Greenpeace flier states that baseline incinerators “will release small but significant quantities” of chemical agents and that they “create and release highly toxic, persistent, and bioaccumulative by-products, including the ultra-toxic dioxins, furans, and PCBs. These and other organochlorines pose an even greater long-term environmental threat than the weapons themselves.”⁷⁹ This stinging, sweeping indictment charges that the Army’s program is less to eliminate a hazard than to create one.

The essential problem with incineration is that it is not a “closed-loop” system: one cannot “put a cork in the stack,” said baseline opponent Williams.⁸⁰ The consequences, according to a Greenpeace report, are grave. “Cancer, birth defects, reproductive dysfunction, neurological damage, and other health effects are *known* to occur at very low exposures to many of the metals, organochlorines, and other pollutants released by waste-burning facilities.”⁸¹ In other words, the opposition identifies a link between dioxin exposure and significant health problems and points to smokestack emissions as a major source of these harmful pollutants.⁸²

The regulatory measure for the completeness of the destruction process—how much of the hazardous waste is actually obliterated by incineration—is something called the Destruction and Removal Efficiency, or DRE. The common federal requirement for the destruction of most hazardous wastes—and the one that has been set for the chemical agents in the stockpile—is that incinerators must destroy at least 99.99 percent of the waste fed into them.⁸³

78. According to the Sierra Club, “incineration...converts relatively compact liquid and solid wastes into high volume gaseous wastes—some of them more toxic and more bioavailable than the original liquids and solids. It then distributes most of these newly generated gaseous wastes across the countryside—toxics, criteria pollutants, greenhouses gases and all.” Vincent, “Combustion Strategy,” 1.

79. “Chemical Weapons At Home” (Washington, D.C.: Greenpeace, undated) 1. PCBs stands for polychlorinated biphenyls.

80. Interview with author, 19 May 1994.

81. Emphasis added. Costner and Thornton, *Playing with Fire*, 2. See *Idem.*, 35–43 for a more detailed presentation.

82. Although the EPA already places more than thirty different controls on dioxins, a new EPA study classifying dioxins as a probable cause of cancer and other diseases in humans is likely to result in even more restrictions, including restrictions on incinerator emissions. The EPA study states that thirty pounds of dioxins and furans are released annually in the United States. The combustion of wastes is believed to account for 95 percent of that amount, although more data are needed about specific sources of emissions. Gary Lee, “Dioxin Study Spurs Plea for Restrictions,” *The Washington Post*, 14 September 1994, A8; and Gary Lee, “EPA Study Links Dioxin to Cancer,” *The Washington Post*, 12 September 1994, A1.

83. If the waste is “dioxin-listed,” 99.9999 percent must be destroyed. See “Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities,” *Code of Federal Regulations*, part 266, section 104, Standards to Control Organic Emissions, 1 July 1992, 482–485. Federal regulations for the baseline facilities will therefore require that some of the materials processed meet the “six nines” standard. Moreover, since states have the right to set standards that are more rigorous, Kentucky, Utah, Indiana, and Maryland, have stipulated that one or more of the four incinerators will have to meet the more stringent “six nines” standard. Other states are likely to follow suit. For more on the Kentucky’s conditions governing a future baseline facility, see OTA, *Alternative Technologies*, 4–5.

This standard allows a great deal of hazardous materials to be released into the air. According to the Sierra Club, “mere compliance with environmental regulations is better than non-compliance but cannot assure protection” of public health and the environment.⁸⁴ During initial operations of the Army’s prototype baseline facility on Johnston Island, an opposition analyst charges that out of 75,000 pounds of the nerve agent GB put into the liquid incinerator, an estimated 0.008 pounds or over 3.5 grams emerged from the stack. Out of approximately 300,000 pounds of mustard gas incinerated, 3 pounds allegedly escaped.⁸⁵ Moreover, incineration opponents point to two instances when the Army has reported live agent emissions outside of the Johnston Atoll facility, which is shown in Figure 10. They also state concerns about agent emissions within the facility, which indicate carelessness and could have repercussions for the environment and the general population.⁸⁶ Moreover, they question what else might be going on that the Army is not reporting.

Incineration opponents also accuse the Army of not knowing or caring what PICs come out of its stacks. “The Army has lots they don’t identify. It isn’t that these PICs are not there, it’s that they do not look for them.”⁸⁷ According to an opposition coalition called the Chemical Weapons Working Group, “during the Army’s metal parts trial burn, only dioxins, furans and 22 other chemicals were identified, although many others were certain to have been present.”⁸⁸ Opponents also doubt that the data in the Johnston Atoll trial burn reports on PIC emissions tell the true tale.⁸⁹

The EPA establishes whether an incinerator can meet a specified DRE standard by monitoring its performance during “trial burns.” Instruments are placed in the emission stack and detailed chemical analyses are run when the incinerator is operating under worst case conditions, being pushed to its limits. As a result of these tests, the EPA stipulates the parameters under which the incinerator is permitted to operate, including

84. Sierra Club, “Analysis of Dr. Carl Peterson’s Recommendations,” 2.

85. Pat Costner, *Chemical Weapons Demilitarization and Disposal: Johnston Atoll Chemical Disposal System, GB and VX Campaign* (Washington, D.C.: Greenpeace, 12 May 1993) 5.

86. For example, Pat Costner cites thirty-two instances during the trial burn with GB where active agent was present in the facility’s corridors and fifteen instances where agent was present in the life support air system. See Pat Costner, *Chemical Weapons Demilitarization and Disposal: The Army’s Experience At Johnston Atoll Chemical Disposal System* (Washington, D.C.: Greenpeace, 11 April 1993) 2. The Sierra Club states that “there have been no releases of ‘live’ agent from storage, but there have been more than a dozen such releases” from the Johnston Atoll facility. Sierra Club, “Analysis of Dr. Carl Peterson’s Recommendations,” 3. Author’s note: see page 14-15 for information on leak rates during storage.

87. Pat Costner (Presentation to a meeting of the Chemical Weapons Working Group, Washington, D.C., 19 March 1994). See also Pat Costner, *The Incineration of HD Agent at JACADS: MPF Trial Burn and LIC Demonstration Burn* (Washington, D.C.: Greenpeace, 17 March 1994) 18.

88. See “The Citizen’s Solution,” (Berea, Kentucky: Chemical Weapons Working Group, undated) 1.

89. “The nature of these data and the procedures followed during the Army’s sampling and analysis of stack gases for PCDD/Fs suggest strongly, however, that these data do not accurately represent the actual PCDD/F emissions from the MPF during the trial burn.” Costner, *Incineration of HD Agent*, 13. PCDD/Fs are a combination of two products of incomplete combustion, polychlorinated dibenzo-p-dioxins and dibenzofurans. MPF stands for the metal parts furnace, one of a baseline facility’s four incinerators.

Figure 10: An Aerial View of the Baseline Facility on Johnston Atoll.



Photograph courtesy of the U.S. Chemical Materiel Destruction Agency.

how much hazardous waste can be in the incinerator at any one time, how long the waste must reside in the incinerator, the combustion temperature and combustion gas velocity, allowable design and operating variations, and other operational requirements, as needed. If during routine operations any of these parameters are not being met, the Army must stop feeding materials into the incinerator.⁹⁰

According to incineration opponents, "Incinerators rarely, if ever, operate optimally. The temperature of the combustion chamber, the amount of time the waste is in the chamber and the mix of air and waste are critical determinants of complete incineration. Disruption of any one of these factors causes incomplete combustion and can lead to the release of quantities of unburned waste and PICs."⁹¹ The Sierra Club's Vincent agreed, describing incinerators as "very cantankerous critters, highly susceptible to design error or operator mistakes."⁹² The operational record of the Johnston Atoll

90. "Hazardous wastes...must not be fed into the incinerator unless the incinerator is operating within the conditions of operation (temperature, air feed rate, etc.) specified in the permit." Guidelines are also set for the start-up and shut-down of operations. See *Code of Federal Regulations*, Operating Requirements for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, section 264.345, 1 July 1992, 290-291. For a brief description of the trial burn process, see *Environmental Report for the Johnston Atoll Chemical Agent Disposal System: Operational Verification Tests 1 & 2* (U.S. Army Chemical Materiel Destruction Agency, 3 September 1993) 14.

91. Triana Siltan, "Out of the Frying Pan...Chemical Weapons Incineration in the United States." *The Ecologist* 23 (January/February 1993) 19; "During combustion upsets, which occur frequently, greater amounts will be released." See also Greenpeace, "Chemical Weapons At Home," 1.

92. Vincent also stated that incinerators never perform as the designers intend. Telephone interview with author, 11 August 1994.

incinerator, opponents note, is a harbinger of things to come in continental baseline facilities. Alarms indicating agent releases have sounded frequently.⁹³ So often did the alarms sound, the opposition reasons, that the Army's reaction to them became lax, like neighbors failing to react to the boy who cried wolf. At the trial burns, purportedly when the Army was demonstrating its best capabilities for the EPA authorities, the opposition emphasizes that the baseline facility was inoperable more often than not. Reports from one trial burn show that the baseline system failed, on an average, about every six hours.⁹⁴ Baseline opponents point out that the GAO also documented the extensive downtime and maintenance required at Johnston Atoll.⁹⁵ The opposition contends that if the Army cannot get the incinerators to perform well during the limited operations required for these trial burns, the Army can hardly be expected to run baseline incinerators at several U.S. locations properly, simultaneously, year-round, and around-the-clock.

Moreover, baseline opponents question the independence of the "independent" experts brought in to review the Army's program. Many of the reports have been written by the Mitre Corporation and the NRC, but the Kentucky Environmental Foundation's Williams called the relationship between these organizations and the Army "insidious." These reviewers were paid by the Defense Department and therefore put the "best face on a bad situation." Nor did Williams have any confidence in the EPA or the Centers for Disease Control and Prevention, which performs much of the toxicological research underlying U.S. pollution control standards. "The EPA is in the business of permitting people to pollute things" and is responsible for such things as the Agent Orange cover-up and the oversight of an incinerator in Arkansas that opponents contend was "clearly out of regulation." Also, fully at issue "is the military record of environmental stewardship," said Williams.⁹⁶ That record, opponents believe, is badly tarnished.

In sum, baseline opponents argue that the Army lacks a credible record, a credible technology, and credible oversight. The opposition posits that the only rational solution is to develop alternative destruction technologies, some of which are briefly described in Table 2. More stable, closed-loop alternatives that pose no threat from dangerous emissions are available, the opposition claims.⁹⁷ The Army, they contend, is loathe to

93. Costner, *GB and VX Campaigns*, 2.

94. Costner summarizes the operational record of the Johnston incinerator during the trial burn for GB agent as having 500 hours of operation versus 929 hours of cumulative down time. *Ibid.*, 8-9.

95. The GAO noted that the main cause of downtime during the processing of VX rockets was an explosive detonating in the deactivation furnace, creating a hole that had to be repaired. The facility did not operate on thirty-two of the 105 days that it was scheduled to process VX rockets. See *Chemical Weapons Destruction: Issues Affecting Program Cost, Schedule, and Performance*, GAO/NSIAD-93-50 (Washington, D.C.: GAO, January 1993) 22-23.

96. Interview with the author, 19 May 1994. Dr. Peter Montague of the Environmental Research Foundation noted, "The Army has created, presumably inadvertently, thousands of chemically contaminated sites, at least 66 of these are at Aberdeen Proving Ground. Thus, the Army in general, and the Aberdeen staff in particular, have a notably poor record of handling chemicals." Lawyers Alliance for World Security, *Citizen Attitudes*, 16.

97. For more on alternative technologies, see Picardi, et al., *Alternative Technologies*. At a public forum at Aberdeen Proving Ground in August 1992, Greenpeace's Hawkins stated unequivocally that all of the

pursue alternative technologies, having sunk so much money and effort into the baseline process.⁹⁸ All that stands in the way between local citizens and the truly safe destruction of chemical weapons, they conclude, is the will and additional funding to develop alternative technologies. Baseline opponents have proposed a different approach that would, in their view, allow international treaty commitments to be kept. This approach consists of: 1) stopping incineration; 2) disassembling the weapons (separating agents from the munitions); 3) neutralizing the agent; 4) storing the separated components; and 5) developing of alternative, closed-loop technologies to enable final treatment of the neutralized agent and other components.⁹⁹

Local citizens modify this general approach to address the particular characteristics of the stockpile in their midst. For example, in Anniston, local baseline opponent Harmon recommended building the front end of the baseline facility to disassemble the munitions. Harmon recalled that a high-level Army official had told him that by the time this portion of the facility would be built, the Army could be ready to neutralize the GB nerve agent in the M55s, drawing upon their experience from Rocky Mountain disposal operations. While this was being done, research could refine the neutralization approach needed for treating VX and later for mustard. By the time the VX is destroyed, 95 percent of the danger will have been addressed. Officials at Tooele depot have told him that components could be decontaminated with the same solution that is used on Johnston Atoll to clean tools, uniforms, and the facility. Metal parts could thus be decontaminated to the “3X” level and landfilled. The only reason to decontaminate to the “5X” level is to sell the scrap metal, and, Harmon argued, the few million dollars profit that could be gained is not worth the effort or the danger of treating these materials via incineration. Explosives and propellants, though, would probably still be best treated in an incinerator, Harmon said.¹⁰⁰

technologies that Greenpeace had reviewed would “definitely be better than incineration.” Lawyers Alliance for World Security, *Citizen Attitudes*, 26.

98. The Sierra Club firmly supports the development and use of alternative technologies. See “Analysis of Dr. Carl Peterson’s Recommendations” and “Chemical Weapons Resolution,” (Pueblo, CO: Sierra Club, 10 September 1993).

99. Excerpted from a flier entitled “Urge Congress to Pursue the Safe Disposal of Chemical Weapons,” disseminated by the Military Toxics Project on 21 April 1994 and compiled by the Chemical Weapons Working Group; and Craig Williams (Presentation to the Henry L. Stimson Center’s Chemical Weapons Convention Implementation Project Luncheon in Washington, D.C., 21 June 1994). Greenpeace was perhaps the first to conceive of this strategy, which would enable the Convention’s destruction deadlines to be met, by de-linking the demilitarization of the weapons and their final destruction via a variety of alternative closed-loop technologies. See Lawyers Alliance for World Security, *Citizen Attitudes*, 22. The Sierra Club concurs with this approach. “We believe that expedited implementation of safer options—in particular those involving reconfiguration of problem portions of the stockpile (such as the M55s) and neutralization of the agent from those weapons—would produce a dramatic reduction in the risk of continued storage and, ultimately, faster destruction of the stockpile than the Army’s ‘baseline’ approach.” Sierra Club, “Analysis of Dr. Carl Peterson’s Recommendations,” 3.

100. Telephone interview with author, 9 August 1994.

Molten Salt Oxidation	Combines chemical and thermal treatment. Wastes and oxygen are fed into a bath of molten caustic salt—usually sodium carbonate or a mixture of sodium and potassium carbonate. The wastes are oxidized, typically producing emissions of carbon dioxide, water, nitrogen, and oxygen; ash and soot are retained in the melt. Salt can later be removed for disposal or for processing and recycling.
Fluidized Bed Combustion	Uses fluidized, granular solid as heat transfer medium. For chemical agent destruction, solid of choice would be aluminum oxide or calcium oxide. The material is kept suspended by gas flow, which is primarily air.
Molten Metal Pyrolysis	Involves use of metals, such as copper, iron, or cobalt, at 3,000 degrees Fahrenheit, to decompose organic compounds like chemical agent.
Plasma Arc Pyrolysis	Involves passing an electric current through a low-pressure airstream to split chemical agent into its atomic elements in a thermal plasma field at a very high temperature (e.g., 10,000 degrees Fahrenheit).
Steam Gasification	Organic materials are treated with super-heated steam under reducing conditions to produce simple organic molecules. Also known as reformation.
Wet Air Oxidation	Based on the principle that organic compounds can be oxidized slowly at temperatures that are low compared with normal combustion temperatures (e.g., 572 degrees Fahrenheit versus 3,632 degrees Fahrenheit). The oxidation is carried out at high pressure (e.g., 1,000 per square inch in the presence of water).
Supercritical Water Oxidation	Involves mixing chemical agents with water that has been pressurized and heated to a point at which organic compounds become soluble (e.g., above 705 degrees Fahrenheit and at a pressure above 221 atmospheres, or 3,205 pounds per square inch). Solution is oxidized at an elevated temperature, producing carbon dioxide and inorganic acids and salts.
Chemical Neutralization	Involves mixing chemical agents with other substances to form less toxic compounds. An example of this process is hydrolysis—the breakdown of a chemical agent by water.
Biodegradation	Involves the use of enzymes or cellular systems to degrade nerve agents or reaction productions in dilute (approximately 10 percent) aqueous solutions.

Sources: *Chemical Weapons: Issues Involving Destruction Technologies*, GAO/T-NSIAD-94-159 (Washington, D.C.: GAO, 26 April 1994) 10-15; and *U.S. Army's Alternative Demilitarization Technology Report for Congress* (Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, 11 April 1994) table 2.3.2-1, 2-10.

The Army's Viewpoint

Army officials believe that the record of the chemical weapons destruction program, though not flawless, can stand on its own. First, the Army refutes the charge that significant quantities of agent are coming out of the smokestack on Johnston Atoll. Calculations showing over three grams of nerve agent and thirty pounds of mustard agent escaping the Johnston Atoll stacks are, according to the Army, quite misleading because they are based on simple reverse calculations of the DRE. Furthermore, the Army asserts that baseline incinerators destroy even closer to 100 percent of the waste.¹⁰¹ A

101. "In all cases, since no agent was detected in the stack gases during the trial burns, the actual DRE is

survey of other chemical agent incineration programs shows that the highest temperature previously used to destroy chemical agents was 2,192 degrees Fahrenheit.¹⁰² Baseline's incinerators operate at or above the temperatures proven to obliterate agent. Furthermore, the Army keeps materials in the incinerators for a longer time than needed to achieve virtually total destruction of the agent.

Baseline's incinerators differ from regular commercial hazardous waste incinerators in how they treat solid and liquid wastes.¹⁰³ For example, the primary agent incinerator has a minimum operating temperature of 2,600 degrees Fahrenheit, but normally runs at 2,700 degrees Fahrenheit, which is hot enough to destroy agent in 0.42 seconds. The agent remains in the incinerator for one-half of a second and the exhaust gases move to the 2,000 degrees Fahrenheit afterburner for another 1.5 seconds. The total time and heat is enough to destroy the agent four times over. A commercial hazardous waste incinerator treating liquid wastes will usually treat the material for about the same amount of time, but at lesser temperatures. The agent incinerator's temperature is "on the order of about 500 or 600 degrees higher than any other hazardous waste liquid incinerator operating," and therefore, the trial burns show "an above the norm" performance in terms of DRE.¹⁰⁴ (Figure 3 in chapter 1 provides a schematic diagram of a baseline facility for reference purposes.)

The standards used for the metal parts and deactivation furnaces, both of which treat solid materials, also differ from those normally observed in the hazardous waste industry. One differentiating factor is the Army's internal rule for checking processed material to ensure that no agent remains. Another is the Army's practice of incinerating solid wastes that have passed through the primary chamber for at least an extra fifteen minutes of treatment time at 1,000 degrees Fahrenheit or above. As a result, both of these incinerators "are out-performing any of the incinerators we normally see."¹⁰⁵

better (i.e., higher) than the calculated DRE." Mitre, *Summary Evaluation of the Johnston Atoll Chemical Agent Disposal System: Operational Verification Testing*, 3-4.

102. The incinerators used in Canada's project Swiftsure, as well as Britain's and Germany's destruction of mustard agent, operated at this temperature with agent kept in the incinerator an average of two seconds. Another British agent incinerator operated at 1,112 degrees Fahrenheit. See NRC, *Alternative Technologies*, 64-72.

103. Descriptions of the baseline incinerators are available in various Army documents, such as *Process Report for the Johnston Atoll Chemical Agent Disposal System* (U.S. Chemical Materiel Destruction Agency, 3 September 1993). A 12 July 1994 interview at Aberdeen Proving Ground, MD, with Special Assistant to the Program Manger for Chemical Demilitarization Mark Evans also helped the author confirm information in the following paragraphs. Note that the dunnage incinerator operates at about 1,400 degrees Fahrenheit and the items put into it, mostly wooden pallets, are burned to ash. The dunnage incinerator has a 2,000 degree Fahrenheit afterburner to treat exhaust gases. The amount of time materials spend in these incinerators will vary depending upon the quantity of waste fed into them.

104. Most other commercial incinerators operate at around 2,000 to 2,100 degrees Fahrenheit. The first comment was made by the EPA's Y.J. Kim, national incineration expert, and the second by the EPA's Cathy Massimino, senior Resource Conservation and Recovery Act/Superfund technical specialist. Telephone interview with author, 23 August 1994.

105. Massimino, telephone interview with author, 23 August 1994. Kim, also of the EPA, concurred with this statement in the same interview.

Drained munitions and ton containers are handled in the metal parts furnace, which operates at over 1,400 degrees Fahrenheit. Items stay in the three incineration zones of this first chamber for about forty minutes. In contrast, most commercial incinerators treat items for fifteen to thirty minutes. Exhaust gases then go through a 2,000 degree Fahrenheit afterburner, while the projectiles or containers pass into an airlock, where the air is sampled twice to see if any agent is remaining on the items. If detectors register the presence of any agent, the part(s) that did not pass muster are sent back into the incinerator for further treatment.¹⁰⁶ This post-incineration scanning is not used at any other incinerator in the country.

In the deactivation furnace system, propellants and explosives remain in the first incinerator, which operates at 1,300 degrees Fahrenheit, for about six minutes. Exhaust gases then move into a 2,000 degree Fahrenheit afterburner, while the remaining material transfers to a heated conveyer for another fifteen to twenty minutes of treatment at 1,000 degrees Fahrenheit. That latter step is what sets the deactivation furnace system apart from commercial incinerators that treat similar wastes.¹⁰⁷

The second reason that the Army is certain it is destroying more than the DRE is that it sets its detectors to monitor much lower than the DRE, which the Army believes is an inappropriate barometer by which to judge the completeness and safety of incineration. According to former Program Manager for Chemical Demilitarization Baronian,

Efficiency of the combustion is not a good way to measure environmental safety. For example, if I put ten pounds of hazardous material into an incinerator and 90 percent destruction efficiency is desired, that allows me to put one pound of hazardous material up the stack. If I put a million pounds in for this hypothetical 90 percent destruction efficiency requirement, then I can put 100 pounds of hazardous material out the stack. With this approach, efficiency stays the same no matter how much you put in. The Army rejected this as an environmentally safe principle or way of going about this. The Army instead sets standards for the stack and monitors against them, regardless of whether one pound or 1,000 pounds goes into the incinerator. In the case of GB, we are measuring for agent at a parts per trillion level instead of for some magic efficiency number. Whether we are putting a pound in or ten thousand pounds in, we still have the same requirement for no agent to come out of the stack and that is what we monitor.¹⁰⁸

106. Note that minimum treatment time in the first incinerator is at least thirty minutes. The EPA's Kim and Massimino, telephone interview with author, 23 August 1994.

107. Ibid.

108. Interview with author, 10 May 1994.

The microscopic amounts of agent for which the Army monitors are therefore not based upon the DRE, but upon much stricter standards that the Army, with its unique expertise in agent exposure, determined with the assistance and approval of the Department of Health and Human Services (HHS), notably with the Surgeon General's Office and the Centers for Disease Control's toxicology experts.

These standards are set to levels substantially below the amount that could cause adverse health problems for the general public, whether from acute or long-term, direct or indirect exposure.¹⁰⁹ These standards are expressed in two terms, the Allowable Stack Concentration and the General Population Limit.¹¹⁰ The standards are set so rigorously so that if they are tripped, the Army has time to take corrective measures to prevent a release of real significance. Furthermore, the Army lowers the action levels even further by setting its agent monitors to go off if they detect twenty percent of the Allowable Stack Concentration.¹¹¹

Columns two and three of Table 3 show where these agent detectors would have been set if the Army were monitoring just for DRE-level agent emissions. The Army's detection standard for nerve agents is roughly 21,000 times more stringent than the monitoring level needed to demonstrate the basic federal DRE and about 210 times stricter than the monitoring level for the 99.9999 percent removal standard. When monitoring for mustard agent emissions, the Army's monitors are approximately 416 times stricter than the federal DRE and four times stricter than the 99.9999 standard for mustard. Even with monitoring levels that are much more stringent than required, agent monitors tracking emissions on Johnston Atoll have detected *no agent coming out of the stack while the incinerators were operating.*¹¹²

The Army's agent detectors screen the air continuously, the bulk of them operating on sample cycles that vary from three to ten minutes. For U.S. facilities, the specific number of perimeter detectors will be determined based mostly upon a site's topography and prevailing winds. Because they are set to such a low level, other elements, known as "interferents," can trigger an alarm. This approach has led to a high number of alarms on Johnston Atoll. When further analysis reveals that agent was not present and that

109. After public review and comment, the HHS announced these standards in the *Federal Register*, vol. 53, no. 50, 15 March 1988, 8504-8507.

110. The Allowable Stack Concentration refers to how much agent can be present in the emissions in the smokestack. The General Population Limit refers to how much agent could be present outside the facility, taking into account wind conditions. These extremely minute quantities are far below the exposure level that would cause harm. See Table 3.

111. According to the EPA's Kim and Massimino, no other incinerator in the United States has an Allowable Stack Concentration or this type of direct, continuous monitoring for emissions of concern. Other incinerators monitor for PICs by monitoring carbon monoxide and hydrocarbon emissions. Carbon monoxide monitoring is an indicator of "whether or not you are getting good combustion," said Massimino. If the carbon monoxide level is low, the combustion efficiency is high, and studies have shown that the relative concentration of PICs is also at a low level. Baseline incinerators also have carbon monoxide and hydrocarbon monitors. Telephone interview with author, 23 August 1994.

112. The Johnston Atoll facility has ninety-one monitors inside and twelve around the perimeter, placed according to prevailing wind patterns. See Mitre, *Summary Evaluation*, 3-4, 1-7.

something else caused the monitor to go off, these alarms are known as “false positives.”¹¹³

When establishing its monitoring policy, Army officials observed matter-of-factly that they were in a catch-22 situation. The Army could have set the agent monitors to a higher level and gotten fewer alarms. Had they opted for this choice, the Army would have been open to charges that low-level, but still detectable emissions were taking place below this higher threshold. They chose instead to set the monitors to much lower detection thresholds, knowing that the number of false positives would be high.

The previously noted two agent releases on Johnston Atoll took place while the incinerators were *not* in operation. One incident occurred on 8 December 1990 when an incinerator was cooling after it was shut down; another on 24 March 1994 when the incinerator was shut down for routine maintenance. In both instances, agent was detected in the stack but not by the perimeter monitors. After investigation, the Army and federal regulators determined that these incidents did not result in a health risk. In addition, a number of procedures used in shutting down and maintaining the agent incinerator were changed to prevent similar incidents in the future.¹¹⁴ The Army's reports also detail other occasions when agent was present *within* the facility. Designers understood that munitions would be handled and disassembled within this facility, so they instituted redundant containment mechanisms, including ventilation and filter systems that induce negative air flow, airlocks, explosive-containment walls, and special partitions that keep situations such as interior agent releases in check.¹¹⁵

The number of problems encountered on Johnston Atoll, however, should be placed in context. The Army's experience with this prototype baseline facility has been consistent with expectations. Other types of sophisticated industrial plants have similar problems in their initial operational phases. Research shows that in the first three

113. Two different types of monitors, each with backups, are placed at each incinerator and in the common exhaust stack, according to Mark Evans, a civilian official with the chemical demilitarization program. One type of detector provides near-real time monitoring by sampling every three to ten minutes, while the other type of detector samples over a period of several hours. These monitors are tested frequently with live agent to ensure that they are working properly, Evans said. Common stack monitors are challenged with live agent every four hours. Evans and Edwin Muniz, task manager in the Environmental and Monitoring Division of the Chemical Materiel Destruction Agency, interviews with author, Aberdeen Proving Ground, MD, 21 July 1994.

114. The first incident entailed an agent release that was 22 percent of an allowable release concentration from the stack, while the second was found to be 0.032 percent of the limit for a release to the general population. Officials from the HHS and the EPA concurred that these incidents did not present a significant public health risk. See Mitre, *Summary Evaluation*, B-1; “Risk Assessment Survey News Release” (Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, 25 March 1994); Gregory W. St. Pierre, *Johnston Atoll Chemical Agent Disposal System: Report of the 23 March 1994 Chemical Agent (GB) Release from the Common Stack* (Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, March 1994).

115. See Program Manager for Chemical Demilitarization, *Final Programmatic Environmental Impact Statement*, “Demilitarization Plant Design,” C-5 of appendix C. Many of the problems with the migration of agent within the Johnston facility were due to a plant design that did not incorporate the rooms in which the furnaces are housed within the facility's cascaded air filtration system. The design for U.S. facilities has been changed to minimize this problem. Evans, interview with author, 21 July 1994.

Table 3: Monitoring for Just the Destruction and Removal Efficiency versus the Army's Actual Monitoring Standard.

	Monitoring Level for 99.99% Destruction and Removal Efficiency^a	Monitoring Level for 99.9999% Destruction and Removal Efficiency^a	General Population Limit	Allowable Stack Concentration	Actual Stack Monitoring Levels
Nerve Agent GB	1.26mg/m ³	0.0126mg/m ³	0.000003mg/m ³	0.0003mg/m ³	0.00006mg/m ³
Nerve Agent VX	1.26mg/m ³	0.0126mg/m ³	0.000003mg/m ³	0.0003mg/m ³	0.00006mg/m ³
Mustard HD	2.5mg/m ³	0.025mg/m ³	0.0001mg/m ³	0.03mg/m ³	0.006mg/m ³

^aThe author asked the Army's assistance in calculating monitoring levels for columns two and three to enable a comparison. Edwin Muniz, task manager in the Environmental Monitoring Division of the U.S. Chemical Materiel Destruction Agency, calculated the DRE for nerve agents in the liquid incinerator based upon a feed rate of 700 pounds per hour, the average at the Johnston Atoll facility, and a volumetric flow rate of 14,800 actual cubic feet per minute of gases coming out of the stack. For mustard, he used a feed rate of 1,320 pounds per hour, the average at Johnston Atoll, and a volumetric flow rate of 13,820 actual cubic feet per minute of gases emerging from the stack.

Note: mg/m³ means milligrams per cubic meter.

months of operation, production at similar plants averaged only about 40 percent of design expectations, while fully 50 percent of these pilot plants did not meet their production goals in the seven to twelve months after operations were initiated. Factors influencing this poor performance rate included the use of new technology or the scale of the technical innovations.¹¹⁶ Both of these factors clearly contributed to down time in the Johnston Atoll facility.

The Army will never be able to provide incineration opponents with the type of *absolute* guarantees they seek for the operation of baseline facilities.¹¹⁷ Any time humans interact with complex equipment, the possibility of error exists. To prevent any errors that might happen from having significant consequences for the public or the environment, the Army states that it has built numerous redundancies and safeguards into the baseline facility.¹¹⁸ Furthermore, when the Army has had problems with the baseline

116. The types of plants studied were first-of-a-kind process plants from the chemical, oil, minerals, and design services industries. The report concludes that "poor plant performance...occurs when new technology is being introduced for the first time..., when waste handling difficulties are involved, and fairly consistently when the plant engages in solids processing." See Edward W. Merrow, Kenneth E. Phillips, and Christopher W. Myers, *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants*, R-2569 DOE (Washington, D.C.: RAND, September 1981) vi, 65-83.

117. Nor, the Army states, are there any guarantees that an alternative technology will be safer. Or, as David Koplow points out, "there is no certainty that" an alternative technology "would be any more free of legal, technological, ecological, financial or other telling defects, or that it would attract unanimous political support from affected communities." Koplow, *Some Disassembly Required*, 12.

118. The Army's specialized operator training programs, at a mock facility and also on-the-job, also discipline baseline operators to take steps to minimize any errors that occur. Within seconds of any alarm detecting any agent emissions, corrective and additional containment measures are taken by control room operators and other personnel. For example, during the 23 March 1994 incident, control room operators

system, it has not ignored them. The Army has reacted constructively, investigating the causes and instituting remedial procedures, whether in refining equipment design or operator training.¹¹⁹ Incineration opponents emphasize the Army's mistakes but give little, if any, credit for the corrective steps taken in their aftermath.

The Army uses a computer system to regulate the operational parameters of the incinerators.¹²⁰ Computer readouts on the various operational parameters of each incinerator, which are taken every nine seconds to ten minutes, are watched by several control room technicians.¹²¹ If, for example, the readings for carbon dioxide, carbon monoxide, temperature, or agent are not within the stated parameters, the operators immediately stop feeding materials into the incinerator. In such situations, the fuel feed into the incinerator is increased to maintain the required temperature long enough to complete the destruction process. Moreover, each incinerator has an afterburner, a second incinerator, that serves as a backup and ensures that, at the very least, the required DRE is achieved. Emissions pass through a complex pollution control system, which, upon the recommendation of the NRC, will be augmented by a bed of charcoal filters as an extra precaution to preclude agent emissions in the event of upset operating conditions.¹²² These charcoal filters will function like a sponge, soaking up the elements—whether agent or other combustion by-products—that manage to make it through the two incinerators and the first several steps of the pollution control system. The Army believes that adhering to operational guidelines, in combination with the safeguarding redundancies built throughout the baseline facility, thoroughly address the problem of upset operating conditions.

Finally, the Army is puzzled by the charge that they are not screening emissions for PICs. Federal standards actually would have required the Army to test just for a small number of heavy metals and particulates. The Army decided, however, to sample emissions in each trial burn for more than 130 PICs. When the Army informed the EPA

seeing agent detection alarms go off at 10:51pm began that same minute to issue a series of commands to site personnel to evaluate and safely contain the situation. See St. Pierre, *23 March 1994 Chemical Agent (GB) Release*, 3–4.

119. Continental U.S. destruction sites will benefit from the improvements and the lessons learned from the Johnston Atoll experience. See Program Manager for Chemical Demilitarization, *Executive Summary*, 3.

120. The EPA requires that temperature, waste feed rate, combustion gas velocity, and other relevant controls be monitored continuously, checked at least every fifteen minutes. The incinerator, associated equipment, and alarms must receive at least daily inspection. See *Code of Federal Regulations*, "Operating Requirements for Owners of Hazardous Waste Treatment, Storage and Disposal Facilities," section 264.345, 1 July 1992, 422.

121. Thermocouples measure the incinerator's temperature every nine seconds, while the Automatic Continuous Air Monitoring System detectors are set on cycles of ten minute or less. During operations, the parameters for each incinerator are watched by one dedicated technician. In addition, a technician monitors utilities such as electricity and fuel. Others watch the processing of materials before they reach the incinerator (e.g., the rocket shear machine) and the pollution control system. Finally, a supervisor and superintendent are always on duty. As many as ten technicians may be in the control room during operations, depending on what type of munitions is being destroyed. Evans, interview with author, 21 July 1994.

122. NRC, *Alternative Technologies*, 205.

of its plans to test additionally for volatile and semi-volatile PICs and dioxins and furans, the EPA in turn made those tests a requirement for the permits on Johnston Atoll.¹²³ Table 4 details the type and number of PICs that the Army screened for in each trial burn. For example, in the third operational verification test, where mustard was incinerated in ton containers, screening for dioxin/furan isomers was more intensive because one of the largest components of mustard is chlorine, a likely producer of dioxins/furans when burned.

The Army notes that the majority of the PICs tested for were not detected. Any PICs detected were factored into analyses that concluded that the total chronic health effects were “well below the EPA level of concern.” In particular, “Dioxins and furans in the common stack emissions were low, ranging from 0 to 0.16 ng/m³. None of the dioxins found were the 2, 3, 7, 8 – tetrachlorodibenzo-p-dioxin (2, 3., 3, 8 TCDD) isomer, which is the most toxic form of dioxin. In comparison, municipal incinerators emit dioxins in the 50–7,000 ng/m³ range.”¹²⁴ For these reasons, the EPA has not imposed any additional pollution control requirements on the baseline program.¹²⁵ These facts, the Army argues, give credence to their assertions that baseline incinerators are superior to the incinerators to which they are being compared.

In sum, Army officials running the baseline program do not dispute that some incinerators, past or present, may have been polluters. They argue, however, that they have taken many precautions and set requirements far beyond other incineration efforts. They contend that a normal amount of operational problems in the start-up phases of this program should not indict it. The Army asks that the baseline program be evaluated on its own merits and against the risk of delaying destruction about a decade for the development of an alternative technology, which may or may not prove feasible or significantly safer than baseline. Even if alternative technologies are developed, the Army cautions, they will not be risk-free.

Information Synthesis and Informed Decision-Making

Much of what the Army has to say about the baseline program differs from popular perceptions about incineration. An additional hurdle that the public has to overcome when considering the baseline program is the Army’s presentation style and documentation. Most Army documents, written for the program’s federal overseers in the EPA

123. The EPA required that the Army conduct a trial burn for each type of agent processed—mustard and the nerve agents VX and GB. These trial burns coincided roughly with the operational tests that the Army performed for each type of munitions or item to be processed—rockets, projectiles, ton containers. The EPA drew its conclusions about the trial burn performance from its own analysis of trial burn data. Muniz, interview with the author, 21 July 1994. For documentation, see “JACADS RCRA Permit Trial Burn Plan” (Program Manager for Chemical Demilitarization, 3 January 1990) and the “Sampling and Analytical Protocol for the Resource Conservation and Recovery Act Trial Burns and the Toxic Substances Control Act Demonstration Burn at JACADS” (Environmental and Monitoring Division, Program Manager for Chemical Demilitarization, 2 July 1991).

124. Note: ng/m³ means nanograms per cubic meter. Mitre, *Summary Evaluation*, 3–4.

125. According to EPA official Jim Michael, the Army’s baseline facility on Johnston Atoll is improving incineration technology and standards. “This facility is actually driving the technology,” he said. Interview with author, 10 August 1994.

Table 4: Products of Incomplete Combustion Screened for in Army Sampling.			
	Trial Burn #1^a	Trial Burn #2^b	Trial Burn #3^c
Volatiles	39	34	41
Semivolatiles	73	70	80
Metals	17	19	20
Dioxin/furan isomers	2	10	17
Total Products of Incomplete Combustion Screened	131	133	158

Sources: *Health Risk Assessment No. 42-21-M1BE-93: Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing - Phase 1*; *Health Risk Assessment No. 42-21-MQ49-92: Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing, Johnston Atoll Chemical Agent Disposal System*; and *Health Risk Assessment No. 42-21-M1X6-93: Inhalation Risk from Incinerator Combustion Products, Operational Verification Testing - Phase 3* (Aberdeen Proving Ground, MD: U.S. Army Environmental Hygiene Agency).

^aConducted in the agent incinerator with M55 rockets filled with the nerve agent GB.

^bConducted in the agent incinerator and deactivation furnace with M55 rockets filled with the nerve agent VX.

^cConducted in the metal parts furnace and agent incinerator with ton containers filled with mustard agent.

and elsewhere, are quite obscure. Furthermore, many of the Army officials sent to describe the program to local groups have spoken in very technical or bureaucratic language, using terms that are familiar in Washington but ring false to local ears. Many opponents of the baseline program also speak of the Army's condescension toward their questions and views.

Conversely, some opponents have adopted a strategy to debunk experts. One Arkansas woman, for example, notes that "In the past, 'experts' have assured her that industries polluting her surroundings would have no health impact, but her own experiences and knowledge of the community clearly indicate the contrary. She believes that incineration can only magnify existing health problems in the community, so she refuses to accept the advice of 'experts.'"¹²⁶ This woman's experiences have bred a healthy mistrust of incineration. Her concerns, like those of other local citizens, deserve to be heard and, to the extent possible, addressed.

In conclusion, people with strongly held views are not amenable to information that contradicts those views. The only way to judge the credibility of each side's experts, however, is to hear what both sides have to say. Informed decision-making requires open-minded consideration of the information put forward by both sides.

126. Silton, "Out of the Frying Pan," 21-22.

Observations and Recommendations

Introduction

While the destruction of chemical weapons is at its foundation a very technical matter, it is also a highly political process. One key political issue relates to federal priorities and the rights of the local communities and states. Another relates to the nation's environmental standards and hazardous waste disposal policies.

If this chapter has a theme, it would probably be "buyer beware." Seek basic information from all available sources. Compare what they say. Ask follow-up questions. See if the dots connect, so to speak. If not, ask more questions.

The opponents of baseline have done an impressive job of asking penetrating questions. Supporters of baseline have not done nearly as well in questioning the opposition. Several reasons exist for the lack of a critical assessment of opposition claims. Criticism of the opposition gives the appearance of being against public safety and environmental conservation or against the rights of local citizens to determine what happens in their communities. In other words, it is an invitation to be labelled an incineration apologist and/or an out-of-touch Washington policy wonk.

The author's natural sympathies lie with the opponents to the baseline program. However, the technical underpinnings of some of the arguments advanced by Greenpeace and some other incineration opponents apparently do not stand up well to closer scrutiny by scientific peers. The discussion that follows is meant to provoke thought, not to condemn the environmental movement or to curtail the voice of local communities in decision-making. To the contrary, the material presented below is meant to encourage concerned citizens to review information from all sources with a critical eye. Most of the recommendations below are designed specifically to help citizens cope with the dilemma that they and their communities face.

This chapter starts with a discussion of how animosity escalated between the Army and baseline opponents, then asks probing questions about the science of incineration opponents. The following sections broach the relative threat to health and the environment posed by baseline emissions as well as the threat of litigation that hangs over the baseline program. The chapter concludes with a series of recommendations.

How It Came To This

The absence of trust is the crux of many problems relating to the U.S. chemical weapons destruction program.¹ The roots of this mistrust can be traced to three main

1. For instance, one study concluded that "the current controversy over the disposal program stems more from the social and institutional problems of implementation than from purely technical considerations." Mark Brown, *Public Trust and Technology: Chemical Weapons Destruction in the United States. Consequences of Crucial Technology Colliding With Unyielding Political Difficulties* (Committee on National Security: Washington, D.C., 3 December 1992) 2.

sources: the Army's original relationship with each community, the influence of outside activists, and the lack of satisfactory citizen input mechanisms.

Each of the eight communities had a relationship with the Army that pre-dated the onset of the chemical weapons destruction program. This relationship is the foundation for the trust or lack thereof that currently exists between the parties. General Walter L. Busbee acknowledged that "We have had experiences at some of these locations in operations that did not even have to do with chemical munitions, but in other hazardous operations in which trust was not built up."² Some citizens in Lexington, Kentucky, are particularly bitter. "It is likely that friction began after local residents learned, ten years after the fact, of the Army's chemical weapon stockpiling activities in the 1950s. The community felt the Army had somehow 'sneaked' in these weapons without any regard for the health and safety of citizens."³ Umatilla citizens, having been subjected to unannounced releases of radioactive material from the Hanford nuclear facilities during the height of the arms race, likewise have a healthy skepticism of military operations.⁴ Some living near Colorado's Pueblo Depot believe the Army used an irresponsible method to dispose of missile boosters under another arms control agreement and think the same thing may happen with chemical weapons disposal.⁵ In Maryland, citizens were outraged when officials who ran a chemical weapons development pilot plant at Aberdeen Proving Ground let the facility fall into disrepair. In 1985, at about the time when the Army was launching its destruction program, a trio of officials was convicted of violating pollution control standards. Aberdeen's neighbors have thus been extremely wary of the chemical weapons disposal program from the beginning.⁶

Even in communities where the Army has had a better relationship with its neighbors, such as in Tooele and Pine Bluff, incineration opponents have been planting and nurturing the seeds of discontent.⁷ This campaign has been aggressive, persuasive, and successful. For example, Greenpeace, which has been crusading against incineration

2. Busbee is commander and director of the U.S. Army Chemical Materiel Destruction Agency. Interview with author, 5 May 1994.

3. The Lexington-Blue Grass Depot is about a half a mile from an elementary school and within five miles of several other schools. Brown, *Public Trust and Technology*, 2.

4. Both Karyn and Susan Jones of Hermiston, Oregon, cited this as principal reasons for their involvement in opposition to the baseline program. Discussions with the author, Chemical Weapons Working Group meeting, Washington, D.C., 19 March 1994. The Citizens for Environmental Quality, a coalition of community groups and indigenous tribes opposed to waste incineration in the Pacific Northwest, oppose the proposed baseline facility at Umatilla Depot.

5. The incident in question concerned the elimination of missile stages under the 1987 Intermediate-Range Nuclear Forces Treaty. The task was done by static firing of the rockets, which some local citizens vehemently opposed as the destruction method. Ross Vincent, chairman of the Sierra Club's National Hazardous Materials Committee, and member of the Pueblo, Colorado, Citizens Advisory Commission. Telephone interview with author, 11 August 1994.

6. Marilyn Tischbin, public affairs chief for the U.S. Army Chemical Materiel Destruction Agency, interview with author, 14 October 1993.

7. Grassroots activism is normally a desirable activity, except in cases where materials being distributed contain false claims and inaccuracies. For an assessment of some of the materials being distributed in this instance, see the next section of this chapter.

for more than a decade, has organized rallies in communities where incinerators may be built, distributing anti-incineration literature and videos. Other national opposition organizations, such as the Sierra Club and the Military Toxics Campaign, have also been vocal.⁸ Incineration opponents have suggested that the Army would deliberately execute a program that would be the equivalent of eight different chemical Chernobyls, with several federal oversight agencies actively colluding in that endeavor.⁹

In addition, the Kentucky Environmental Foundation has also made a concerted effort to reach other communities, generating grass roots opposition in congressional districts where there was none.¹⁰ The Foundation has spun off an opposition network, the Chemical Weapons Working Group, which has members in each community.¹¹ The result of these organized activities is that the Army now faces opposition at every site, although this opposition is small in comparison to the overall local population.

The influence of the views expressed by the above named organizations is readily evident. Each new anti-incineration report or press statement they release ripples through opposition camps in local communities. Not long afterward, the Army and members of Congress receive a series of inquiries that repeat the arguments or issues cited in the original documents. When Army officials meet with local citizens, the issues highlighted by national organizations are prominent among those raised locally.¹² On the one hand, this phenomenon may indicate the strength of the arguments raised. On

8. The Military Toxics Project, formerly with the National Toxics Campaign Fund, promotes the safe remediation of hazardous waste, increased control of toxic releases, and pollution prevention at Department of Defense installations. The Sierra Club champions the responsible use of the earth's ecosystems and a moratorium on incinerators. Greenpeace advocates a ban on incinerators and chlorine.

9. Other motives attributed to the Army are the intent to: 1) build incinerators to destroy other military wastes as well; 2) line the pockets of the Army's baseline contractors; and, 3) avoid the embarrassment of having the baseline program cancelled. Conversely, one can question whether it is possible to prohibit the future use of these facilities, whether other contractors would be funded if alternative technologies were used, and whether there are worse things in life than embarrassment.

10. Congressional staffers, interviews with author, Washington, D.C., 21 March 1994 and 18 April 1994. Another staffer, interviewed on 21 April 1994, described the Foundation's Craig Williams as "making a cottage industry out of people's fears."

11. The lion's share of the Foundation's funds go into the Chemical Weapons Working Group project. Williams, who preceded one comment with the disclaimer that "I'm no scientist, so I don't know, but this is what I understand," is typical of the incineration opposition: low on the scientific skills needed to evaluate data dispassionately and high on energy and conviction that incineration is wrong. He described the Foundation's mission as "to ensure safe disposal of chemical weapons and to disseminate information." He admitted, "We emphasize the problems with the current program," which he says is only fair because so many federal agencies and contractors are on board the incineration bandwagon. Williams stated that decisions about the destruction program should rest with local citizens. Williams is founder and president of the Kentucky Environmental Foundation. Interview with the author, 19 May 1994. Author's note: In lieu of forcing citizens to make such technically complex decisions on a routine basis, federal pollution control regulations are set to provide a standard that protects the health of citizens and the environment. Citizen participation in shaping those regulations is desirable but may be dangerous when lack of technical knowledge leads citizens to advocate positions that the scientific community deems inadvisable.

12. This trickle-down effect was noted by the author, attending first a Chemical Weapons Working Group meeting and later a meeting of the Maryland Citizens Advisory Commission. The author also observed this effect among congressional staffers and letters received by members of Congress.

the other, it may also suggest both the susceptibility of local communities to outside influence and the inadequacy of the Army's efforts to convey comprehensible information about the baseline program.¹³

Early on, the Army made the rounds in the local communities trying to explain its programs. Despite advertisement in local media outlets, turnouts for these meetings were typically low.¹⁴ The Army funded citizens groups to provide technical assistance in evaluating the original Environmental Impact Statement and, afterwards, set up Inter-governmental Coordination and Consultation Boards in each state to help disseminate information about the program. The Arkansas board met once and declared the need for no further meetings. The Oregon board meets once annually, while the mechanism has waned in Utah, Indiana, and Maryland.¹⁵ Given a general lack of public interest, the Army started to feel secure in its decision, equating low meeting turnouts with approval. Ironically, the Army thus unwittingly gave the local baseline opponents an assist. As one Washington, D.C., research institution observed, "By failing to *creatively* engage local community leaders and their constituents in the decision-making process, the Army has unintentionally increased the power of a small, but determined opposition."¹⁶ At about this time, the environmental movement began targeting the baseline program.

In most communities, opposition activities have significantly raised both the profile of the destruction effort and concerns about it. Consequently, more citizens are looking for avenues to state their views about the program. Local citizens noticed that it was Congress, not the Army, that instituted a new formal citizen input mechanism in 1992 by establishing the Citizens Advisory Commissions (CACs).¹⁷ At least twice a year, an Army representative is "to meet with each commission...to receive citizen and State concerns."¹⁸ The CACs evaluated the February 1994 National Research Council (NRC) report and the Army's response to it. CAC members receive no pay or compensation for service rendered. All states now have CACs, with Arkansas being the last to form one.

The Kentucky Environmental Foundation's Craig Williams described the CACs as "too little, too late," arguing that the Pentagon is keeping the CACs at arm's length instead of working with them as partners in decision-making. "Here is the Pentagon,

13. Although there has been some improvement of late, most of the Army's documents about baseline have been highly technical, turgid volumes that are extremely difficult for the lay reader to decipher.

14. Approximately 100 attended the first meeting in Aberdeen, whereas only about twenty-five turned out at the other sites, except in Lexington, where attendance at meetings has always been high. Tischbin described the Army's early outreach activities. Interview with the author, 14 October 1993.

15. Each site spent \$100,000 on technical expertise, which according to Tischbin was not always of a suitable caliber. In one instance, a graduate student evaluated the risk assessment. As for the Consultation Boards, only those in Kentucky and Alabama have remained fairly active. Interview with author, 14 October 1993.

16. Lawyers Alliance for World Security, *Citizen Attitudes*, ii.

17. The Secretary of the Army was to start a CAC in Kentucky, Maryland, and Indiana, the so-called "low-volume" states. Governors in other states could also request the formation of CACs. Seven of the nine members of a CAC are to be local citizens, with the remaining two being state representatives who have jobs related to the destruction program. All members are appointed by the governor.

18. See Public Law 102-484, section 172, 23 October 1992.

they are going to tell us what role we have to play," Williams said. Describing an instance where an Army official refused to send him the information he had requested, he continued "They do not really know if we are supposed to be involved in *that* part of it, we are just supposed to be out here having public meetings and fra-la-la-la-la'ing. Why have they not asked us what role we think we should play?"¹⁹ According to Williams, the advent of the CACs did not change the Army's attitudes; citizen participation is a canard.

Outside reviewers have also taken note of the shortcoming of the current CAC approach. One review said that the CACs "are an ill formed and late attempt to formalize citizen input into the decision making process. The weakness of the CACs is due to the people various Governors have felt obliged to appoint and the limited and vague mandate with which they were tasked."²⁰ Opponents believe that the governors have purposefully appointed individuals who would support the Army's program.²¹

Given this setting, when the Army comes to town to talk about the status of the program, the opposition turns out in impressive numbers. "Large public meetings [about the destruction program] often degenerate into opportunities for local citizens to berate the U.S. Army in an unconstructive fashion."²² At times, statements made by individuals representing both camps take on decidedly nasty and personal overtones. "The people I have dealt with in the program have had selective memory, manipulated the facts, or outright lied to me and to the press," said Anniston baseline opponent James Harmon.²³ His sentiments reflect those of many others who distrust public officials and institutions. Similarly, baseline opponents tell of having overheard Army representatives making derogatory remarks about individuals opposing the program.²⁴ In this atmosphere, constructive discussion of the issues is extremely difficult.

A Word About Advocacy Science

Smokestacks have an odious reputation. One hallmark of the industrial age, they mar the skyline, venting emissions. According to experts, however, this stereotype is outmoded. Incineration opponents emphasize the impression that incinerators are the "landfills of the sky," claiming that no one really knows what is coming out of the stacks.²⁵ Government experts counter by stating that they know approximately 99 percent of what is emerging from a hazardous waste incinerator smokestack: most of these emissions are fairly innocuous compounds, such as nitrogen, oxygen, carbon

19. Interview with author, 19 May 1994.

20. Lawyers Alliance for World Security, *Citizen Attitudes*, i.

21. This view was expressed by several participants in the Chemical Weapons Working Group meeting on 19 March 1994.

22. Lawyers Alliance for World Security, *Citizen Attitudes*, i.

23. Harmon is a member of the Anniston CAC and The Families Concerned About Nerve Gas Incineration. Telephone interview with author, 9 August 1994.

24. Personal interviews with the author, who in interactions with various Army officials, observed that at times they did not so much respect baseline opponents as wearily tolerate them.

25. For other critiques by incineration opponents, see chapter 2 and appendix A.

dioxide, and water vapor. They have also been able to pin down and regulate 40 percent of that remaining one percent of emissions, which are the so-called products of incomplete combustion, or PICs. Thus, the mystery all boils down to six-tenths of 1 percent of what is coming out of the stack—a far cry from what is portrayed by incineration opponents.²⁶

Advocacy science is aimed primarily at the citizens in the eight stockpile communities. The studies used by incineration opponents are apparently not held in high regard by many others in the scientific community. Of particular concern is Greenpeace's *Playing With Fire*, written by Pat Costner and Joe Thornton. Several studies have critiqued *Playing With Fire*, finding the report replete with errors and misleading about incinerators.²⁷ Table 5 provides a list of reviewers' observations about this report. *Playing With Fire* appears to have been compiled and presented for the purpose of supporting previously established positions.²⁸

These misleading practices can be illustrated by presenting one of the report's assertions about the health and environmental impacts of incineration and the peer review of it. *Playing With Fire* cites a Scottish study showing a higher or "dramatic increase" in the number of twins born to humans and dairy cattle living near a chemical waste incinerator. Costner and Thornton claim this study found a causal link between the incinerator's emissions and the increased incidence of human and bovine twins. According to an independent analysis of this case and *Playing With Fire*'s interpretation of it, Costner and Thornton

26. Y.J. Kim, national incineration expert, and Cathy Massimino, senior Resource Conservation and Recovery Act/Superfund technical specialist, both of the EPA. Telephone interview with author, 23 August 1994. Note that another study concluded that for most incinerators, the most common PIC is methane gas, which can constitute from 22 to 64 percent of the one percent of emissions believed to be PICs. Paul Chrostowski and Sarah Foster, *Scientific Peer Review of Greenpeace's Position on Hazardous Waste Incinerator Impacts in Its 'Report on the Hazardous Waste Incineration Crisis' and 'Playing With Fire'* (Fairfax, VA: Clement International Corporation, 29 January 1992) E-5. Also, according to Dr. Carl Peterson of the NRC's Stockpile Committee and the Massachusetts Institute of Technology, "Incinerators can be hazardous and should be examined carefully—we do not argue that some incinerators are really bad. But, the fact that there are dirty incinerators in the world does not prove that there cannot be clean ones." With regard to the baseline system, he added that "the incinerators with the pollution abatement system that are involved here are believed by the committee to pose no health hazard." (Statement made at a meeting sponsored by the Henry L. Stimson Center, Washington, D.C., 21 June 1994). Note that the author does not intend to endorse incineration with this discussion, but to point out that not all incinerators are alike and that much of what comes out of the stack can indeed be identified.

27. For those who doubt that manipulation of data takes place, see Darrell Huff, *How to Lie With Statistics*, 1st ed. (New York: Norton, 1954).

28. Similarly with regard to the baseline program, Greenpeace's Sebia Hawkins flatly stated that the organization will oppose the addition of carbon filters to baseline facilities, but had yet to conduct a study to evaluate how these filters would work. Sebia Hawkins, Pacific campaign coordinator, interview with author, 2 March 1994.

Reviewers' Observations	References
<ul style="list-style-type: none"> • <i>Playing With Fire</i> does not appear to have been subjected to the standard peer review process that the scientific community uses to make sure that scientific information is reported in a truthful and accurate manner. 	2, 3
<ul style="list-style-type: none"> • The report omitted a large amount of scientific data that contradicts the data it presents or the conclusions reached. 	1, 2, 3, 4, 5
<ul style="list-style-type: none"> • The authors use data selectively and misinterpret it. The report contains technical errors (e.g., inaccurate rounding of numbers; use of data from pilot plants, which are not typically as efficient as full-scale incinerators, despite the existence of the latter category of data; citation of data points that are the worst out of hundreds of data points. 	2, 3, 4
<ul style="list-style-type: none"> • The authors use outdated information. 	2, 3, 5
<ul style="list-style-type: none"> • The authors use quotes out of context and incompletely, often giving an impression that is exactly opposite of what the original author intended. 	1, 2, 3, 4
<ul style="list-style-type: none"> • The report frequently relies on single newspaper articles, activist newsletters, interviews with admittedly biased respondents, or anecdotal evidence, rather than scientific documentation to support points made. 	1, 2, 3, 5
<ul style="list-style-type: none"> • A relatively small group of people appear to be consistently generating most of the allegations. 	1(verbatim)
<ul style="list-style-type: none"> • The format of the allegations tends to be similar; often just the name of the facility changes. 	1(verbatim)
<ul style="list-style-type: none"> • The same individuals tend to repeat the same allegations about the same facilities, even after the allegations have long been proven incorrect. 	1(verbatim)

Sources: 1) Richard C. Pleus and Kathryn E. Kelly, *Health Effects of Hazardous Waste Incineration...More of the Rest of the Story* (Seattle, WA: Environmental Toxicology International, June 1994).

2) Paul Chrostowski and Sarah Foster, *Scientific Peer Review of Greenpeace's Position on Hazardous Waste Incinerator Impacts in Its 'Report on the Hazardous Waste Incineration Crisis' and 'Playing With Fire'* (Fairfax, VA: Clement International Corporation, 29 January 1992).

3) The EPA's Y.J. Kim, national incineration expert, and Cathy Massimino, senior Resource Conservation and Recovery Act/Superfund technical specialist, telephone interview with author, 23 August 1994.

4) James J. Cudahy, *The Rest of the Story: Literature Research and Technical Review of the Greenpeace Report *Playing With Fire** (November 1992).

5) Joseph J. Santoleri, et al., "Facts or Myths: The Burning Issue of Incineration" (Paper presented at Air and Waste Management Association Meeting, Denver, CO) 13-18 June 1993.

Note: Sources number 4 and 5 in this table may reflect a pro-incineration bias because these authors are associated with the hazardous waste management industry.

quote misleadingly from the initial report of twinning, and make no mention of the several other studies that essentially discredit the hypothesis linking the Rechem incinerator to twinning. No actual or estimated concentration data are provided to show a correlation between exposure to facility emissions and twinning in the populations, and the authors of the twinning report say it would be 'premature to attribute causality to this association between air pollution from incinerators and twinning.' At least three major government reports, as well as articles in the medical

literature, have provided data which dispute the conclusions of the claims made by Costner and Thornton.²⁹

Furthermore, a second study showed that "Greenpeace overestimated PIC emissions by factors ranging from two to approximately 45" and metal emissions by at least ten times.³⁰

Costner, it should be noted, wrote a series of decidedly unflattering analyses of the trial burns on Johnston Atoll that have been at the center of the concerns raised by the baseline opponents.³¹ At the very least, the above review of *Playing With Fire* raises concerns about the objectivity of Costner's analysis of Johnston Atoll operations.³² Furthermore, reports are beginning to emerge that seriously contradict Costner's interpretation of the trial burn data from Johnston Atoll.

A forthcoming study by an analyst from the Centers For Disease Control and Prevention juxtaposes data from the Johnston Atoll trial burns against criteria for safe emissions levels that are more rigorous than the Environmental Protection Agency's (EPA's) guidelines. In this comparison, the Johnston Atoll data were pitted against two emission monitoring standards. One is known as the "media evaluation guides," which are described as "somewhat more restrictive" than the EPA's guidelines. The other is the

29. Richard C. Pleus and Kathryn E. Kelly, *Health Effects of Hazardous Waste Incineration...More of the Rest of the Story* (Seattle, WA: Environmental Toxicology International, Inc, June 1994) 5-6.

30. Chrostowski, *Scientific Peer Review*, E5-6. Another example, drawn from *Playing With Fire's* description of how incinerators operate, is that the report "establishes a level [for metal emissions from incinerators] at least 650 times greater than found in report trial burns covering metal emissions testing." Joseph J. Santoleri, et al., "Facts or Myths: The Burning Issue of Incineration," (Paper presented at American Waste Management Association meeting in Denver, CO, 13-18 June 1993) 2. (Given the author's association with the hazardous waste management industry, this paper may reflect a pro-incineration bias.)

31. These documents are cited in chapter 2 and appendix A and listed in the bibliography.

32. Even with admittedly limited scientific capabilities, the author was able to spot errors in Costner's Johnston Atoll reviews. For example, Costner concludes that 9.5 pounds of waste were produced for each pound of agent burned during the incineration of VX from M55 rockets, but to arrive at this high amount she incorporates data that should not be factored into the calculations in the first place. Her calculation includes 497,250 pounds of wastes from the deactivation furnace, which treats explosives and propellants. Some of those materials were indeed probably contaminated with agent, so it is fair to attribute a small portion of the wastes from this incinerator to the waste per pound of agent burned. A reasonable calculation would include closer to 5 percent of the deactivation furnace wastes (24,862 pounds). Therefore, the correct figure is just over six pounds of waste per pound of agent (6.0391 pounds, to be exact) burned during this period of operations. For Costner's version, *GB and VX Campaigns*, 8. The tables with the original processing and waste data can be found in Scott Macrae et al., *Evaluation of the VX Rocket Test: Johnston Atoll Chemical Agent Disposal System Operation Verification Testing*, MTR-92W0000064 (McLean, VA: Mitre, November 1992) 2-23 and 2-29. Sonya Sasseville, chief of the EPA's Alternative Technology Section in the Office of Solid Waste, concurred with this characterization of Costner's work and opposition science in general. "They pick a lot of statements in isolation, but do not indicate what the overall report said. By doing so, they hit on important issue areas, but they do not give the full range of views." Interview with author, 10 August 1994. An NRC representative described the reports used by baseline opponents as using "a lot of very inaccurate information mixed with spin" that paints a very bad picture of the Army and the NRC. Interview with the author, Washington, D.C., 15 August 1994.

“ambient air level guides” developed by Dr. Edward Calabrese and his colleagues, which “can be as low as one-tenth of the EPA screening values.”³³ This study concluded that the Johnston Atoll emissions

still met all criteria for acceptability. Even at the location of maximum potential human exposure, the levels of organic species examined usually were several orders of magnitude below the most restrictive screening values. Emissions of metals were generally well below levels of health concern. The closest any metal came was about one tenth the Calabrese [measure] which translates into a cancer exposure risk of 1 excess death per 10 million exposed individuals...Health professionals generally consider any risk less than one excess death per 100 thousand to 1 million exposed individuals to be acceptable.³⁴

Army rebuttals aside, such conclusions cast doubts about the reports baseline opponents are using as the basis of their criticism of baseline incinerators.³⁵

In addition to questionable scientific practices, some incineration opponents are making exaggerated claims about the promise and availability of alternative technologies. According to Greenpeace’s Sebia Hawkins, “all of the technologies Greenpeace reviewed would definitely be better than incineration.”³⁶ A bit more cautious, Ross Vincent of the Sierra Club said that, “Whether alternative technologies are safer will depend on the technology, the facility design, and the operators. There are some alternative technologies that by their very nature under normal operating circumstances and even under upset conditions are almost certain to be safer because they do not involve the routine release of waste materials.”³⁷

Since data about how alternative technologies will work with chemical agents, much less with large quantities of agent, are not yet available, incineration opponents are articulating best-case scenarios as if stellar results were already in hand.³⁸ The

33. The media evaluation guides are used by the Agency for Toxic Substances and Disease Registry. Harvey W. Rogers, *Incinerator Air Emissions: The Bigger Picture*, draft paper, submitted for publication (May 1994) 6–7.

34. *Ibid.*, 7.

35. The Army, of course, disputes Costner’s interpretation of the data about Johnston Atoll operations.

36. Lawyers Alliance for World Security, *Citizen Attitudes*, 26. Craig Williams made similar claims, stating that it does not matter if there are operational problems with “neutralization or any closed loop configuration process, where if you have upset conditions, you do not have releases into the community. You have it fail-safed so that you have control over your upsets.” Interview with author, 19 May 1994.

37. Vincent conceded the possibility that some alternative technologies will also produce pollutants, but he said that these systems will either not release the pollutants or will release them in substantially smaller quantities. Telephone interview with author, 11 August 1994.

38. The exception to this data paucity is that extensive data are available on how neutralization works with chemical agents. Initial results indicate significant problems with neutralization, including flammability of chemicals used in the process and the reconstitution of the chemical agent. Additional work with neutralization is being pursued, but it is premature to draw conclusions about it. See appendix one.

opposition portrays “closing the loop” as an absolute guarantee of increased safety, but other experts say this is by no means likely. According to Cathy Massimino, senior Resource Conservation and Recovery Act/Superfund technical specialist with the EPA, “No matter what we do with the agent, there is going to be some risk involved, even with non-thermal treatments. For instance, waste materials from alternative technologies will have to be landfilled and that will involve risk. There is no zero risk alternative.”³⁹

Greenpeace’s Hawkins and the Sierra Club’s Vincent have confidently predicted that alternative technologies can be brought into service within a few years.⁴⁰ Such claims significantly contradict the conclusions drawn by the General Accounting Office (GAO) and the NRC, which state more than a decade will be required to develop alternative technologies.⁴¹ As another study concluded: “Technical and political problems, and subsequent delays, may occur with any development program. Failure during required full-scale tests is always possible. Even after the best efforts to develop new technologies, it is still possible that the results may be no better, and may even be worse, than those of the current system.”⁴² Moreover, to the extent that development of alternative technologies necessitates continued storage of the stockpile, this alternative technology route may actually increase the risk to the communities.⁴³

In sum, key assertions by incineration opponents distort data and make exaggerated claims—precisely the charges levelled by critics of the Army’s program.⁴⁴ Moreover, the EPA and other regulatory authorities recognize that PICs pose a health and environmental hazard and that incinerators are a source of those pollutants. Therefore, they set regulatory standards for incinerators with the purpose of protecting both public health

39. Kim concurred with this statement. Telephone interview with author, 23 August 1994. The NRC observes that the risks from storage, transportation, and munitions handling are greater than those posed by baseline incineration. These risks would still be present were an alternative technology to be used. Furthermore, other risks associated with using alternative technologies cannot be fully assessed because the feasibility of using these technologies has yet to be proven. See NRC, *Recommendations for the Disposal*, 78–80.

40. Hawkins claimed that biological remediation would require three or four years of applied research before it could be implemented. Interview with the author, 2 March 1994. Vincent stated that neutralization “could be operable within two or three years.” Telephone interview with author, 11 August 1994.

41. The GAO estimates that alternative technologies could not be available for full-scale operations until 2007, while the NRC puts the time frame for developing and demonstrating alternative technologies at nine to twelve years. For more information, see NRC, *Alternative Technologies*, 89–93; and GAO, *Advantages and Disadvantages of Alternatives to Incineration*, 5–8.

42. Brown, *Public Trust and Technology*, 7.

43. Dr. Carl Peterson observed that, “Those who would extend storage to foster development of marginally better disposal technologies should do so in the knowledge that they will increase the total cumulative risk to the public and the environment.” “Disposing of Chemical Warfare Agents And Munitions Stockpiles,” *Arms Control Today* (June 1994) 13. The Army presently assures the safety of the stockpile only until 2004. U.S. Army Chemical Materiel Destruction Agency, *1993 Annual Status Report*, 30.

44. When asked to assess the data that supports that conclusion that incineration is an effective method of hazardous waste disposal, the Sierra Club responded: “We can’t respond to unsubstantiated claims, based on data we haven’t seen, leading to conclusions that are inconsistent with our experience. We suspect that we would find this ‘large body of data’ unimpressive and the claims of effectiveness to be based on an inadequate definition of ‘effective.’” Vincent, “Combustion Strategy,” 2.

and the environment. These standards are based upon extensive, peer-reviewed research that draws upon all of the data and studies that Greenpeace and other incineration opponents fail to cite, as well as upon data provided by opposition scientists. To date, federal regulators have clearly stated that the Army's program has met or exceeded these standards.⁴⁵

Putting Baseline Emissions in Context

That baseline incinerators will release a certain amount of PICs or pollutants into the air is not a matter of dispute. However, trial burn data from Johnston Atoll indicate that the PICs released from a baseline incinerator will be far below the levels that the EPA and other federal organizations have identified as potentially causing harm to the population or the environment.⁴⁶

Therefore, an essential question for citizens is whether baseline operations will noticeably increase the amounts of PICs already present on a daily basis at the eight stockpile storage communities. According to EPA experts, hazardous waste incinerators contribute a relatively small fraction of PICs compared to such sources as fossil fuel power plants, cement kilns, refineries, medical incinerators, automobiles, and diesel trucks.⁴⁷ One EPA specialist noted that at times the EPA has had difficulty sampling for PICs in other incineration trial burns because the gas coming out of the stack was cleaner than the surrounding atmosphere in the host communities.⁴⁸

Trial burn results at Johnston Atoll indicate the same difficulty may be encountered with baseline incinerators at continental U.S. sites.⁴⁹ One study compared the maximum ground level concentrations of the Johnston Atoll stack emissions for fourteen inorganic and organic pollutants from the agent, metal parts, and deactivation furnaces with the ambient air concentrations of the same pollutants. The items surveyed were benzene, chloroform, styrene, xylenes, toluene, chlorobenzene, ethylbenzene, arsenic, chromium, lead, zinc, copper, manganese, and cadmium.⁵⁰ This comparison found that "for all but one substance (manganese)," the concentrations from the Johnston Atoll stacks "were generally well below" average urban air concentrations.⁵¹

45. Two of the EPA regulators who have been very closely involved with monitoring the Johnston Atoll operations, Kim and Massimino, confirmed this in a telephone interview on 23 August 1994.

46. Furthermore, the Army's agent detection monitors on Johnston Atoll, which are set to extremely low levels, have not detected the release of any chemical agent while the incinerators were operating. See the discussion in chapter 2 on pp. 37-38.

47. The EPA's Kim and Massimino, telephone interview with author, 23 August 1994.

48. Sasseville of the EPA, interview with author, 10 August 1994. Another study also found that, "The ambient air impacts of modern hazardous waste incinerators are much lower than currently prevailing ambient air [dioxin/furan] levels in rural or industrialized areas." Chrostowski, *Scientific Peer Review*, E-6.

49. General Busbee stated that an Army background analysis for PICs at the Anniston site "shows that a baseline facility is almost not even a blip on the curve with respect to the ambient background concentration" of these kind of pollutants. Interview with author, 5 May 1994.

50. Rogers, *The Bigger Picture*, 11. The maximum ground level concentration is a technical term that essentially means the point on the ground at which the most intense exposure from stack emissions would take place. That point will vary, depending upon wind conditions.

51. This comparison involved data from three trial burns of the agent incinerator and one each of the

In addition, baseline emission levels have been compared with routine sources of dioxins. Chlorinated dioxins and furans are found in cigarette smoke and in automobile and diesel exhaust.⁵² A study compared the toxicity equivalents, or the TEQs, for dioxins and furans “in terms of the 2,3,7,8 tetrachlorinated dibenzo p’ dioxin, the species believed to be the most toxic” carcinogen. This research showed that “a diesel truck travelling at an average speed of 40 miles per hour with an equal amount of uphill and downhill driving would emit...about 4 times as much dioxin TEQ” as the deactivation furnace.⁵³ The comparison to cigarettes showed that if an adult stayed at the maximum ground concentration level from the emission plume of the deactivation furnace and breathed in twenty–three cubic meters of that air each day *for an entire year*, it would be an equivalent dioxin toxicity exposure in the worse case of smoking one cigarette every three weeks. In the best case, it would be equal to smoking 1.7 cigarettes in a year.⁵⁴ In other words, while engaging in daily activities such as walking through their neighborhoods or sitting in local restaurants, citizens living near these eight stockpile sites may already be routinely exposed to levels of pollutants that exceed by a significant margin the expected emissions from a baseline incinerator. The crux of the matter is thus the comparative risk between a baseline facility’s very low–level pollution and the risks associated with continuing to store the stockpile.⁵⁵

Incineration opponents, it is worth noting, may not view this situation the same way that local citizens do. For the Sierra Club’s Vincent, who readily acknowledged that coal power plants, automobiles, and trucks are bigger polluters, the amount of pollution contributed by baseline’s incinerators or incinerators in general is immaterial. The point is that the disposal of these materials could be accomplished through other means and that the public need not be exposed to the risks of incineration. “That the EPA and the Congress have not had the courage to bite the bullet and do something about these other sources of PICs is no excuse,” he said. Small source of pollution or large, the opposition

deactivation furnace and metal parts incinerators. In seventeen instances, the trial burn screening did not detect or report the pollutants being screened. *Ibid.*, 12.

52. For a study that points to heavy duty diesel trucks as a principal source of dioxin emissions, see Kay H. Jones, “Diesel Truck Emissions, an Unrecognized Source of PCDD/PCDF Exposure in the United States,” *Risk Analysis*, vol. 13, no. 3 (1993) 245–252.

53. Rogers, *The Bigger Picture*, 13.

54. The range given for the cigarette toxicity equivalent is due not to any change in emissions from the incinerator, but to the difference between the low and high ends of the “mass TEQ range” for cigarette smoking. *Ibid.*, 14.

55. Some critics deride the Army’s original risk assessment because it was based upon such low probability events as airplane crashes, earthquakes, and tornadoes. However, since that assessment was completed in 1988, three airplanes have come down in the vicinity of stockpile storage sites. One aircraft crashed at the Anniston Depot’s firing range; a second crashed on the opposite side of the base at Aberdeen Proving Ground from where the one–ton containers of mustard are stored. In a third incident, an aircraft made a forced landing at Pueblo Depot. Six of the eight sites are located within ten miles of airports and/or air traffic corridors. Three storage sites—Tooele, Umatilla, and Pine Bluff Arsenal—are located on or near earthquake fault lines. Tischbin, telephone interview with author, 23 August 1994. See also Program Manager for Chemical Demilitarization, *Final Programmatic Environmental Impact Statement*, appendix H. While the author did not ask the Army to tally near misses from tornadoes, one killer tornado set down in the same county as the Anniston Depot on Palm Sunday 1994.

is obligated "to go after them one by one by one because there is simply no excuse for allowing it to continue."⁵⁶ Furthermore, should the baseline program go forward, it could be taken as an indicator that incineration is indeed a safe method for disposing of the nation's other toxic wastes. On the other hand, if incineration opponents are successful in inspiring sufficient opposition to the baseline program, they may be able to bring enough political pressure to bear upon Congress to compel the Pentagon, the nation's biggest spender, to invest substantially in alternative technologies. Given the onset of the Army's \$43 million research program in alternative technologies, one could say that incineration opponents are already making progress. Overturning the baseline program could also be the basis for a national referendum on incineration and the way America disposes of hazardous wastes.

Legal Storm Clouds on the Horizon

Some of baseline's opponents have expressed a willingness to enlist the judicial system in the battle against baseline. GAO reviewers preparing a May 1990 report were told that opponents in Kentucky were "prepared to do whatever it takes (including taking legal action) to halt on-site incineration plans."⁵⁷ Three years later, the GAO found that "safety concerns and opposition to chemical weapons incineration have led Kentucky, Indiana, Maryland, and Colorado to either enact or consider enactment of legislation that could delay or even prevent construction of chemical weapons incinerators."⁵⁸ The Office of Technology Assessment (OTA) observed "that political or legal delays could prevent implementation of current technology at some or several of the weapons storage sites for a number of years."⁵⁹ Furthermore, in a recent circular, the Sierra Club listed "controversy, litigation, delay" as "likely" for incineration.⁶⁰ The Kentucky Environmental Foundation's Williams depicted lawsuits as a virtual certainty, whether in Kentucky or elsewhere.⁶¹ Similarly, the Sierra Club's Vincent stated that lawsuits to block the baseline program would probably be filed in Colorado, Alabama, Maryland, and Kentucky.⁶²

In that event, the law may offer magistrates some leeway in hearing such cases.⁶³ The guiding principle of U.S. environmental law involves a partnership between the

56. Telephone interview with author, 11 August 1994.

57. GAO, *Obstacles to the Army's Plan*, 25.

58. The GAO noted that the NRC's review of alternative technologies was intended to address the concerns of these communities. GAO, *Issues Affecting Program Cost, Schedule, and Performance*, 4. Author's note: The NRC's reports do not appear to have had their intended effect.

59. OTA, *Alternative Technologies*, 5. OTA analyst Mark Brown reached a similar conclusion in another study. Brown, *Public Trust and Technology*, 4.

60. These possibilities are listed as "unlikely" for neutralization. Sierra Club, "Analysis of Dr. Carl Peterson's Recommendations," 4.

61. Interview with author, 19 May 1994.

62. According to Vincent, local citizens at these sites have begun talking to lawyers about their legal options. Telephone interview with author, 11 August 1994.

63. The discussion in the following paragraphs draws heavily upon an interview with DePaul University Law Professor Barry Kellman, conducted in Lima, Peru, on 2 September 1994 and the analysis of

federal and state governments. States must adhere to federal pollution control standards, but may set more rigorous ones. If a state plan for involving stricter controls is approved by federal authorities, it then becomes binding upon the federal government and the military services. Kentucky, Colorado, Indiana, and Maryland have set environmental standards for the baseline program that are in some instances tougher than the federal plan. These state plans have not yet been approved by federal authorities, and the federal government can preempt them because federal objectives take precedence. According to Professor Barry Kellman, who teaches environmental law at DePaul University, "After all of the rhetoric about states' rights, this is a national government and it is entitled to govern."⁶⁴

Since the Johnston Atoll trial burn results are a good indication that when the baseline program goes stateside it will be able to meet the more rigorous state environmental standards, a legal challenge to the baseline program may very well be predicated on some other basis. In Kentucky, a lawsuit could be built around the fact that the Army has not proven, as the 1992 Kentucky law requires, that *no* other alternative technology or disposal option, such as transportation elsewhere, "is likely to exist or could be developed...that creates less risk of release or harm to the public or the environment" than baseline incineration.⁶⁵ Authorities overseeing the baseline program may have a more difficult time running that type of legal gauntlet or other legal challenges posed by outside interest groups. Kellman anticipates that federal interests would nonetheless prevail in such situations, but that the legal process is likely to cause delay.⁶⁶

Ironically, both sides may be able to take some refuge in the Chemical Weapons Convention, which, assuming U.S. ratification and implementation, is likely to be the law of the land at that point.⁶⁷ The Convention would be the superior legal document, and "When the United States is dealing with international relations and confronting foreign sovereigns, 'state lines disappear,' so the country can 'speak with one voice' in its international dealings."⁶⁸ Baseline opponents may also be able to find some legal shelter in the treaty's "numerous...passages [that] direct the parties to secure whatever permits are necessary, and to comply with all applicable local environmental protection standards."⁶⁹

Georgetown University Law Professor David A. Koplow, who wrote *Some Disassembly Required*.

64. In this case, Kellman continued, the state law is not null and void, but the federal interest prevails. The preemption doctrine is intended to prevent the federal government from being hamstrung by the states. He noted that, if possible, the Army should comply with the state standards. Interview with author, 2 September 1994. Koplow states the government can "waive strict conformity with otherwise applicable environmental protections, where higher national goals are inextricably involved. But those escape clauses are neither easily exercised nor politically popular." Koplow, *Some Disassembly Required*, 10.

65. A synopsis of the Kentucky law can be found in OTA, *Alternative Technologies*, 4-5.

66. Interview with author, 2 September 1994.

67. Koplow points out that while treaties and statutes are "documents of equal dignity," the more recent legal document, in this case the treaty, would take precedence over an environmental statute. Koplow, *Some Disassembly Required*, 9.

68. *Ibid.*, 10.

69. Article VII.3 directs treaty parties to "assign the highest priority to ensuring the safety of the people

Since the Tooele baseline facility, which is shown in Figure 11, is slated to begin operations in 1995, the first chapter of this legal drama may soon begin to unfold. Legal experts observe that such challenges would be deflated were Congress to enact a law over-riding state statutes.⁷⁰

Recommendations

While the eventual winner in this contest for the hearts and minds of local citizens and national legislators is far from clear, it is evident that the road ahead will be a bumpy one. Crucial decisions will have to be made in each of the affected communities, as well as on a national level. That road will be smoothed somewhat if the issues can be discussed thoroughly, openly, and without the rancor that has come to characterize much of the debate. To that end, the following recommendations are offered.

One of the keys to the success of Canada's chemical weapons destruction program, Operation Swiftsure, was the early and earnest involvement of citizens in the decision-making process.⁷¹ The mistakes made in the past vis-a-vis community relations cannot be undone, but perhaps some lessons could be learned from how the managers of Operation Swiftsure handled a situation with local citizens that closely resembles what the Army is encountering.

The Army and Public Outreach

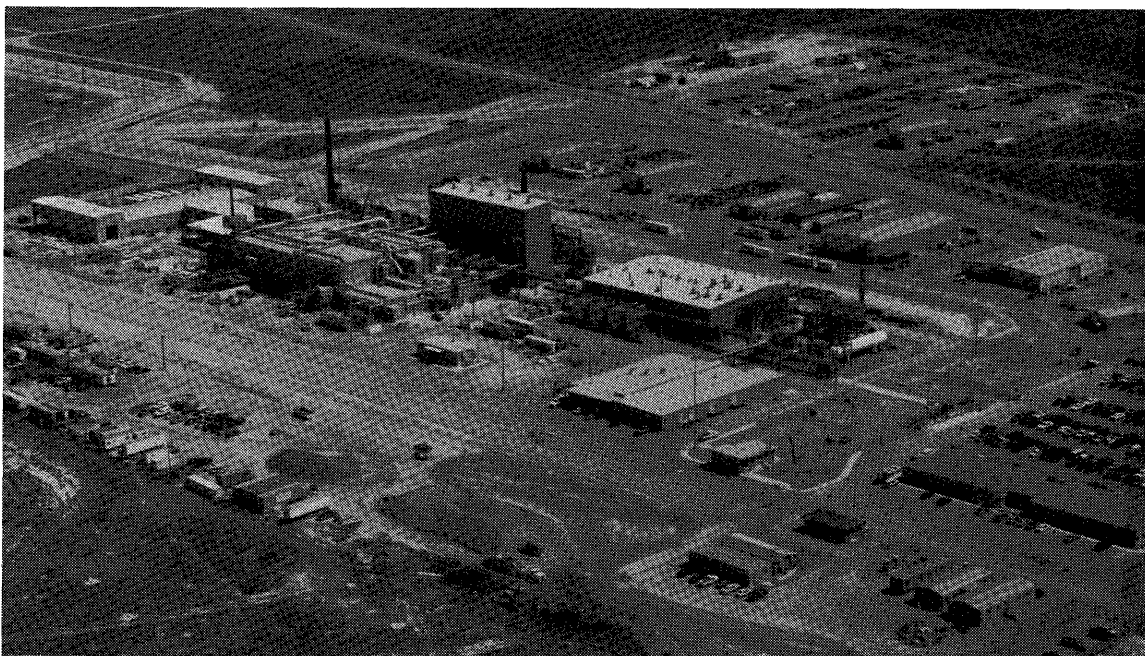
Over the past several years, incineration opponents have charged the Army and the NRC with every conceivable form of malpractice, from negligence to incompetence to sinister intent. For the most part, the NRC and the Army, confident of their data and the steady improvement of the program, have tried to stay above the fray.⁷² An NRC staffer said that the National Academy of Sciences was not inclined to rebut charges on a

and to protecting the environment." Koplow also lists several other portions of the treaty that refer to obligations to abide by safety and environmental standards during treaty implementation activities. *Ibid.*, 9.

70. Koplow notes that, "Congress would have plenary power to pass superseding legislation, pre-empting the field and overwhelming the inferior laws." (*Ibid.*, 10.) Kellman agreed that initiation of a federal over-ride would likely be a congressional task. Such a law might say that nothing in the baseline program would be subject to state law. This course of action would be more efficient legally but it would more difficult to execute politically. Interview with author, 2 September 1994.

71. Canada's chemical weapons stockpile was destroyed at its storage facility in Suffield, Alberta. Compared to the 30,000-ton U.S. stockpile, destruction of Canada's twelve tons of mustard, 2.5 tons of lewisite, and 0.3 tons of nerve agents using neutralization and incineration was not a monumental effort. Operation Swiftsure took place from 1989 to 1991. Many of the following suggestions about improving citizen interaction are patterned after the approach taken by Operation Swiftsure, but altered and enhanced as appropriate for application in the United States. For the tale of Canada's experience, see Canadian Department of National Defence, *Citizens' Environmental Protection Committee Report*.

72. One recent report noted that the Army's approach "has been typically cautious and reactive, rather than creative and anticipatory." Lawyers Alliance for World Security, *Citizen Attitudes*, ii.

Figure 11: The Tooele Chemical Disposal Facility.

Photograph courtesy of the U.S. Army Chemical Materiel Destruction Agency.

point-by-point basis.⁷³ A fairly rare Army rebuttal document stated that “A ‘point-by-point’ rebuttal of the Greenpeace report would be lengthy and would lend undeserved credibility to their ‘assessment.’”⁷⁴ To the extent that these charges are not quickly refuted, however, they gain credibility with the general public.

The Army might well reconsider this passive strategy. At first glance, few citizens know the difference between advocacy science and peer-reviewed, strictly disciplined science. The Army has an obligation to point out when information being circulated about its program is misleading or false. The Army cannot feign impartiality regarding baseline, but it can produce the documents and make the presentations that articulate the sound reasons why local citizens should support the baseline program. At the same time, the Army must continue to inform citizens about its research program to develop alternative technologies for possible application to stockpile destruction.

The Army may receive added criticism for taking a more aggressive approach in explaining its program or in issuing data and analyses that demonstrate how data have been misportrayed by incineration opponents. The Army’s recent efforts to communicate

73. Telephone interview with author, 15 August 1994.

74. “Memorandum on the Response to the Greenpeace Paper for Headquarters,” Department of the Army, dated 28 May 1993, signed by Walter L. Busbee, Commander/Director of the U.S. Army Chemical Materiel Destruction Agency, 2. The paper in question was Pat Costner, *Chemical Weapons Demilitarization and Disposal: The Army’s Experience at Johnston Atoll Chemical Disposal System* (Washington, D.C.: Greenpeace, 11 April 1990).

more effectively have already come under fire. Some baseline opponents say that these efforts are nothing more than a glossy public relations campaign meant to cover up the truth.⁷⁵ Yet, the opposition also complains that the Army does not release enough documentation and what information it does publish is full of errors and half-truths. Local citizens and legislators would do well to recognize such pincer tactics.

Rejuvenating the Citizens Advisory Commissions

The CACs, meant to facilitate citizen input to the destruction program, are apparently floundering. Were they to function better, the CACs could become a basis for a partnership between the Army and local communities in planning and implementing the destruction program at each site. CAC reform is definitely in order, and the experience of the citizens group that worked with Canada's Operation Swiftsure is a good model for how such mechanisms should work.⁷⁶

The size of the CACs might be increased to ten or twelve members, allowing for more diversity and expertise to be represented on them. Half of the members could be appointed by the governor, as presently stipulated. The other half could be appointed by local community entities, such as the town council or the mayor's office, to ensure broad-based representation from the community. The governor's appointees should be individuals with the appropriate technical backgrounds, while the other CAC members might be citizens interested in taking an active oversight role and functioning as a liaison between the Army and the community at large.

Next, the earlier practice of funding a technical consultant to assist CACs in evaluating program documents and developments might be revived. Ground rules in terms of technical qualifications and job experience, preferably for a range of clients and not just special interest or government clients, could be established to avoid some of the problems encountered with such consultants in the past.

CAC responsibilities might be broadened so that these groups play a role throughout the life of the destruction program in their communities. For example, the CACs could evaluate and make recommendations concerning: 1) program milestones in the Army's alternative technology research effort; 2) the site specific risk assessments that are being prepared; 3) the status of the local Chemical Stockpile Emergency Preparedness Program; 4) budgetary documents; 5) engineering documents; 6) contract bids; 6) contractor selection and performance reviews; and 7) other appropriate areas of program planning and operations. Recommendations from the CACs could automatically be sent to the Army and congressional oversight committees. Within a reasonable time frame, the Army could report back on responses to the suggestions made.

75. The Kentucky Environmental Foundation's Williams was particularly critical of the Army's efforts in this regard. Interview with author, 19 May 1994. Similarly, the Sierra Club's Vincent asserted that the Army was preparing for an escalation of its "public relations war on the local communities. This suggests that the Army still believes that what they have is a public relations problem, not a major public health and safety problem." Telephone interview with author, 11 August 1994.

76. Canadian department of National Defence, *Citizens' Environmental Protection Committee Report*, 3-5, 15, 18-19.

All documents applicable to the destruction program and its execution could be available to the CACs in their work. The Army might be required to give the CAC notification of major structural changes planned during the construction of the facility; the same could hold for significant operational changes. CAC members could have access to the facility at all stages of construction and operation. When on site, they could be able to use cameras and take notes. The CAC might also be able to request written confirmations on particularly sensitive matters from facility managers.

Finally, funds could be established to enable CAC members to perform their tasks without undue personal hardship. CAC members should continue to be unpaid, but those who take on this responsibility are performing a valuable community service and could be reimbursed for incidental expenses (e.g., materials needed to perform the job or travel to meetings). Coverage of expenses for other CAC activities, such as site visits to other baseline or hazardous waste disposal facilities or attendance at important review meetings with NRC officials, could also be included. A ceiling for such funds could be set to prompt CAC members to tap them conservatively. Appropriate guidelines should be set up to prevent misuse of these funds.

The Importance of Citizen Involvement

When asked why local citizens and the U.S. population at large should trust the Army to do a good, safe, cost-efficient job, former Program Manager for Chemical Demilitarization Charles Baronian quickly responded with a somewhat surprising reply. "Don't," he said.

Do not make this an issue of trust in the Army. Insist—and the Army will support this—that the local state enforcement agencies participate in this program, including granting the permit only if they are comfortable that the Army can do what it says it is going to do. Insist that your local people are in the plant, doing the required oversight to make sure the Army will live by its word. I welcome that kind of procedure, but do not trust the Army.⁷⁷

Local citizens might well heed this advice. No matter what type of destruction facility is eventually built at a site, they must be actively involved in making sure that the Army is operating it as promised.

General Busbee also welcomed citizen involvement. He said that he wanted to create mechanisms for "continuous public involvement in the oversight of the operation of these facilities." He spoke of "informed citizens who can participate, have the opportunity to review the results, visit the control room, sit in the control room twenty-four hours a day, if necessary." He noted the utility of having local citizens and state regulators "interview plant operators" and "be there when decisions are being made as to whether the plant is in conformance or not." Busbee wanted local citizens and state

⁷⁷Interview with author, 10 May 1994.

regulators to be “confident that we are following the prescribed rules or to blow the whistle if we are not.”⁷⁸ Such involvement should not be limited to CAC members.

To facilitate broader citizen involvement, the Army could explore the possibility of having the data from the important operating parameters for baseline’s incinerators available at a computer terminal in the local library or city hall. Some commercial hazardous waste destruction facilities have made this type of data available on a real-time basis via telemetry link so that local citizens can track facility operations without having to come to the facility itself.⁷⁹

Hands-on citizen involvement was one of the keys to the success of the Canada’s Operation Swiftsure, both from the perspective of local citizens and the officials implementing the destruction program.⁸⁰ The Kentucky Environmental Foundation’s Williams observed that citizen oversight has made the baseline program safer. “Regardless of how this thing winds up,” he said, “we feel that we have made this process many, many times safer than it would have been had we just said ‘yes’ when they first came in 1984.”⁸¹ Active citizen involvement has already proven its worth for the U.S. and Canadian destruction programs and it should be a goal of each stockpile site community throughout the operation of these destruction facilities.

Emission Monitoring

As long as the technical capability to monitor smokestack emissions continuously and conclusively for products of incomplete combustion is lacking, local citizens will always harbor concerns about what is coming out of the stack. Therefore, when it comes to monitoring incinerator emissions, it is useful to avoid even the appearance, if not the fact, of having the fox guard the henhouse. In this regard, two steps might be taken.

First, two different contractors could be hired to run each baseline facility: one to operate the incinerators and another to run the monitoring systems. This approach could counter the passivity that can accrue among employees during long-term operations and inspire heightened vigilance in both operators and monitors.

Second, local CACs could be given funds to hire an outside contractor to monitor emissions around the facility on a continuous or a spot-check basis, whichever the local community deems appropriate.⁸² The CAC could task the contractor to do plume tracking or other specific monitoring tasks, as needed. This approach was used in the Swiftsure program and gave citizens throughout the community independent confirmation that emissions from the incinerator were indeed as portrayed by the authorities operating it.

78. Interview with author, 5 May 1994.

79. See the remarks of Peter Daley, vice president for environmental technology at Waste Management International and member of the NRC’s Alternatives Committee. NRC, *Alternative Technologies Forum*, (Washington, D.C.: National Academy of Sciences, 30 June 1993) 100.

80. Canadian Department of National Defence, *Citizens’ Environmental Protection Committee Report*, 8–14.

81. Interview with the author, 19 May 1994.

82. Canadian Department of National Defence, *Citizens’ Environmental Protection Committee Report*, 3, 16–17.

This independent contractor would start sampling before baseline operations begin to obtain historical data for comparative purposes. The contractor could routinely report the results of its monitoring activities, including full data and analysis, simultaneously to the CAC and the Army. Any concerns arising out of those reports could be discussed in a regular CAC meeting or one called specifically for that purpose.

Giving Clear Signals: End-Use of Baseline Facilities

Whether intended or not, members of Congress who are watching the budgetary bottom line are sending mixed signals to the constituents of the eight stockpile sites. Contemplation of possible future uses of baseline's incinerators feeds tendencies to mistrust the Army on other aspects of the destruction program. U.S. taxpayers demand responsible management of government funds, but responsible behavior in this case requires that baseline facilities be used only for their primary purpose, as the law stipulates. Undoubtedly, Congress needs to pay closer attention to the implications of some of its actions regarding the stockpile destruction program. One indication of rising congressional sensitivity is a new law prohibiting the use of federal funds to study future uses of baseline incinerators.⁸³

If communities themselves wish to change their minds about on-going incineration efforts, they necessarily have this right. Absent this expression from the localities involved, key officials, both in the administration and in Congress, should reiterate the commitment to destroy baseline facilities upon the completion of their principal task. At regular intervals, the Secretary of Defense and the Chairmen of the Senate and House Armed Services Committees should sign letters reconfirming this pledge to the local communities. This type of personal commitment on the part of key officials was crucial to easing the qualms of Canadian citizens regarding the end-use of Swiftsure's incinerator.⁸⁴

Fulfilling an Obligation: Emergency Preparedness

The Army's principal argument for destroying the stockpile *in situ* was predicated upon the creation of a viable emergency response capability at the stockpile storage sites. According to scathing GAO reviews, the Chemical Stockpile Emergency Preparedness Program can hardly be called viable. Furthermore, the lackluster implementation of this program has heightened the suspicions of local citizens about its origins and utility in the event of a real chemical emergency.

The Chemical Stockpile Emergency Preparedness Program is in need of a major resuscitation effort. The Army *must* devote a concerted effort to administering this program promptly and completely. Local citizens deserve and should insist on nothing less.

83. Public Law 103-139, section 8075A, 11 November 1993 (Department of Defense Appropriations Act, 1994) states: "None of the funds in this or any other Act shall be available for the preparation of studies on...the potential future uses of the nine chemical disposal facilities other than for the destruction of stockpile chemical munitions and as limited by section 1412(c)(2), Public Law 99-145." Future-use studies for the destruction test facility at Tooele are exempted under this law.

84. Canadian Department of National Defence, *Citizens' Environmental Protection Committee Report*, 3-4.

Appendix A: The Baseline Program and Opposition To It: An Overview of Charges and Responses

Amy E. Smithson

This appendix juxtaposes the concerns and arguments that opponents to the high-temperature baseline incineration program raise with the responses of officials responsible for operating, regulating, and reviewing the Army's chemical weapons destruction program. Some of the issues addressed in the following pages were touched upon in chapter 2, but they are dealt with more deliberately in this segment of the report. Other issues are also broached. For each separate issue, the viewpoint of the opposition to baseline is presented first and in italics. The response from officials from the Army, the Environmental Protection Agency (EPA), and the National Research Council (NRC) follows in regular print. Despite this more extensive treatment, this appendix still presents an overview rather than a comprehensive ledger of all of the issues that have been raised throughout the evolution of the chemical weapons destruction program.

Issues are grouped under general category headings, as follows:

Destruction Program Management and Ethics.....	64
The Army's Adherence to Regulations	64
Disposal of Wastes from Baseline Incinerators	66
The Army and Its Contractors.....	67
The Legitimacy of the Army's Interaction with Local Communities	68
The Operation of the Johnston Atoll Baseline Facility	69
Combustion Efficiency and Incinerator Operating Conditions.....	69
The Scientific Standards of the Army's Operations.....	71
The Caliber of the Army's Agent Monitors.....	72
False Alarm Rates of the Army's Agent Monitors	73
Army Screening for Products of Incomplete Combustion	75
Comparative Wastes from Incineration and Neutralization	77
The Risk Assessment Supporting the Army's Decisions	78
Completeness of the Army's Risk Assessment	78
M55 Rocket Instability and the Risk Assessment	79
Alternatives to the Current Destruction Program.....	80
Capabilities and Availability of Alternative Technologies.....	80
Army Efforts to Develop Alternative Technologies.....	82
Feasibility and Desirability of Disassembling the M55 Rockets	84
Neutralization as a Satisfactory Method of Destruction	85
Destruction Methods for Stockpile and Non-Stockpile Munitions.....	86
Feasibility of Transporting Chemical Weapons	87
The National Academy of Science's Role.....	88
Composition of the NRC's Committees	88
Independence of the NRC's Oversight	89
The Charcoal Filters Recommended by the NRC.....	91

Destruction Program Management and Ethics

The Army's Adherence to Regulations

Baseline opponents charge that the Army has been short-cutting regulations in several areas. Accordingly, Craig Williams, founder and president of the Kentucky Environmental Foundation, says, "The Army historically has the capability to get agencies like the EPA and the Centers for Disease Control and Prevention and all of these other agencies to sign off on this stuff. The Army has just muscled their way past...regulations."¹ For example, Greenpeace asserts that the Army transported U.S. stocks from Germany to Johnston Atoll prior to issuing a final record of decision, and that the Army's Environmental Impact Statements on this transfer were incomplete.² Williams also points out that Army contractors began preparing the Anniston, Alabama, site for construction of a baseline facility before permits to build that facility were granted.³

More recently, critics assert that the EPA looked the other way when operating records showed that incinerators on Johnston Atoll dipped below the specified limits for the oxygen level. Adequate quantities of oxygen are key to the combustion process, yet when the nerve agent GB was being incinerated, the oxygen levels were inadequate twenty-five times. Oxygen levels were insufficient another 496 times when munitions were not being processed. The EPA, says Pat Costner of Greenpeace, "offered the Army a novel interpretation of the law" by redefining these incidents as "exceedences" since the Army terminated feed into the incinerators after each incident. This interpretation was tantamount to saying that "if the waste feed was stopped after the violation took place, then the violation did not take place."⁴ Furthermore, Costner says, "This is not a credible process. It is no credit to the Army and certainly no credit to the EPA. This shows illegalities, lack of ethics, lack of integrity, and lack of credibility."⁵

The Army is trying to meet congressional deadlines to complete the destruction program and the permitting process is widely recognized as a cumbersome one. On occasion, the Army has asked for their requests to be given expedited consideration, but that does not equate to skirting the regulations. Charles Baronian, formerly the Program Manager for Chemical Demilitarization, states that, "The EPA has given the Army waivers that allows it to put in a change that they feel comfortable with prior to going through the formal regulatory process for implementing those changes. These waivers were given primarily because the EPA felt that the waivers were scientifically sound. Rather than go through their normal procedures they agreed to allow us to implement

1. Interview with author, 19 May 1994.

2. Alfred Picardi, *Greenpeace Review of Johnston Atoll Chemical Agent Disposal System Draft Final Second Supplemental Environmental Impact Statement For the Storage and Ultimate Disposal of the European Chemical Munition Stockpile* (Washington, D.C.: Greenpeace, 9 July 1990) 8-9.

3. Interview with author, 19 May 1994.

4. Costner, *The Army's Experience at Johnston Atoll Chemical Disposal System*, 9.

5. Pat Costner (Presentation at a Chemical Weapons Working Group meeting, Washington, D.C., 19 March 1994).

the changes while the request was being processed.”⁶ Had the Army not made such requests, the resulting schedule delays would have likewise been criticized.

As for the so-called exceedences, the EPA’s incinerator permits stipulate that the operator automatically shut off the waste feed if any operating parameters are not being met, bring the operating parameters back to the specified range within several minutes, and if not, shut down the entire incinerator. According to Mark Evans, special assistant to the program manager, operational events can be categorized in several ways. First, the bounds of the permits do not apply to situations when no waste is being fed into the incinerator, such as when the incinerator is being started up with fuel oil. Thus, almost 500 of the alleged violations or exceedences did not involve any regulated activity. Second, when waste is being fed into the incinerator, and for instance, the oxygen level has dipped below specifications, the Army has shut off the feed as required. A third category of event would be where Army regulators reviewing operational reports later found that an operational parameter was not met and waste feed was not cut off at the time. If the Army duly reported such an event upon discovery, it would be deemed in noncompliance with the permit. Finally, if the EPA, which also reviews the operational reports, found that the Army had willfully evaded reporting a noncompliant event, the EPA would in all likelihood state that the Army violated the permit. All of the events on Johnston Atoll, Evans notes, have fallen within the first two categories and therefore have not been categorized as permit violations.⁷

Furthermore, the EPA’s Y.J. Kim, national incineration expert, and Cathy Massimino, senior Resource Conservation and Recovery Act/Superfund technical specialist, note that most of the oxygen alarms on Johnston Atoll are due to the plugging of the probes in the incinerators that measure oxygen levels. This problem has since been addressed, but the probes were plugging because of the corrosive environment and the higher operating temperatures being used, not necessarily because there was not enough oxygen in the chamber. Kim points out that the Army is “maintaining a higher oxygen supply in the combustion chamber than most other operating incinerators.” This excess oxygen in the combustion chamber and the Army’s higher operating temperatures accelerate the thermal oxidation of the wastes. These two factors also enable a higher level of destruction of the agents and reduce the formation and emission of products of incomplete combustion, or PICs. Documentation of these alarms shows whether it was a probe malfunction and if the waste feed was cut off, in which case the EPA has no reason to issue a citation. The EPA’s “enforcement is based on what type of environmental effect it has,” Kim says, and these incidents had no environmental effect.⁸

Insinuations that the EPA is “in bed” with the Army are “totally false,” says Jim Michael, chief of the Disposal Technology Section, Permits and State Programs Division of the EPA’s Office of Solid Waste. “Nothing could be further from the truth. We treat them as a regulated industry. If anything,” notes Michael, “we probably hold them to a

6. Interview with author, 10 May 1994.

7. Interview with author, 21 July 1994.

8. Massimino concurs with Kim’s statements. Telephone interview with author, 23 August 1993.

higher standard” because of the controversy surrounding the baseline program. The decision to allow the Anniston site to be prepared for construction, which amounts to bulldozing dirt around, explains Michael, was made by an Alabama EPA official who had worked in a program that allowed site preparation in advance of permit approval.⁹ The Army did not violate any regulation since this decision was consistent with regulations, a judgment that he documents with two 1992 letters.¹⁰ Michael further notes that what baseline opponents term “exceedences” on Johnston Atoll are really temporary authorizations that the EPA grants either to “protect human health and the environment” or to “prevent disruption of ongoing waste management activities.” Temporary authorizations are also well within the regulations governing hazardous waste disposal.¹¹ What the Army has done so far, Michael concludes, is consistent with regulations, and the trial burns have achieved destruction removal efficiencies beyond 99.9999 and even beyond 99.9999999. However, the EPA, he says, has given the Army “no special treatment whatsoever.”¹²

Disposal of Wastes from Baseline Incinerators

The opposition states that the Army, whether purposefully or accidentally, is engaging in ethnic ecocide. According to Greenpeace’s Costner, the Army has purposefully arranged to have the solid hazardous wastes from Johnston Atoll shipped to a storage facility in Kettleman, California, a primarily Hispanic community. The liquid hazardous wastes are being sent to Corpus Christi, Texas, another mostly minority community. Yet, once the waste leaves the island, the contracts relieve the Army of liability for it.¹³ The ash from the proposed Anniston, Alabama, incinerator would purportedly be transported to Emelle, Alabama, where the largest hazardous waste landfill in the world is located. According to another baseline critic, fully one-third of this Alabama county’s residents “live below the poverty line, and 90 percent of the residents near the landfill are African-American.” Since minority communities are frequently the last resting place for hazardous and solid wastes, “the grassroots toxics movement is composed of predominantly African-American, Asian-American, Native American, Pacific Islander, Latino and poor white communities.”¹⁴ The Army’s program is proving to be no exception to this rule.

Former Program Manager Baronian hardily refutes these charges. “These wastes are sent to licensed hazardous storage areas or landfills. I doubt that the criteria for awarding the contracts in question included any type of analysis of the racial makeup of these communities. Kettleman Hills was selected competitively.” Plant managers for baseline facilities, he explains, are responsible for contracting with certified hazardous waste handling facilities to deal with the wastes in question. “They contact the hazardous

9. Interview with author, 10 August 1994.

10. See Robert Hunter, letter to William Reilly, 24 July 1992; and Lisa Friedman, letter to Robert Hunter, 21 October 1992.

11. See Jeffrey Zelikson, letter to General Walter L. Busbee, 28 July 1994.

12. Interview with author, 10 August 1994.

13. Costner, remarks at 19 March 1994 meeting.

14. Silton, “Out of the Frying Pan,” 22.

waste industry, ask for bids, and then select the winner from the proposals submitted. What is sent to a landfill is the same kind of hazardous waste that is being sent to that facility from other parts of the United States. There is not any ulterior motive here; these are transactions with legitimate, approved businesses.” If these communities do not want to continue being in the hazardous waste disposal business, Baronian observes, they do not have to bid on these or any other contracts.¹⁵

Victoria van Roden, chief of the Permit Policy and Review Section in the Permit Branch of the EPA’s Office of Solid Waste, states that the EPA grants permits for a landfill based on technical qualifications, not the ethnic or economic demographics of the surrounding communities. Kettleman Hills is one of the oldest landfills in the United States, and the demographics surrounding that facility have undoubtedly changed since it was built, just as all communities change over time. “The Army has to deal with the sites that are permitted and available to handle these wastes. They do not go out and get a list of who lives there,” van Roden says. “People throw out this ethnic ecocide accusation because it is the latest buzzword.” What baseline opponents are driving at with this accusation, she observes, “is a bigger social issue than the baseline program’s wastes alone.” Regardless of who lives near these facilities, van Roden concludes, the federal regulations governing them “are supposed to be supportive of human health and the environment for everybody.”¹⁶

Baronian also notes that neutralization “will probably generate about twice as much material that will have to be stored at hazardous waste sites, in those same communities that the opposition is concerned about in this instance. This contradiction does not seem to bother baseline opponents.”¹⁷

The Army and Its Contractors

Other citizens believe that the Army is trying to obscure the truth about the destruction program, perhaps at the behest of defense contractors feeding a perfidious cycle and motivating the Army to use incineration as opposed to other technologies. “Follow the money,” says the Kentucky Environmental Foundation’s Craig Williams, and the real reasons for the Army’s decisions become apparent.¹⁸ “I know that there are defense contractors chomping at the bit to see the Army turn to other technologies,” says Ross Vincent, chairman of the Sierra Club’s National Hazardous Materials Committee, “but I suspect that there is an institutional interest in maintaining the flow of cash from Congress and the military and that this is part of the problem.”¹⁹ Another baseline opponent disagrees somewhat with this indictment of the defense contractors. “Defense contractors,” says James Harmon, member of the Anniston, Alabama, Citizens Advisory

15. Interview with author, 10 May 1994.

16. Interview with author, 10 August 1994.

17. Interview with author, 10 May 1994.

18. Interview with author, 19 May 1994.

19. Vincent is also a member of the Pueblo, Colorado, Citizens Advisory Commission. Telephone interview with author, 11 August 1994.

*Commission, "cannot drive something that they Army does not want. Congress and the Army are the bigger villains in this."*²⁰

A sinister connection between defense contractors and the Army's baseline program, Baronian observes matter-of-factly, does not exist. A different set of contractors would be assisting the Army had another technology been chosen. Many contractors have proposed alternative technologies, perhaps in the process falsely inflating expectations because these technologies have been tested on a small scale only with simulants, not with large quantities of real chemical agents. In sum, the Army's decisions, past and present, were based upon the fact that baseline could do the job well, not because of the persuasiveness of defense contractors. Baronian adds that the contractors for this program are mostly engineering and construction firms, rather than the big defense contractors normally associated with the procurement of military weapons systems.²¹

The Legitimacy of the Army's Interaction with Local Communities

*Many citizens believe that their concerns are not being taken seriously by the Army, which considers their opinions to be driven more by emotions than by technical facts. "The Army has a history of identifying its favorite waste disposal technologies and, from that point on, treating the effort to get it developed and used almost like a military campaign," says the Sierra Club's Vincent. "It does not matter who stands in the way. The Army views the communities to be effected like the next hill to be taken."*²² *Similar complaints about the Army's interaction with local citizens can be heard in every stockpile community.*

The public, observes former Program Manager Baronian, tends to confuse listening with heeding the advice given. "One of the things the public says is that 'we don't listen to them.' Well, what they really mean is that the Army does not *obey* them. The Army is listening and trying to react, but when it does not agree, it does not obey." Baronian lists several instances when the Army has tried to address specific recommendations from local communities. For example, the Army funded the Arthur D. Little study on demilitarizing the M55s because the people of Lexington requested it. "It cost us a couple of hundred thousand dollars, and if that is not listening, I do not know what listening is," says Baronian. Lexington citizens also requested that the Army look separately at the possibility of airlifting the stocks out of Kentucky, resulting in another study. Edgewood citizens made a similar request for a tailored shipment study for the Aberdeen Proving Ground stocks, which the Army did.²³

General Walter L. Busbee, commander and director of the U.S. Army Chemical Materiel Destruction Agency, comments that, "Johnston Island is our prototype, 6,000 miles from here, and it is hard to convince people that we did not put it out there to hide it." In fact, with the exception of the stocks transferred from Germany in 1990, the

20. Harmon is also a member of The Families Concerned About Nerve Gas Incineration. Telephone interview with author, 9 August 1994.

21. Interview with author, 10 May 1994.

22. Telephone interview with author, 11 August 1994.

23. Interview with author, 10 May 1994.

weapons had been on the island for decades. Johnston Atoll's sea environment encourages more rapid corrosion of the weapons than is occurring at U.S. storage sites, so the Army decided to destroy these stocks first. This portion of the destruction program was meant to be an open process, Busbee notes, grist for public dialogue. "We will have to demonstrate that same openness," says Busbee, "at Tooele and at the other sites in the United States."²⁴ Both Baronian and Busbee admit that the Army must do a better job of communicating with the public, of taking complicated information and presenting it in a way that the public can understand, without the "technical mumbo-jumbo that is now available."²⁵

The Operation of the Johnston Atoll Baseline Facility Combustion Efficiency and Incinerator Operating Conditions

Baseline opponents contend that the Army cannot really assure that the required destruction removal efficiency will occur at less than optimal operating conditions, such as when temperatures fall below the stipulated threshold, the rate at which material is fed into the incinerator is slower than normal, or when the agent concentration is comparatively low (e.g., on contaminated metal parts). According to Greenpeace's Costner, "Even if major upsets at incinerators could be avoided by flawless maintenance and consistent operating conditions, localized and short-term variations from ideal combustion would still occur constantly within the incinerators. These transient departures from ideal conditions can decrease an incinerator's destruction efficiency, increasing releases of both unburned wastes and PICs." During the VX trial burn, for example, about 25 percent of the process alarms were triggered when oxygen levels in the liquid incinerator dropped below permit standards. This trial burn involved just over 470 hours of processing, yet "some 3,691 major process alarms—more than 7 alarms per operating hour—occurred."²⁶ A major process alarm requires shutting off feed to the incinerator.

Another critic focuses on the Army's ability to maintain high standards once several baseline facilities are operating. "The serious question involving health effects and emissions from the proposed incinerators deals not with the optimal operation" during the trial burns on Johnston Atoll, but with "whether or not such 'up-to-the-mark' operation can be guaranteed at all times."²⁷ Or, as Harmon of Anniston put it, whether the Lincoln Towncar or the Indianapolis 500 race car wins the race depends on whether the mechanic keeps it in good order and the driver knows what levers to push. Harmon believes that baseline's incinerators "are capable of operating much more efficiently" than they have on Johnston Atoll. The Johnston Atoll track record proves that the Army is both a bad mechanic and a bad driver."²⁸

24. Interview with author, 5 May 1994.

25. Interviews with author, 5 May 1994 and 10 May 1994.

26. Costner, *GB and VX Campaigns*, 2, 10, 15.

27. Scott Mohr, "A Critique of Incineration Proposal For Destruction of Chemical Warfare Agents" (Boston, MA: Physicians for Social Responsibility, 18 March 1994) 1.

28. Telephone interview with author, 9 August 1994.

The EPA's permitting strategy, as summarized by General Busbee, is to push an incinerator to its design limits during instrumented trial burns to demonstrate that the system meets the pollution control standards. Each incinerator at each site will undergo a trial burn, supervised by the EPA, which will review the resulting data. If satisfied, the EPA will issue a permit for each incinerator that specifies the criteria and parameters at which a facility must operate at all times. For example, a feed rate ceiling that must not be exceeded is established. The Army will feed waste into the incinerators at or below the rate that has been successfully demonstrated to the EPA.²⁹ Combustion efficiency is determined by a "family of conditions," mainly by the relationship between temperature, waste feed, and oxygen, say the EPA's Kim and Massimino. When lesser quantities of waste are fed into the incinerator, additional fuel is added.³⁰ Oxygen levels, which are high to begin with, are also adjusted to maintain combustion efficiency. Therefore, variations in feed rates are not themselves problematic.³¹

As for the number of process alarms, Kim and Massimino state that the Army has set its own operational alarming system that goes beyond what the EPA requires. Other hazardous waste incinerators do this as well, but not nearly as extensively as the Army has done on baseline. For example, on the deactivation furnace there are fourteen alarms on operational parameters required by federal regulations, but the Army has added another 186 alarms for its own monitoring purposes. If one of those fourteen alarms goes off, the Army must shut off waste feed. An alarm from one of the other 186 would simply notify the Army of a need to make an adjustment to preclude a problem of actual significance. Similarly, the agent incinerator has twenty-nine federal "waste cutoff" alarms and seventy-one of the Army's own additional alarms. The metal parts furnace has ninety-five total alarms, only twenty-nine of which are federally required. In sum, Kim and Massimino say that the number of process alarms may be high, but the lion's share of them do not involve federally regulated activities.³²

To illustrate the baseline facility's capabilities under less than optimal operating circumstances, Baronian describes a scenario where several contaminated artillery shells are in the metal parts furnace, which is used to decontaminate drained munitions and containers, when feed is stopped because an operational parameter is not being met. (Waste cutoff, he notes, is instantaneous in the case of the agent incinerator.) To begin with, Baronian explains there are two incinerators capable of destroying the agent: primary furnaces each have an afterburner. If the primary incinerator experiences problems, the afterburner would destroy any hazardous materials in the exhaust gases. Conversely, since the agent will be destroyed in the first incinerator, problems in the afterburner should not be a concern. Therefore, the only truly credible scenario for a failure of the system would be that both furnaces would not be operating at optimal

29. Interview with author, 5 May 1994.

30. Telephone interview with author, 23 August 1994. Former Program Manager Baronian concurs. Interview with author, 10 May 1994.

31. Telephone interview with author, 23 August 1994. See also Kim and Massimino's remarks about the causes and implications of oxygen alarms under the heading "Army Adherence to Regulations."

32. Telephone interview with author, 23 August 1994.

conditions simultaneously. Should that happen, he explains, residual heat in both chambers continues to destroy the agent. If necessary, however, the metal part can be removed from the furnace. "The Army cannot see a scenario whereby both furnaces are lost simultaneously, the item being processed cannot be removed, *and* it stays in so long that residual heat is also lost," says Baronian. "The redundancy in the system is such that under any scenario, we can take appropriate corrective action to prevent an agent release from the stack. If, however, the critics are right and all of these impossibilities occur at once," Baronian continues, "the Army is taking another safety step by adding the new charcoal filters that the NRC recommended to prevent the escape of agent during upset operating conditions. These charcoal filters will be used at Tooele and at all of the subsequent sites. Charcoal filters will also further eliminate semi-volatile and volatile organics, including dioxins and furans."³³

The Scientific Standards of the Army's Operations

Baseline opponents assert that the procedures used during the trial burns and operational verification tests do not meet commonly accepted scientific standards. Greenpeace's Costner states that, "Numerous inconsistencies in the data collected during these burns attest to a broad array of shortcomings ranging from carelessness to apparent falsification of data. These problems are of sufficient magnitude to invalidate entirely the results" of trial burns for the agent and metal parts incinerators.³⁴ More specifically, Costner charges that during the trial burn of mustard from ton containers, the Army did not know the extent to which the mustard had jelled or formed different compounds. To measure how much of this goo was left in the ton container before putting it into the incinerator, the Army used wooden dipsticks, which calls into question their ability to quantify the amount of agent remaining. This approach shows "either a total lack of integrity or absolute incompetence" and, according to Costner, it negated any ability to measure the true efficiency of the incinerator.³⁵

During tests with simulants-filled munitions before the trial burn, the Army determined that draining the ton containers and projectiles would be problematic because the contents in some cases may have thickened. General Busbee explains that the EPA was present throughout all of the trial burns. In this particular instance, the Army complied with the EPA's request to enable a worst-case evaluation of the incinerator's capabilities by artificially refilling a tray of projectiles and ton containers with the amount of jelled agent that would have been left over after draining. These items were then processed in the metal parts furnace. As part of the permit request, the Army presented the EPA with very detailed analyses of mustard agent, as well as the other agents in the stockpile. Despite the age of the agents and evidence of their decomposition noted at the time, the basic chemical composition of what was being incinerated—sulfur, chlorine, carbon, and hydrogen—was clear to those overseeing the trial burn. Next, by taking a dipstick measurement and using calculus, Army officials were able to quantify

33. Interview with author, 10 May 1994.

34. Costner, *Incineration of HD Agent*, ii.

35. Costner, remarks at 19 March 1994 meeting.

the amount of agent remaining in the containers. The practice derided by Greenpeace, according to Busbee, is an accepted scientific one involving proven mathematic principles.³⁶

The EPA's Massimino and Kim note that the weight of empty munitions and containers is known and that these items are weighed after being drained and before they are processed. However, since measurements are not always exact, they rely upon a very conservative calculation that assumes that 5 percent of the contents of a munition or container will remain in these items when they are incinerated. High operating temperatures, lengthy treatment times, and the safeguard of a final airlock, where detectors sample processed items twice for the presence of agent, combine to destroy any residual agent in these munitions and containers. Massimino and Kim explain that if the agent monitors in the airlock go off, the items are returned to the incinerator until no detectable signs of agent remain.³⁷

Moreover, observes Baronian, since the Army has set monitoring standards that are independent of and stricter than the destruction removal efficiency, the exact composition or quantity of agent really does not matter. The Army does not consider the destruction removal efficiency to be a suitable approach or standard, so it set its monitors to detect *any* agent coming out of the stack. No agent was detected during the trial burn of mustard agent from ton containers. In fact, no agent has been detected while the incinerators were running. "Regardless of the exact composition or quantity of what we are putting in, we still cannot detect agent emitting from the stack," says Baronian.³⁸

The Caliber of the Army's Agent Monitors

*Standard commercial monitors are not being used to detect agent and therefore are not reliable, according to the opposition. In the words of Greenpeace's Costner: "These systems have not been validated by the U.S. Environmental Protection Agency as suitable for monitoring stack emissions of agents. Consequently, no means were available for providing reliable estimates of stack emissions or fugitive emissions of active chemical agent nor were means available for adequate identification and quantification of other chemicals released from the stack.... Given monitors of such obviously poor reliability and undisclosed accuracy, the placement of only one functioning monitor in the common stack seems more an attempt to avoid detecting stack releases of agent than an effort at detection."*³⁹

*Vincent of the Sierra Club classifies the equipment used to monitor incinerators as typically "pretty primitive." The problem, he explains, is that the enormous quantities of air coming out of the stack mask the toxic pollutants. If the air flow was smaller, the monitors might be able to detect more.*⁴⁰ *Anniston's Harmon believes that the Army "would be embarrassed" if it allowed its monitors to be independently tested. He recalls*

36. Interview with author, 5 May 1994.

37. Telephone interview with author, 23 August 1994.

38. Interview with author, 10 May 1994.

39. Costner, *GB and VX Campaigns*, 2, 20.

40. Telephone interview with author, 11 August 1994.

reports that detectors provided by the Russians, Czechs, and West European military services performed, by some accounts, better than U.S. detection equipment during the Persian Gulf War. He also notes that the NRC reviewed the Army's monitoring systems and made several recommendations for improvements.⁴¹

Army officials state that the agent monitors were developed specifically for the baseline program, but gas chromatography, which is at the heart of the detection technology, is a standard laboratory and commercial technology. Baronian explains that the Army adapted this technology, primarily by adding a mechanism to allow detection of smaller concentrations. Special Assistant to the Program Manager Evans adds that similar detectors for commercial use are available.⁴²

Two different types of agent monitors, each with backups, are placed at each incinerator and in the common exhaust stack, according to Evans. The near real-time detectors, called the Automatic Continuous Air Monitoring System (ACAMS), are placed in each furnace duct and in the smokestack. Key ACAMS placements operate around-the-clock, and they also have backups. Figure 12 shows an ACAMS detector. All monitors are tested at least every twenty-four hours to ensure that they are operating correctly. Monitors in the smokestack are tested every four hours. Evans states that this approach guards against a "false negative," where the alarms would not detect an agent release. The monitors used for more detailed analysis to confirm or disprove ACAMS readings, the Depot Area Air Monitoring System, collect samples over a period of hours, which are then analyzed using gas chromatography.⁴³

False Alarm Rates of the Army's Agent Monitors

Throughout the trial burns on Johnston Atoll, opponents charge that agent detectors have gone off at an alarming rate. "The analytical systems used to detect unburned chemical agent in the incinerator stack, other on-site monitors and monitors at the perimeter of the facility had unacceptably high rates of malfunction during both the GB and VX campaign," claims Greenpeace's Costner. She asserts that during the GB trial burn, the reliability of these monitoring systems was, "at best, questionable." Costner categorizes a "sensitivity to interferences that accounts for 34 percent of" these alarms as "unacceptable."⁴⁴ Harmon observes that baseline operators often could not tell when an alarm was a real or false one, perhaps because the sophisticated equipment employed was too much for the operators to handle. "The system does not seem to work," he said, because "the process seems to be too complex for the people operating it."⁴⁵

None of these alarms should be a cause for real concern, according to Baronian, formerly the destruction program's top civilian official. These alarms are investigated with in-depth chemical analyses, which in the large majority of instances proves them

41. Telephone interview with author, 9 August 1994.

42. Interviews with author, 10 May 1994 and 21 July 1994.

43. Interview with author, 21 July 1994.

44. Costner, *GB and VX Campaigns*, 2, 15, 20.

45. Telephone interview with author, 9 August 1994.

to be false alarms, or “false positives.” Well below one-tenth of 1 percent (0.1%) of the readings taken by these detectors have involved alarms. On Johnston Atoll, the Army has nearly seventy alarms sampling on roughly five minute cycles. If one does the arithmetic, that works out to over 20,000 monitoring samples *daily*. This figure does not include the samples by the other, more sophisticated detectors, which test the air over a period of hours to prove or disprove false positives. Given the sheer magnitude of the samples taken, getting one false alarm out of approximately every 8,750 monitoring cycles is a very small percentage.⁴⁶

Special Assistant to the Program Manager Evans also explains that calculations showing the average number of false alarms over a period of time can be misleading. The Mitre and NRC reports, for example, refer to an average of one alarm every fifty-two or 152 hours for different periods of operation. “False alarms do not occur in ‘one’s,’ they happen in groups. A cluster of false alarms is usually tied to a single event, such that several will go off in succession,” he says. Most calculations do not count these clusters as a single false alarm, which makes the overall false alarm rate appear to be higher than it actually is.⁴⁷

One cause of the high false alarm rate is that the monitoring system being used is generic, as opposed to agent-specific. A preferable situation would be to have dedicated detectors for each type of agent being processed. Baronian adds, therefore, that the Army is weighing the use of passive infrared and mass spectrometer monitors that are being developed—both of which would be more specific to the agent. The Army’s efforts to improve the monitoring system are in line with the NRC’s recommendations.⁴⁸ According to the EPA’s Massimino and Kim, while there is always room for improvement in a monitoring system, the Army has taken the initiative in improving its monitors without being asked. For example, they have reduced the sample cycling time from twelve minutes to three or four minutes.⁴⁹

Another factor that makes the detectors vulnerable to interference is that their detection limits are set so low. The Army could have set the concentration that is measured high enough that interfering elements would not cause an alarm, or, alternatively, it could keep it as low as possible and shut down after an alarm. The Army erred on the side of safety, Baronian says, because the Army understands that it is better to have false alarms than to have an agent release that is not detected.⁵⁰ Massimino and Kim also note that “any” monitoring system would have problems with interferents causing false positives.⁵¹

46. Interview with author, 10 May 1994.

47. Interview with author, 21 July 1994.

48. Interview with author, 10 May 1994. See also NRC, *Review of Monitoring Activities Within the Army Chemical Stockpile Program* (Washington, D.C.: National Academy Press, 1994) 33–41.

49. Telephone interview with author, 23 August 1994.

50. Interview with author, 10 May 1994.

51. Telephone interview with author, 23 August 1994.

Figure 12: The Automatic Continuous Air Monitoring System.

Photograph courtesy of the U.S. Army Chemical Materiel Destruction Agency.

Army Screening for Products of Incomplete Combustion

Baseline critics often point out that the EPA says that incineration probably causes thousands of PICs. Moreover, the opposition says that the Army is not monitoring for PICs. According to Greenpeace's Costner, "No attempt was made to identify many of the other products of incomplete combustion (PICs) that were known or suspected to be present in stack emissions and residues. This lack is particularly problematic for those chemicals of greatest toxicological concern that are potentially created during the incineration of mustard."⁵² Vincent of the Sierra Club gives a somewhat more charitable review. "The Army," he says, "has certainly done no worse and maybe even a little better than most commercial operations. Still, their effort falls far short of identifying all of the PICs."⁵³

Army officials state that during the trial burns on Johnston Atoll, stack gases were sampled using EPA-approved procedures and later analyzed by the EPA and the Army. "All of these PICs were measured for at the very, very lowest level that micro-quantitative chemistry allows," states General Busbee. However, Busbee recalls that dioxins and furans were detected only in the set of trial burns when aviation fuel oil, not chemical agent, was being incinerated. "While there were more detectable compounds in that instance, the related stack emissions were essentially the equivalent of a Boeing 747 jetliner in flight. The baseline incinerators met or exceeded all EPA standards for the

52. Costner, *The Incineration of HD Agent*, 2.

53. Telephone interview with author, 11 August 1994.

specified compounds. In the case of particulates, dioxins, and furans, the Johnston Atoll incinerators were on the order of a hundred to a thousand times better than the average hazardous waste incinerator operating in the United States.” Busbee adds that trial burns at Tooele should show improvement over this record, since Tooele and all other U.S. facilities will have improved pollution control and monitoring systems.⁵⁴

Incineration, notes former Program Manager Baronian, is not “alchemy or matter conversion.” Incinerator emissions bear a resemblance to what is put into them and the products of incomplete combustion screened for on Johnston Atoll were carefully predicated upon the type of waste processed in each trial burn. “If you put carbon, hydrogen, oxygen, and nitrogen into the incinerator, those same elements have to come out of the stack,” he says. The Johnston Atoll samples looked for the whole menu of possible PICs—heavy metals, volatiles, nonvolatiles, dioxins, furans, organics.⁵⁵ According to the EPA’s Kim, during trial burns they did their “best to include all known compounds that would come of these agents.” Though these tests did not search for all possible PICs, they included the PICs flagged by the EPA as of most concern.⁵⁶ The Army screened for more than 130 PICs in each trial burn with agent.⁵⁷

Busbee points out that the EPA has not even established standards for all PICs.⁵⁸ Moreover, says Baronian, “the technology to look for one thousand possible compounds or to quantify 100 percent of the emission contents simply does not exist.”⁵⁹ Nor, for that matter, does the technical capability to monitor continuously for PICs exist, adds Busbee. No hazardous waste incinerator in the United States monitors on a continual basis for PICs.⁶⁰ Therefore, an element of uncertainty will always remain as far as the nature and quantity of what is coming out of the smokestack. Baronian observes that baseline opponents do not assail the actual trial burn data, but seek instead to exploit that element of uncertainty by lodging an incredible all-purpose “what if” charge. This charge is impossible to address, he says, technically or otherwise.⁶¹

To put all of this in perspective, Busbee encourages a comparison of the Johnston Atoll trial burn results to background sources of PICs that would normally be encountered in various parts of the United States—the emissions from coal burning power plants, smelters, refineries, diesel trucks, and other combustion sources. The Army has done a

54. Interview with author, 5 May 1994.

55. Interview with author, 10 May 1994.

56. Massimino, also of the EPA, concurs with this statement. Telephone interview with author, 23 August 1994.

57. For more information, see Table 4 on p. 42.

58. Interview with author, 5 May 1994.

59. Interview with author, 10 May 1994.

60. Interview with author, 5 May 1994. Kim and Massimino note that the baseline will have the only incinerators monitoring on a continual basis for any particulate emissions—in this case for agent emissions. Baseline incinerators will follow the standard practice of surrogate monitoring for PICs by continually tracking carbon monoxide and hydrocarbon emissions, which are good indicators of combustion efficiency and therefore PIC emissions. Telephone interview with author, 23 August 1994.

61. Interview with author, 10 May 1994.

background pollutants analysis for the Anniston site. According to Busbee, “it shows that a baseline facility is almost not even a blip on the curve with respect to the ambient background concentration” of these kind of pollutants.⁶²

Comparative Wastes from Incineration and Neutralization

The operational verification tests on Johnston Atoll have produced more wastes than would have resulted under neutralization, according to baseline opponents. Costner calculates that 9.5 pounds of residues were created per pound of VX processed on Johnston Atoll.⁶³ She asserts that these results invalidate one of the principal reasons why Army officials decided to discard neutralization as a destruction technology—that neutralization would produce far more wastes than incineration.

Anniston’s Harmon states that Johnston Atoll is now getting about four pounds of waste salts per pound of agent destroyed. He notes that if the newest approach to neutralization can achieve similar success with larger quantities of agent, then neutralization may produce about three pounds of waste per pound of agent. In that case, the waste question would be a “toss up” between which method was substantially more effective in waste reduction. However, Harmon observes, “In Anniston, whether we end up with 800,000 or one million pounds of waste should not be the determining factor” as to which type of technology is used.⁶⁴

The Johnston Atoll facility, General Busbee reports, is actually getting about two pounds of salt per pound of agent destroyed.⁶⁵ Evans, special assistant to the Program Manager, explains that this higher yield of waste is due to a plant design flaw that has since been corrected. The Johnston Atoll facility has a large pipeline feeding pH into the pollution abatement system, which makes control over that feed less precise and has resulted in higher brine salt yields than predicted. Smaller pH feed pipes in the continental baseline facilities will enable the actual salts per pound of agent yield to come closer to the calculated quantities, which are 0.6 pounds for the nerve agent VX, 0.9 pounds for the nerve agent GB, and 1.2 pounds for mustard.⁶⁶

Busbee also explains that other items that come out of the plant, including the decontaminated artillery shells and the protective suits worn by workers, are sometimes lumped into the figures cited for Johnston Atoll wastes, inflating the waste per pound of agent. Had neutralization been used, these other items would also be part of the total wastes from destruction. Neutralization involves diluting the material and then adding an oxidizing agent, a caustic solution like sodium hydroxide (lye). To obtain an irreversible degree of destruction and to get rid of the resulting neutralizing solution, the Army’s best efforts in previous research yielded five to six pounds of brine salts for every

62. Interview with author, 5 May 1994.

63. Costner, *GB and VX Campaigns*, 8.

64. Telephone interview with author, 9 August 1994.

65. Interview with author, 5 May 1994.

66. Interview with author, 21 July 1994.

pound of agent. The waste still contained trace amounts of heavy metals. This type of hazardous waste must be disposed of in an approved landfill.⁶⁷

Neutralization may reduce air emissions, observes Baronian, but the by-products of destroying something must go somewhere. "I say, without fear of being wrong, that neutralization will generate, based on what we know today, at least twice as much waste as the incinerators do." Baronian concludes that, "Neutralization is certainly not the answer to reducing waste," but the Army is nonetheless sponsoring additional research in this area.⁶⁸

The Risk Assessment Supporting the Army's Decisions

Completeness of the Army's Risk Assessment

According to baseline critics, the risk of exposure to dioxins and toxins is many times greater through the food chain than it is through direct inhalation. Greenpeace states that, "As with metals, both deposition of PICs onto the surfaces of edible vegetation and their uptake from soil and water play significant roles in human exposure." Greenpeace also reports that exposure to PICs can also occur via ingestion of milk, meat, and eggs. "In Europe and the U.S., ingestion of dairy products is considered a primary route of human exposure to [dioxins and furans], with daily doses approximately 12 times higher than those associated with inhalation."⁶⁹ A new EPA study on dioxin also focuses on exposure via the food chain.⁷⁰ Critics therefore argue that the Army's risk assessments have calculated the risk of relatively improbable things, such as airplane crashes and earthquakes, but have ignored the most important factors, like the long-term health risks to the population through the food chain.

In particular, baseline opponents emphasize that the Army's risk assessment does not evaluate the risk of incineration (e.g., actual smokestack emissions, food chain exposure) and the risk of using alternative technologies (e.g., demilitarizing the weapons followed by neutralization). Furthermore, a good risk assessment would address: 1) the destruction removal efficiency for incinerators processing items with low concentrations of contamination (e.g., the metal parts and dunnage incinerators); 2) operational upsets in the incinerator; 3) knowing violations of the law that Army officials or contractors may commit; and 4) persistence of health and environmental effects due to the agent/dioxins in the environment and the food chain. In short, a sound risk assessment would address what came out of the stack, who and what was exposed to it, and what happened as a result.⁷¹

Baronian firmly states that all of these factors have indeed been taken into account to the extent possible. The risk assessments supporting the Environmental Impact

67. Interview with author, 5 May 1994.

68. Interview with author, 10 May 1994.

69. Costner and Thornton, *Playing With Fire*, 39-40.

70. Lee, "Dioxin Study Spurs Plea for Restrictions," A8.

71. Mick Harrison (Presentation at a Chemical Weapons Working Group Meeting, Washington, D.C., 1994).

Statement calculated the acute risks—the one-time events that may never happen but could have catastrophic consequences if they did. For the chronic risks, the Army went to the Centers for Disease Control and Prevention and the EPA, which have calculated with a great degree of safety factors the emissions that can be released from an incinerator without creating a long-term risk to the population or the environment. “The Army accepted their conclusions because they are the experts in this area. They are confident that they have established criteria that would adequately protect against chronic exposure,” Baronian says. In short, latent health risks, while not calculated directly by the Army, have been addressed by the government authorities that regulate these matters.⁷²

General Busbee adds that while the Army did not study the latent or long-term risks associated with PICs, it did study exposure to agent. Still, the Army does not claim that this research is comprehensive because its database on human exposures to agent simply does not support a definitive study. To address the concerns about the risk assessment done for the destruction program as a whole, Busbee reports, “We are doing the site-by-site programmatic risk assessments and site-specific environmental impact statements that will update earlier risk assessments and include indirect latent risk and health assessments.” However, he observes that completion of these studies is not likely to resolve the controversy surrounding the risk assessment because the Army will still lack a database encompassing forty years of exposure data that would be related to this type of incineration operation. Nonetheless, the Army has understood from the beginning that agent emissions were unacceptable and therefore designed its facilities “to operate so that we never detect agent coming out of the incinerator,” Busbee concludes. As a result, the PIC emissions from baseline incinerators are way below federal standards and what is normally associated with incineration operations.⁷³

M55 Rocket Instability and the Risk Assessment

The Chemical Weapons Working Group asserts that the Army “grossly exaggerated” the risks of continuing to store the M55 rockets by saying that accidental detonation could take place within 17.7 years. Instead, this group believes that the results of a new study on the M55s show that the rockets should be safe for at least 120 years. These new figures undermine the Army’s risk assessment, as well as the recommendations of the NRC that are built upon it. This opposition coalition also charges that recent safety improvements at the storage sites have reduced the risk from storage by over 90 percent from what they were when the 1988 risk assessment was compiled. This factor as well was not included in the NRC’s recent recommendations. The bottom line, according to the Kentucky Environmental Foundation’s Williams, is that, “The Army has tried to sell their incineration scheme based on fear, intimidation and outright lies.”⁷⁴

The whole decision-making process, states baseline opponent Harmon, has been distorted because everyone has been working under the impression that “my god, we have

72. Interview with author, 10 May 1994.

73. Interview with author, 5 May 1994.

74. Press Release (Berea, KY: Chemical Weapons Working Group, 10 August 1994).

got to hurry. We cannot afford to wait because of the M55s." This impression is false, says Harmon.⁷⁵ The Sierra Club agrees. "They now appear to be using the M55s as an excuse to discourage thoughtful analysis of better approaches and to urge 'panic' construction of controversial and unreliable 'baseline' incinerator complexes."⁷⁶

Initial results from a study being conducted in response to a request from Tooele, Umatilla, Pine Bluff, Anniston, and Blue Grass Army Depot citizens show that the M55 "may have a longer safe storage life than had previously been predicted." The NRC had also recommended that the stability of the M55s be reevaluated. The full study will be completed later this year, but the Army does not expect the results to effect the viability of the original risk assessment that supported the decision to destroy the stockpile on-site via high temperature incineration. The main reason is that this risk assessment did not factor in the M55 problem in the first place. Instead, it focused on the potential for stockpile accidents to result from such events as tornadoes, airplane crashes, and earthquakes. The Army will use the new M55 study to enhance its stockpile maintenance program until destruction is completed.⁷⁷

The NRC's Stockpile Committee responds that, "The risk of detonation of M55 rockets from spontaneous ignition of M55 propellant was never the basis of the committee's recommendations for promptly proceeding with the disposal program. Consequently, the new information regarding propellant stability does not change the recommendations of the committee." Moreover, "the committee believes that the Army, during its ongoing briefings and presentations to the committee over the years, and in its recent presentation of this new information, has been honest and candid."⁷⁸

As for the assertion that the risk of stockpile storage has been reduced by 90 percent since the 1988 risk assessment was done, the Army is unaware of any data that supports this contention. Furthermore, plans for mitigating the risks of stockpile storage had been laid at the time the original assessment was prepared and were factored into that evaluation. Updated and site specific risk assessments that include all of the latest data are now being done for Tooele and Anniston and will be prepared for the other sites as well.⁷⁹

Alternatives to the Current Destruction Program

Capabilities and Availability of Alternative Technologies

Greenpeace advocates a destruction program that uses a number of "closed-loop" technologies. In a major 1991 report, Greenpeace described several alternative technologies categorized under the headings of biological methods, chemical processes, photochemical processes, electrochemical techniques, neutralization, chemical reprocessing,

75. Telephone interview with author, 9 August 1994.

76. Sierra Club, "Analysis of Dr. Carl Peterson's Recommendations," 3.

77. U.S. Army Chemical Materiel Destruction Agency, Risk Assessment Survey, News Release (Aberdeen Proving Ground, MD: Chemical Materiel Destruction Agency, 8 August 1994).

78. "Statement of the Stockpile Committee" (Washington, D.C.: NRC, 15 August 1994).

79. U.S. Army Chemical Materiel Destruction Agency, Risk Assessment Survey, News Release.

and thermal processes. Since the publication of that report, baseline opponents have argued with increasing conviction that safer alternatives are both feasible and available. According to Pacific Campaign Coordinator Sebia Hawkins of Greenpeace, "All of the technologies Greenpeace reviewed would definitely be better than incineration."⁸⁰

Baseline opponents also state these technologies could be available in sufficient time to meet international treaty commitments and to demilitarize the stockpile before the purported dangers of storing these weapons increase significantly. According to the Sierra Club's Vincent, the Army already has enough experience with neutralization to make a neutralization facility "operable within two or three years. The private sector could do it in that time-frame."⁸¹ Another example of a technology that opponents tout is the Defense Department's Advanced Research Projects Agency's supercritical water oxidation project, which, according to bench-scale tests on all chemical agents, can achieve a destruction and removal efficiency of six nines or better.⁸²

Other experts counter that well over a decade could be required to develop, test, and bring alternative technologies on line. The NRC, for example, concludes that it could take from five to twelve years to take an alternative technology through research, development, and pilot plant phases.⁸³ Building upon the NRC's work, the GAO estimates that alternative technologies could be available between the years 2007 and 2011. As Table 6 shows, the GAO also notes that several alternative technologies would need to be combined to treat the stockpile, since no technology except baseline can destroy or decontaminate the chemical agent, the explosives/propellants, the metal parts, and the dunnage.⁸⁴

The main disadvantages to incineration are that its health effects are still unknown, and complex pollution control systems are needed. The GAO also lists the disadvantages of other technologies. For example, the by-products of neutralization are extremely variable and may cause problematic emissions. Moreover, the neutralized wastes must be treated again, oxidized to stabilize the waste for suitable disposal (e.g., landfilling). With fluidized bed combustion, the GAO notes that it is difficult to achieve the desired destruction and removal efficiency. Operating pressures used during wet air oxidation could result in dangerous leaks. The gas emissions from wet air oxidation will also contain appreciable concentrations of volatile organic compounds and will require additional treatment before release into the atmosphere. Use of molten metal pyrolysis would create gases that contained combustible organic materials and would be very dirty or sooty. A separate afterburner and purifier unit would therefore be needed to clean these gases.⁸⁵ In short, no single technology can be portrayed as risk-free or free of drawbacks.

80. Lawyers Alliance for World Security, *Citizen Attitudes*, 26.

81. Telephone interview with author, 11 August 1994.

82. "Supercritical Water Oxidation Proven," *Environmental Protection* (29 June 1994) 123.

83. This estimate does not take permitting and construction timelines into account. NRC, *Alternative Technologies*, 90.

84. GAO, *Advantages and Disadvantages of Alternatives to Incineration*, 5-9.

85. GAO, *Chemical Weapons: Issues Involving Destruction Technologies*, GAO/T-NSIAD-94-159 (Washington, D.C.: GAO, 26 April 1994) 10-16.

Table 6: Destruction and Decontamination Capabilities and Availability of Alternative Technologies.					
Technology	Can the technology destroy/decontaminate...				Estimated Year to Reach Full-Rate Operations
	Chemical Agent?	Explosive Propellants?	Metal Parts?	Dunnage?	
Baseline Incineration	Yes	Yes	Yes	Yes	Present
Molten Salt Oxidation	Yes	Yes	No	No	2007 to 2008
Fluidized Bed Oxidation	Yes	Yes	No	No	2007 to 2008
Molten Metal Pyrolysis	Yes	Yes	Yes	No	2007 to 2008
Plasma Arc Pyrolysis	Yes	No	No	No	2007 to 2011
Steam Gasification	Yes	No	No	No	2007 to 2011
Wet Air Oxidation	Yes	Yes	No	No	2007 to 2008
Supercritical Water Oxidation	Yes	Yes	No	No	2007 to 2008
Chemical Neutralization	Yes	No	No	No	2007 to 2008

Sources: *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration*, (Washington, D.C.: GAO, March 1994) table 1 and table 3, pp. 5, 8.

Army Efforts to Develop Alternative Technologies

Many baseline opponents suspect or believe that the Army has never earnestly studied alternative technologies. "Since the 1970's, the Army has never seriously considered alternatives to incineration, even though the Army, in its various laboratories and at its many contractors, has the technical capability to develop other options," says the National Toxics Campaign Fund. Moreover, the Army tried to block a Defense Advanced Research Projects Agency research program that might have buttressed some of the opposition's positions.⁸⁶ While that program was funded, opponents point to the comparative lack of funding for alternative technologies in the last several years as evidence of the Army's unwillingness to consider technologies other than baseline. The Sierra Club concludes that, "The Army has already spent a decade and several billion taxpayer dollars supporting incineration and has a history of resisting serious consideration of alternatives."⁸⁷

Harmon of Anniston observes that, "For the last two years the Army has had \$25 million that Congress has directed them to spend on alternative technologies and they have not spent one damn dollar. The Army says that nobody has come to them and asked for it." This is nonsense, according to Harmon, who explains that the normal process is that the Army would solicit bids for developmental work on alternative technologies. The Army's present approach allows them to tell Congress that no firms are interested in developing alternative technologies, Harmon states. He does concede that the Army gave neutralization a "realistic look" earlier, but then discarded it because there was a question of whether "a toxic adventure might rise up out of a barrel." Incineration was chosen because at that time it gave the Army "less visible problems," says Harmon.⁸⁸ Vincent

86. Siegel, *The Threat at Home*, 16.

87. Sierra Club, "Analysis of Dr. Carl Peterson's Recommendations," 4.

88. Telephone interview with author, 9 August 1994.

*comments that lately, however, the Army has not intently pursued an alternative technologies research program, despite the promise of several potential candidates, most notably a neutralization approach that could treat all agents. "If the Army were really serious about developing alternative technologies, they would have been doing it for years and we would have them by now," says Vincent.*⁸⁹

For more than seventy years, the Army has conducted research to devise means to protect its soldiers on the battlefield from chemical attacks. Efforts to devise a destruction program grew out of this research. According to General Busbee, "The Army did study a whole series of alternatives, including neutralization, going back to our pioneering programs in the 1970s, when we had to destroy aging weapons at Rocky Mountain Arsenal. On an industrial scale basis, we pursued destroying the nerve agent GB and mustard using two destruction technologies—neutralization and high-temperature incineration." In Busbee's narration of events, the next key milestone was when the Army presented all of its data from laboratory work and the experience with prospective destruction technologies to the NRC, which in 1984 endorsed incineration as the most direct and likely route applicable to all three agents in the stockpile. In 1985, when Congress mandated that the stockpile be destroyed within such a short time-frame—originally by 1994—there were still questions about neutralization's reversibility and disposal of the resulting hazardous wastes. The Army therefore went with the most efficient technology that could completely destroy the agent. Once this decision was made, unless significant problems or concerns of catastrophic failure arose, Busbee says the Army saw no reason to spend an extra \$200 million on parallel research programs.⁹⁰

Comparisons of the money spent on baseline versus alternative technologies are difficult, says former Program Manager Baronian, because baseline was developed before the current, more stringent regulatory requirements. The permitting process consumes a significant amount of time and effort. The baseline development program at the Tooele pilot facility cost about \$22 million, whereas the Army is initiating a \$45 million research and development program to investigate the feasibility of neutralization as a stand-alone technology or followed by biodegradation. If one must make funding comparisons, Baronian concludes that these two figures are roughly comparable.⁹¹

This new research program is built around a recent Army breakthrough with a modified neutralization technique. Laboratory tests using a few hundred grams of pure agent—not degraded or gelled agent that is more difficult to destroy—have shown that neutralization might produce three or four pounds of waste per pound of agent neutralized. The results of this "pioneering" laboratory work may not hold true on the larger scale that would be needed for neutralization to be used for stockpile destruction, Busbee warns, but this additional work is being pursued.⁹²

89. Telephone interview with author, 11 August 1994.

90. Interview with author, 5 May 1994.

91. Interview with author, 10 May 1994.

92. Interview with author, 5 May 1994.

Feasibility and Desirability of Disassembling the M55 Rockets

*The opposition interprets the Arthur D. Little report as proof that chemical agent can be separated safely from munitions. The Chemical Weapons Working Group states that "The Arthur D. Little study of 1985 provides a blueprint for removing the agent from M55 rockets in a closed-looped system and decontaminating rocket parts to the 3X level," which is safe for personnel handling without protective equipment.*⁹³ *Similarly, another baseline opponent states, "The Army can demilitarize its active CW munitions, decreasing the threat of accidental release of nerve gas or mustard gas. By separating the agent from explosive bursters and propellants, the risk that explosion will disperse the poison is virtually eliminated."*⁹⁴ *If the Army was really interested in mitigating risks to the community as soon as possible, concludes the Kentucky Environmental Foundation's Williams, they would not have let this demilitarization concept plan sit on the shelf for almost a decade.*⁹⁵ *Karyn Jones, who lives near the Umatilla site, says, "If safety is really the main issue here, I'd like to know why" the Army has not separated these dangerous munitions as diagrammed by this study. "It is very distressing," she notes, "that this technology has been available so long, and that it has not been done."*⁹⁶ *The Sierra Club agrees. "The Army has had in its archives a contractor-recommended approach to eliminating those excess risks for nearly a decade. They have done nothing about it."*⁹⁷

According to General Busbee, the Army requested the Arthur D. Little study to see what could be done if the M55s presented an imminent danger before they could be eliminated. Since the baseline program was not encountering difficulties that would significantly delay its implementation, the Army saw no need develop this plan. This preliminary study examined a series of processes and presented suggestions to de-mate the rocket motor from the warhead. A follow-up study, due in October 1994, is being conducted, including a safety analysis of the multiple handling steps recommended in the original report. This analysis will enable a comparison of whether it is safer to get rid of the M55s in one step, as the baseline process does, or to disassemble them in the interim.⁹⁸

Busbee cautions that the M55 hazard would not be eliminated by de-mating the rocket motor from the warhead. The 500,000 M55s at five continental U.S. locations would, if this approach were followed, generate at least one million hazardous components. The M55 warheads, he explains, are made of a thin-skinned aluminum, and their propensity to leak will depend upon the number of times a weapon was moved or shaken and the deterioration of the warhead. Other hazardous components will be burster tubes and shells contaminated with agent. Also undetermined is whether, once de-mated, any

93. Chemical Weapons Working Group, "Citizen's Solution," 1.

94. Siegel, *The Threat at Home*, 14.

95. Interview with author, 19 May 1994.

96. *Umatilla Citizens Advisory Commission Meeting* (Hermiston, OR: Program Manager for Chemical Demilitarization, 14 March 1994) 49, 52.

97. Sierra Club, "Analysis of Dr. Carl Peterson's Recommendations," 3.

98. Interview with author, 5 May 1994.

of these items could be shipped elsewhere for disposal. In short, while the Arthur D. Little report has been portrayed as a final game plan, it is, Busbee notes, only an exploratory study.⁹⁹

Neutralization as a Satisfactory Method of Destruction

*While the Chemical Weapons Convention does not stipulate the method that nations must use to destroy their chemical weapons, it does specify that the destruction method be “irreversible” as well as safe for humans and the environment. Opponents to baseline argue that enough evidence is already in hand to conclude that demilitarizing the weapons—separating the agent from the other weapon components—and neutralizing the agent would be a significant step toward destruction and should therefore satisfy treaty requirements. In its early efforts, the Army had difficulty determining whether neutralization was complete, Harmon recalls. Therefore, the Army kept adding more neutralizing solution to the mix when the problem was not that the agent had regenerated itself, but that the Army’s test of the resulting wastes was inaccurate. Since more neutralizing solution was added than required, the amount of wastes that are normally cited for neutralization are higher than they should be.*¹⁰⁰

Independent assessments appear to support the assertion that demilitarization and neutralization could fulfill treaty obligations. Legal analyst David A. Koplow notes that were the munitions crushed, punctured, or cut in two and the agent neutralized, the weapons “would verifiably no longer be suitable for chemical weapons purposes.”¹⁰¹ The NRC agrees, stating that “initial weapons disassembly and agent detoxification and partial oxidation could meet international treaty demilitarization requirements and eliminate the risk of catastrophic agent releases during continued storage.”¹⁰²

From October 1973 to November 1976, the Army neutralized 8.2 million pounds of the nerve agent GB at Rocky Mountain Arsenal, Colorado. Another 181,950 pounds of GB were destroyed at Tooele from 1979 to 1982. The Army’s experience showed that “neutralization caused some significant problems with respect to the ability to ensure that we had a completely irreversible reaction, that the agent would be destroyed for any further potential military purposes,” says Busbee.¹⁰³ On 9 March 1982, the Army officially decided to abandon neutralization in favor of incineration, citing the following reasons:

- 1) The by-product of neutralizing mustard was hazardous and had to be disposed of by incineration anyway;
- 2) The chemical required to neutralize mustard has a high flashpoint and had caused a laboratory explosion;

99. Ibid.

100. Telephone interview with author, August 9 1994.

101. Koplow, *Some Disassembly Required*, 13.

102. NRC, *Alternative Technologies*, 20.

103. Interview with author, 5 May 1994.

3) The neutralization reaction can be difficult to control, resulting in more waste product—from 2.6 to six lbs of salt per pound of GB neutralized;

4) The neutralization reaction could be very slow—only 50 percent of the agent was neutralized within twenty-four hours, while other batches took between five and sixteen days and one required forty-eight days of processing;

5) Neutralization can be reversed to reform the original chemical agent;

6) Neutralization is not applicable to all agents in the stockpile.¹⁰⁴

Busbee notes that the reversibility of neutralization is still in question and is one of the aspects being studied in the current research program.¹⁰⁵ This research program is seeking to build upon the work of a group of Army scientists led by Dr. Yu-Chu Yang, whose research with several hundred grams of mustard agent in the laboratory has shown promise. The Army is pursuing development of neutralization as well as neutralization followed by biodegradation for the agents mustard and VX. These technologies may be applied, as the NRC recommended, to destroy the agents located at the two sites, Newport and Aberdeen Proving Ground, that have bulk storage containers, but no munitions. The cost of taking this research from the laboratory phase to what is known as the “bench” phase, which deals with larger quantities of agent to see if the same results can be achieved, is \$45 million. If successful, a pilot plant will be constructed for one or both of the alternative technologies at a cost of \$186 million.¹⁰⁶

The EPA’s Michael notes that any alternative involving separation of the munitions and subsequent treatment by another method would also have to go through a lengthy, and by no means automatic, permitting process. For instance, were the munitions to be drained and the agent neutralized, permits would have to be obtained for the agent neutralization process, for interim storage of the neutralized materials and of contaminated components not treated right away, for decontamination and destruction of the metal parts and explosives, and for the ultimate treatment of the wastes. In some cases, federal regulations prohibit storing hazardous materials for more than a year to dissuade postponement of treating hazardous materials. The “permit hurdles” would be just as significant, if not more so, for alternative treatment methods. Michael concludes that choosing alternative disposal options would certainly not buy any time.¹⁰⁷

Destruction Methods for Stockpile and Non-Stockpile Munitions

The opposition has noticed that the Army is recommending neutralization for its non-stockpile weapons, but not for the stockpile itself. The Sierra Club’s Vincent observes that the Army claims that neutralization is not a proven technology, but they have

104. Kevin J. Flamm, *Chemical Agent and Munition Disposal; Summary of the U.S. Army’s Experience*, SAPEO-CDE-IS-87005 (Aberdeen Proving Ground, MD: United States Army, 21 September 1987) pp. 3-75 to 3-80, 3-82.

105. Interview with author, 5 May 1994.

106. Program Manager for Chemical Demilitarization, *Alternative Demilitarization Technology Report for Congress*, pp. 3-30, 3-83.

107. Interview with author, 10 August 1994.

nonetheless issued a bid request for private contractors to develop portable neutralization equipment to treat non-stockpile weapons.¹⁰⁸ According to the 1993 Annual Stockpile Status Report, “the U.S. Army is currently developing two mobile treatment systems utilizing chemical neutralization to convert the agents into conventional waste on site.”¹⁰⁹ At a Chemical Weapons Working Group press conference held on 21 March 1994 on Capitol Hill, Aberdeen Citizens Advisory Commission Chairman John Nunn lofted a copy of the Army’s non-stockpile report and also questioned why neutralization was the likely method of destruction for non-stockpile weapons, but not for the main stockpile sites. If an alternative method is suitable for non-stockpile weapons, he asserts that it should be appropriate for the stockpile sites as well.¹¹⁰

Archival research indicates that the munitions that compose what are known as the non-stockpile weapons are located in various areas, usually in small caches—one to 100 munitions. Incineration may be used at some non-stockpile sites where there are many weapons. However, General Busbee says, “We do not think it is politically possible from a regulatory point of view to put an incinerator on a tractor trailer or railcars” so that it can be used to destroy three or four munitions at each site. Instead, neutralization can be used for small numbers of munitions or to treat soil that is contaminated by agent. The resulting hazardous wastes can then be moved to a government or commercial hazardous waste incinerator. The non-stockpile situation requires “an entirely different scale and scope of program.” In contrast, baseline incinerators will be used at the main stockpile sites, where thousands upon thousands of munitions require destruction. These two situations really are not comparable, Busbee concludes.¹¹¹

Feasibility of Transporting Chemical Weapons

*Some baseline opponents believe that building eight separate destruction facilities is an unnecessary expense, especially when the job could be done just as effectively at a national disposal site or two regional ones. Transportation as an option has not been given serious consideration, especially given the fact that as recently as 1990, the Army safely transported weapons out of Germany. Although many opponents now agree that the destruction should be accomplished at the eight stockpile sites, others continue to argue that the Army can and should transport and consolidate these weapons for destruction at Tooele and perhaps at Anniston. “The idea of transporting the chemical agent out of the community to another site was raised at virtually every forum” hosted in 1992–1993 near Aberdeen Proving Ground by the Lawyers Alliance for World Security and the Committee for National Security.*¹¹²

According to Baronian, the Army’s risk assessments considered several transportation alternatives. Although destruction at each site proved to be somewhat safer than transporting the munitions, the deciding factor was that the Army concluded that a much

108. Telephone interview with author, 11 August 1994.

109. U.S. Chemical Materiel Destruction Agency, 1993 Annual Status Report, 2.

110. Author’s notes from this press conference.

111. Interview with author, 5 May 1994.

112. Lawyers Alliance for World Security, *Citizen Attitudes*, iv.

more viable emergency response capability could be created at eight fixed sites rather than along the transportation corridors that would be needed for shipping these weapons to a regional or national destruction center. "The Army never said transportation was not safe, but the fact that weapons were shipped safely out of Germany demonstrates only that that particular move went safely, not that all such moves would turn out that way. The Germans took special precautions, such as closing highways, and we would probably do the same if a decision was made to move this stuff. We could probably move it safely, but the operative word is 'probably.'" Baronian emphasizes that, "The problem with transportation is not technical: the problem with transportation is political. What governor is going to get re-elected after letting chemical weapons be shipped through his state? Why should the people in that state, who now have absolutely no exposure threat from the stockpile, allow these weapons to transit their state and incur the unspecified risk of transport?" In sum, it is politics, not the Army's capability to move these weapons with reasonable safety, that stands in the way of transportation options.¹¹³

The National Academy of Science's Role

Composition of the NRC's Committees

Baseline opponents assert that the NRC panels were imbalanced, stacked with combustion engineers that skewed the NRC's reports in favor of incineration. The panels lacked expertise in such key areas as the environmental sciences, toxicology, public health, and risk assessments, say the Kentucky Environmental Foundation's Williams and Greenpeace's Hawkins. Furthermore, candidates nominated by the opposition were not seated on the two oversight panels, the Stockpile Review Committee and the Alternative Technologies Committee.¹¹⁴ The Alternatives Committee was pretty well constituted and did a reasonably good job, according to both Vincent and Harmon, of Pueblo and Anniston, respectively. These two opponents criticize the Stockpile Committee, which, as Vincent recalls, was created to advise the Army on its incineration program, not on alternative technologies. He believes that the Stockpile Committee's membership continues to reflect this original bias. Since the committee does business by consensus, the "incineration advocates" on it have overwhelming influence. Vincent also questions whether the committee members went beyond the bounds of their expertise. "The Stockpile Committee," he states, "on any number of occasions drew conclusions about the safety of incineration as a method of disposal with literally no expertise in the medical, public health or other disciplines that are necessary to draw those conclusions." Harmon simply says, "I am really disappointed in them. I have a higher opinion of scientists than what I have seen come out of this group."¹¹⁵

Such charges confound Dr. Carl Peterson, who chaired the Stockpile Review Committee. "A committee is by definition of a finite size," he says. "There will always

113. Interview with author, 10 May 1994.

114. Interviews with author, 19 May 1994 and 2 March 1994.

115. Ross Vincent, telephone interview with author, 11 August 1994; James Harmon, telephone interview with author, 9 August 1994.

be some expert that somebody can find that they think should be on the committee because they represent a specific point of view. To be effective, we do not need to have 'one of every kind' of expert on the committee." Instead, he explains, the panel holds meetings and talks with other specialists to tap additional expertise, which the panel is competent to evaluate. When the panels were formed, the NRC solicited nominations. One member of both the Alternatives and Stockpile panels, a biochemist, was nominated by Greenpeace, Peterson notes.¹¹⁶ Figure 13 depicts the role that the NRC has played in evaluating alternative technologies and the Army's baseline destruction program.

Donald Siebenaler, a key staff assistant to both committees, explains that the committees are composed mostly of scientists that have a "broad depth in the hard sciences," such as chemists or chemical engineers, who can evaluate any type of destruction proposal. The Alternatives Committee consisted of five chemists or chemical engineers and seven specialists of other types, including experts in toxicology, risk assessment, and monitoring technologies. The Stockpile Committee had one chemist, eight members who were environmental, chemical, or biomechanical engineers, and eight specialists in other disciplines, including two risk assessment experts, a biochemist, and a biologist. Siebenaler states that the Stockpile Committee's composition was changed because alternative technologies were being weighed. Also, Dr. John Longwell, who chaired the Alternatives Committee and served on the Stockpile Committee, is a chemical engineer whose research at the Massachusetts Institute of Technology's Environmental Health Sciences Center focuses on the health effects of incineration. Nominations for these committees, Siebenaler explains, are reviewed by peers and can be ruled out for bias, insufficient expertise, or conflict of interest.¹¹⁷

Independence of the NRC's Oversight

According to some baseline opponents, the NRC has functioned as a sales force for incineration, bought and paid for by the Army. They claim that the so-called independent oversight of the NRC is seriously flawed. The Kentucky Environmental Foundation reviewed the NRC's latest report in the following way: "For an 'independent' scientific agency, the NRC reported little that was either independent or scientific. Their contradicting conclusions are based on past Army documentation, and the overall tone of the report rings with the Army's influence."¹¹⁸ The Sierra Club's Vincent agrees with this assessment, saying the NRC "even used the same rhetoric as the Army to explain their decisions. They failed to go outside of the Army-provided data to find data that would have been useful and instructive in drafting their ultimate recommendations. Their evaluation of the Army data was superficial and on the outside data it was all but nonexistent," he concludes.¹¹⁹

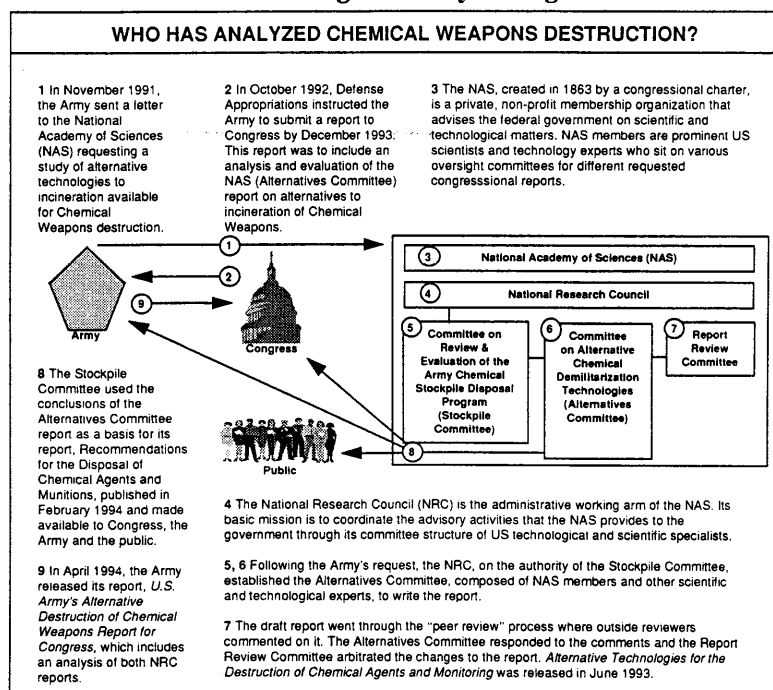
116. Interview with author, Washington, D.C., 21 June 1994.

117. Interview with author, Washington, D.C., 25 July 1994.

118. *Common Sense: A Newsletter of Common Ground* (Berea, KY: The Kentucky Environmental Foundation, March 1994) 1.

119. Telephone interview with author, 11 August 1994.

Figure 13: The Role of the National Academy of Sciences in Reviewing the Army's Program.



Source: "Chemical Weapons: Fact Sheet No. 1: Chemical Weapons Destruction and Disposal in the United States" (Committee for National Security, undated) 2.

The Chemical Weapons Working Group asserts that the NRC's lack of independence is further reflected in the fact that the NRC did not conduct its own risk assessment, nor did it take into account that the Army's stockpile maintenance programs have "reduced the storage risk by over 90 %." The coalition also charges that the Army purposely misled the NRC about these improvements.¹²⁰ According to baseline opponent Harmon, the NRC, lacking information on the risks of incineration, erroneously assigned incineration a risk value of zero. Just as neutralization has risks, so does incineration, argues Harmon, who notes that, "There is risk getting on the interstate. If you do not have enough information, you should not make a recommendation." For these reasons, the NRC's report is invalid, he argues. Furthermore, Harmon asks that the NRC and the Army should reconsider alternative technologies in light of the reduced threat from stockpile storage.¹²¹

"The NRC is not taking sides," says Peterson, who chaired the Stockpile Committee. "We do not have an ax to grind or a technology to sell. We were asked to evaluate the options, which we have done. We believe that the incinerators with the pollution abatement system that are involved here pose no health hazard. To discount what some people have said, committee members are unpaid." This factor should weigh in favor of

120. Chemical Weapons Working Group, press release (Berea, KY: 10 August 1994).

121. Telephone interview with author, 9 August 1994.

the NRC's impartiality, Peterson observes, if "one's integrity is inversely proportional to how much he is paid."¹²² NRC staffer Siebenaler refutes the bought-and-paid-for insinuation by pointing out that committee members receive the barest of recompense—travel, hotel, and \$34 a day for food. They donate their time and are "not paid a dime," says Siebenaler.¹²³

When the NRC first began to review the Army's program, it endorsed incineration in 1984 because "we believed it would do the job safely," says Peterson. The starting point for evaluating any technology or system must be the data on its performance, which in this instance was provided by the Army.¹²⁴ Accordingly, says Peterson, "We based our opinion on the test burn results at Johnston Atoll, which show that the dioxins emitted from this facility are about a quarter of what a diesel truck going forty miles an hour would emit." When these incinerators are operating correctly, Peterson continues, "the pollution in the form of dioxins has to be considered negligible." In the event of upset conditions, the NRC recommended charcoal filters to handle any increase in PICs that might result.¹²⁵

As for a separate risk assessment, that task is beyond the capacity of a committee of volunteers. A risk assessment, Peterson explains, is a major undertaking that requires a full staff. Although the committee did not conduct a new risk assessment, he stated that it "can evaluate the work of others and has done so in this instance with great care." Peterson stresses that the NRC's committees are "not incinerator salesmen. We have seriously recommended promising alternatives" to incineration, as well as improvements to the Army's baseline program.¹²⁶ On the subject of rumors about an Army-NRC cabal, former Program Manager for Chemical Demilitarization Baronian adds, "We have had several disagreements with the NRC. The NRC has criticized our programs and recommended improvements. I do not at all consider the Army and the NRC as one in the same."¹²⁷

The Charcoal Filters Recommended by the NRC

*The charcoal filters that the NRC has recommended are equivalent to putting a Band-Aid on a hemorrhage, according to some opponents. "I have been hearing a lot of horror stories about the carbon filters too," says Williams of the Kentucky Environmental Foundation. For instance, he says that the water used to quench extremely hot exhaust gases must be evaporated before the gases hit the filters or they will not operate correctly. Also, the addition of the charcoal filters could cause pressure to back up in the entire system, increasing the chances of fire and explosion.*¹²⁸ Anniston's Harmon believes that

122. Interview with author, 21 June 1994.

123. Interview with author, 25 July 1994.

124. The NRC states that the Army has provided accurate and complete data for its evaluation. See the statement under the heading "M55 Rocket Instability and the Risk Assessment."

125. Interview with author, 21 July 1994.

126. Ibid.

127. Interview with author, 10 May 1994.

128. Interview with author, 19 May 1994.

*expectations about what the charcoal filters can accomplish are being falsely inflated by the Army and the NRC. A filter is only effective when the volume of air that flows through it is carefully controlled to the absorption capacity of the filter bed; otherwise the filters will fail. Charcoal filters are "highly flammable," he notes, and have not been proven to work with agent.*¹²⁹

*Likewise, the Sierra Club's Vincent is skeptical of carbon filters. He explains that carbon filters are like tiny magnets that attract particulates so that they stick to the surface. However, just as these particulates can be attracted, so can they be released. The Army will be "really lucky" in the first place if the filters attract all of the problem PICs because it is not known whether that will occur, says Vincent. He also adds that the Army plans to incinerate the filters themselves, essentially reincinerating whatever particulates they may have captured. "It is possible that the activated carbon filters are an improvement, but I need more information before I am ready to accept that," he notes.*¹³⁰

The NRC specified four problems that could be encountered in working with carbon filters, namely the need to cool and dehumidify gases; the loss of absorption capacity if water contacts the charcoal; poor removal efficiency due to leakage around or through the carbon beds; and the potential for fire hazard if temperatures are not monitored and controlled. Peterson says that the NRC stipulated these caveats to point out that a charcoal filter system has to be designed correctly to enable the filters to operate well. The charcoal beds are a complete downstream add-on to the existing pollution control system. Peterson is confident that the Army's engineers can adapt this technology, which is used routinely in industry, to the baseline system. More powerful induced draft fans will probably be added to help regulate pressures.¹³¹ Figure 14 shows how charcoal filters are used to clean the air inside the baseline facility at Johnston Atoll. The Army already has some experience working with charcoal filters.

Peterson observes that, "The reduction in PICs brought about by the addition of charcoal filters is small because, to begin with, the quantities are small. The reduction in trace amounts of agent and in dioxins will be such that those things will be undetectable." Peterson notes that the two agent releases on Johnston Atoll that have occurred while the incinerators were not operating would have been captured by these charcoal filters. The NRC recommended them as an additional safeguard against upset operating conditions and human error.¹³²

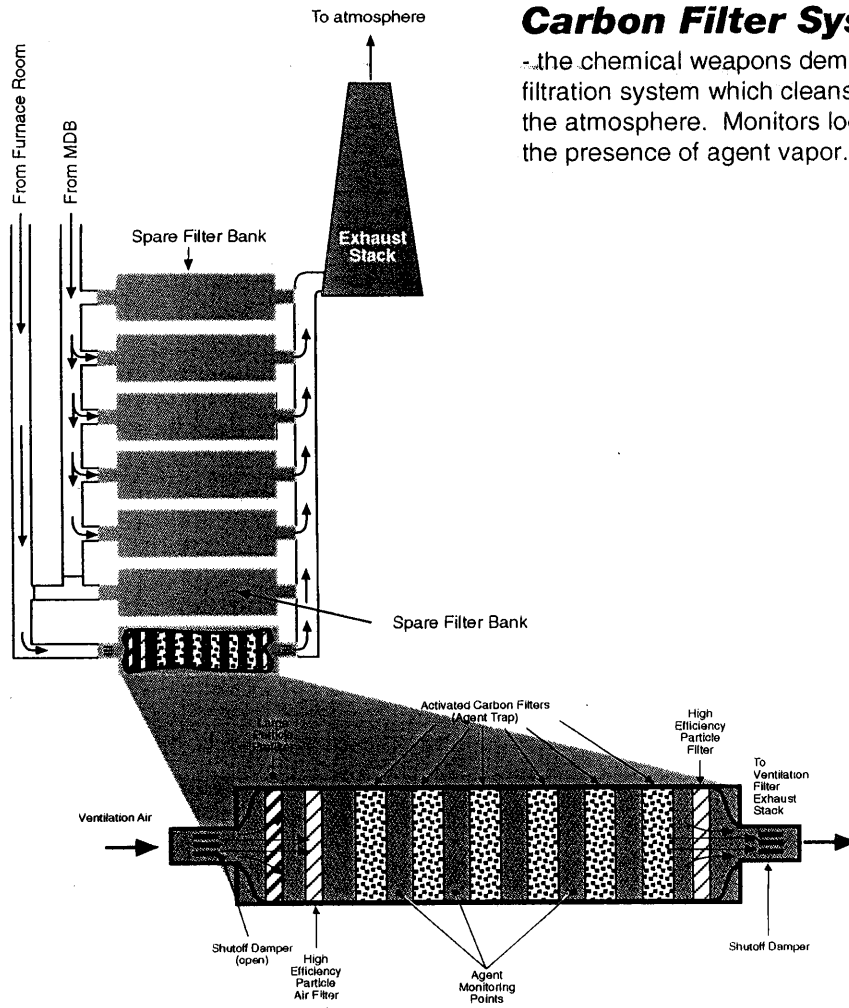
129. Telephone interview with author, 9 August 1994.

130. Telephone interview with author, 11 August 1994.

131. Interview with author, 21 June 1994.

132. Ibid.

Figure 14: The Carbon Filter System for Ventilation at Johnston Atoll.



Carbon Filter System

- the chemical weapons demilitarization plant has a carbon air filtration system which cleans plant air before it is released into the atmosphere. Monitors located in each filter bank check for the presence of agent vapor.

Source: Image courtesy of the U.S. Army Chemical Materiel Destruction Agency.

Appendix B: U.S. Chemical Demilitarization Chronology

Compiled by Maureen Lenihan

- 1915–1969 The United States disposes of old chemical agents and munitions by open pit burning, atmospheric dilution, burial, and ocean dumping.
- 1960 The Ten—later Eighteen—Nation Disarmament Conference begins negotiations to ban chemical weapons and require the destruction of chemical weapon stockpiles. The United States participates in the negotiations.
- June 1969 The National Research Council (NRC) recommends that ocean dumping of chemical munitions be discontinued. The NRC instead suggests incineration for the blister agents and neutralization for the nerve agent GB.
- October 1970 The Armed Forces Appropriation Act requires detoxification of weapons prior to disposal, as well as a public health review of any disposal plans by the Department of Health and Human Services.
- 12 January 1971 The Foreign Military Sales Act prohibits the transportation of chemical weapons from Okinawa, Japan, to the continental United States.
- 1972 A senior advisory panel to the U.S. Army Materiel Command supports the use of incineration to destroy blister agents and neutralization to destroy nerve agents. However, the panel also recommends that the Army continue testing incineration to destroy nerve agents.
- 1972–1976 At Rocky Mountain Arsenal, near Denver, Colorado, the Army incinerates over 2,700 metric tons of the blister agent mustard in ton containers and chemically neutralizes over 3,700 metric tons of the nerve agent GB in ton containers.
- 1979 The Army constructs a new chemical agent disposal system at the Tooele Army Depot, Utah to test high-temperature incineration as well as neutralization. From 1979 to 1987, the Army destroys over eighty-three metric tons of chemical agent and nearly 38,000 munitions and containers by incineration at the Chemical Agent Munitions Disposal System (CAMDS) facility.
- March 1980 Negotiations on the Chemical Weapons Convention continue under the auspices of the Conference on Disarmament's Ad Hoc Committee on Chemical Weapons. The number of nations participating rises to forty.

- 9 March 1982 After encountering significant difficulties with neutralization, the U.S. Army selects incineration as the method of destruction. These difficulties include: 1) a hazardous byproduct that still requires incineration; 2) a laboratory explosion; 3) a greater volume of waste product; 4) lengthy processing time; 5) potential for the chemical agents to reform; and 6) technique not applicable to all chemical agents.
- April 1982 An Arthur D. Little Corporation study concludes that using incineration rather than neutralization to dispose of chemical weapons will produce a net cost reduction.
- 1 July 1983 The United States General Accounting Office (GAO) reports that the Army's annual chemical weapons storage costs, including security and safety expenses, are \$181 million for all storage sites.
- 1984 The NRC Committee on Demilitarizing Chemical Munitions and Agents reviews a range of chemical weapons disposal technologies and endorses the Army's selection of incineration, the so-called "baseline" approach.
- September 1985 Building upon the developmental experience of CAMDS, the U.S. Army begins construction of the Johnston Atoll Chemical Agent Disposal System (JACADS), a prototype full-scale baseline facility.
- November 1985 Public Law 99-145 directs the Department of Defense (DOD) to destroy 90 percent of the total U.S. stockpile of unitary chemical agent and munitions by 30 September 1994. It also directs DOD to destroy the disposal facilities upon completion of the chemical weapons destruction. The Army estimates the total cost for the chemical weapons destruction program to be \$1.7 billion.
- 14 March 1986 The Army provides Congress a concept plan for disposing of the chemical weapons stockpile. The plan has three options: 1) on-site destruction; 2) transportation to a national destruction center at Tooele; and 3) transportation to two regional destruction sites at Anniston, Alabama, and Tooele.
- November 1986 The Defense Authorization Act for fiscal year 1987 prohibits the shipment of chemical weapons, components, or agents to the Blue Grass Army Depot, Kentucky for any purpose, including disposal.
- January 1987 Operations at CAMDS at Tooele are suspended as the result of a low-level release of the nerve agent GB from the incinerator stack. No operations were ongoing at the time of the incident and no injuries were reported.

- 1987 The NRC's Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (Stockpile Committee) is formed at the request of the Under Secretary of the Army to monitor the disposal program and to review and comment on relevant technical issues.
- January 1988 The Army releases the *Programmatic Environmental Impact Statement* for the U.S. chemical weapons destruction program. It determines that on-site disposal poses the smallest environmental and health risks. The Army also determines that a chemical stockpile emergency preparedness plan is necessary to offset the risks of continuing to store the aging chemical weapons stockpile until destruction can be completed.
- 23 February 1988 The Under Secretary of the Army announces that chemical weapons will be incinerated at the eight stockpile storage sites. This alternative was selected over transportation options because a more credible emergency response program could be established at the storage sites rather than along transportation corridors.
- 15 March 1988 The Army submits a Chemical Stockpile Disposal Program implementation plan to Congress in which the deadline for destruction of the chemical weapons stockpile is extended until 30 April 1997 to permit more full-scale testing at the JACADS baseline facility. The total cost of chemical weapons destruction rises to \$2.7 billion.
- 28 September 1988 In Public Law 100-456, Congress orders an operational evaluation period, known as Operational Verification Testing (OVT), for JACADS. This testing allows for the identification of potential problems in baseline facility operations.
- October 1988 The first training session for health care professionals in the medical management of chemical exposures is held under the auspices of the Chemical Stockpile Emergency Preparedness Program.
- September 1989 The Soviet Union and the United States sign the Wyoming Memorandum of Understanding, which provides for bilateral data exchanges and verification experiments. This agreement is intended to enhance cooperation between the two countries, as well as spur efforts to conclude the multilateral Chemical Weapons Convention.
- September 1989 EG&G Incorporated is awarded a \$212 million contract to build the first fully integrated, industrial size chemical disposal facility in the continental United States at Tooele.

- 13 November 1989 Congress directs the Army “to study the feasibility and desirability” of using the chemical weapons demilitarization facilities for other purposes.
- 15 February 1990 The Army releases the *Draft Environmental Impact Statement* for JACADS, which concludes that incineration will have minimal environmental impact on the island and surrounding ocean areas.
- May 1990 Greenpeace publishes *Playing With Fire*, which highlights the dangers of hazardous waste incineration, including possible long-term environmental and health effects.
- 1 June 1990 The United States and the Soviet Union sign the Bilateral Destruction Agreement. The accord stipulates that destruction start by December 1992 and that all but 5,000 tons of each nation’s stockpile be destroyed by 2002. Problems in the Russian destruction program cause deadlines to slip to a June 1997 start date and a June 2004 completion date. This agreement has yet to enter into force.
- 30 June 1990 The Army begins the first full-scale OVT on Johnston Atoll. A series of four OVTs are set to destroy M55 rockets containing nerve agent GB, VX-filled M55 rockets, ton containers of mustard, and mustard-filled 105 mm M60 projectiles.
- 26 July 1990 The United States begins removal and transport of its chemical weapons from West Germany to Johnston Atoll.
- 27 October 1990 President George Bush announces that chemical weapons from the continental United States will not be transported to Johnston Atoll for destruction.
- 8 December 1990 Trace amounts of nerve gas escape through the JACADS stack as the agent incinerator is being shut down. The nerve gas emission is only a fraction of the maximum amount allowable under the Surgeon General’s standard to protect public health and safety.
- January 1991 The Mitre Corporation releases a congressionally requested report about the end-use of baseline facilities. It concludes that while it may be technically possible to utilize the baseline facilities to dispose of contaminated soils or other military wastes, it is not economically feasible when compared to other alternative methods. Nor would such future use be desirable for other reasons.
- 27 February 1991 JACADS completes Phase I of the OVT, destroying over 7,500 rockets and 77,000 pounds of the nerve agent GB. However, problems such as the build-up of molten aluminum in the

- deactivation furnace required the Army to run this OVT longer than originally planned.
- March 1991 The Army reports to Congress that the chemical weapons disposal program will cost at least \$6.5 billion and will not be completed until June 1999 because of design changes and new estimates of processing rates, plant availability, and the number of personnel needed.
- March 1991 The NRC's Stockpile Committee suggested, and the Army agreed, that a new study of alternatives to incineration be undertaken.
- 25 April 1991 Approximately 1,700 citizens turn out in Richmond, Kentucky, to protest the planned incineration facility nearby.
- April 1991 Utah state officials announce that the state will no longer accept deliveries of chemical weapons to CAMDS.
- April 1991 The construction of the Chemical Demilitarization Training Facility is completed at Aberdeen Proving Ground, Maryland, where personnel who will operate baseline facilities will be trained before being posted to an actual disposal plant.
- 13 May 1991 The Bush administration announces that the entire U.S. stockpile of chemical weapons, both binary and unitary weapons, will be destroyed upon entry into force of the Chemical Weapons Convention.
- 24 May 1991 Greenpeace International issues *Technologies for the Detoxification of Chemical Weapons: An Information Document*, which condemns incineration as a method for chemical weapons destruction and proposes alternative approaches including biological, chemical, photochemical, electrochemical, neutralization, and thermal processes.
- May 1991 The National Defense Authorization Act for fiscal year 1992 prohibits the U.S. Government from transporting any more chemical agents to Johnston Atoll except for U.S. World War II munitions discovered in the Pacific region.
- May 1991 The Army transports 109 World War II mustard-filled artillery projectiles from the Solomon Islands to Johnston Atoll for storage and destruction.
- 21 November 1991 An NRC panel concludes that the United States can not employ cryofracture quickly enough to meet the 2002 deadline of the Bilateral Destruction Agreement, but also concludes that cryofracture is technically feasible. With cryofracture, weapons are first frozen, then smashed, and finally incinerated.

- November 1991 The Chemical Weapons Working Group convenes the first international citizens conference in Kentucky to formulate a united platform against chemical weapons incineration.
- January 1992 The NRC Committee on Alternative Chemical Demilitarization Technologies (Alternatives Committee) is established to develop a comprehensive list of alternative technologies and to review their capabilities and potential as stockpile disposal technologies.
- 21 January 1992 On Johnston Atoll, a burster from an M55 rocket detonates and punches a hole in the inner lining of the deactivation furnace, which destroys the explosives and propellants from the weapons. No significant release of agent occurs.
- 31 March 1992 JACADS exceeds production goals when 13,889 VX-filled rockets are destroyed and 134,961 pounds of VX are incinerated during Phase II of OVT.
- May 1992 The site for the proposed cryofracture plant is changed from Tooele to the Pueblo Depot in Colorado for cost efficiency.
- 3 June 1992 For the first time, the United States officially releases the total amount of its chemical weapons stockpile—31,400 agent tons.
- 16 June 1992 The Army tells Congress that the cost of chemical weapons destruction could reach \$9 billion.
- 15 July 1992 A Kentucky law requires that the baseline facility planned for the Blue Grass Depot operate at 99.9999 percent destruction removal efficiency. The Army states that this requirement poses no major obstacle. The law also requires the Army to show that no safer alternative disposal technology exists, or is likely to exist.
- 26 August 1992 JACADS completes Phase III of OVT with test burns of M55 rockets containing GB and VX nerve agents and of one-ton containers of mustard. JACADS exceeded production goals during Phase III after sixty-seven ton containers and 113,031 pounds of mustard were destroyed.
- 1 October 1992 The U.S. Army Chemical Materiel Destruction Agency is established as the single office responsible for all Department of Defense chemical warfare destruction activities.
- 28 October 1992 The National Defense Authorization Act for fiscal year 1993 directs the Army to: (1) dispose of the entire unitary stockpile by 31 December 2004; (2) submit to Congress by 31 December 1993 a report on potential alternatives to the baseline system; (3) establish citizens commissions in Kentucky, Indiana, and

- Maryland. The bill prohibits the study of transporting chemical weapons and of the future use of baseline facilities. In addition, construction at Anniston is halted until the alternatives report is completed.
- 2 January 1993 JACADS shuts down after a fire breaks out in a containment area during OVT IV. No injuries occur. An investigation finds that the suspected cause of the fire is friction that was generated by a fuse booster cup becoming wedged against a moving conveyor belt, which contained explosive material.
- 6 January 1993 Buried chemical munitions were found in the Spring Valley section of Washington, D.C., at a former defense site. Once unearthed, they are sent to Pine Bluff, Arkansas, for storage and eventual disposal.
- 13 January 1993 The Chemical Weapons Convention opens for signature in Paris. The U.S. joins 129 other countries as original signatories of the treaty banning the development, production, stockpiling, acquisition, transfer, and use of chemical weapons.
- 14 January 1993 The NRC's evaluation of the Army's Chemical Stockpile Disposal Program concludes that efforts by the Army to assess the risks of destroying chemical weapons fall short of what is needed. The NRC recommends that the Army perform a site-specific, full-scope, scenario-based risk assessment for each of the planned facilities, instead of relying on its *Final Programmatic Environmental Impact Statement*.
- January 1993 The Secretary of the Army requests that the governors of Kentucky, Indiana, and Maryland—the so called “low-volume” states—begin forming Citizens Advisory Commissions (CACs). Governors in other stockpile states may request formation of CACs.
- 13 February 1993 A commissioner of Tooele County, Utah, proposes that the entire U.S. chemical weapons stockpile be accepted for destruction at the Tooele baseline facility in return for a new \$20 million county hospital.
- 23 February 1993 A GAO study raises new doubts about the Army's ability to meet its chemical demilitarization schedule. The report discusses the various problems, delays, and shutdowns on Johnston Atoll, as well as the problems with time requirements to obtain the requisite environmental permits for all of the destruction facilities.
- 6 March 1993 The fourth and final JACADS OVT ends, having destroyed 18,925 projectiles and 35,487 pounds of mustard.

- 10 June 1993 The NRC's Alternatives Committee releases *Alternative Technologies for the Destruction of Chemical Agents and Munitions*. The report discusses technologies that could replace the baseline system, such as neutralization, biodegradation, wet air oxidation, and plasma arc pyrolysis. Otherwise, the NRC supports enhancing the emissions safety of whatever technology is eventually selected for each destruction site, specifically recommending the addition of charcoal filter beds to the pollution control systems of baseline facilities.
- 30 June 1993 The NRC's Stockpile and Alternatives Committees hold a public forum to hear concerns with the planned disposal operations.
- 16 July 1993 The GAO testifies that local communities near the country's chemical weapons storage depots are unprepared to cope with an accidental release of poison gas, despite the \$187 million already spent on the Chemical Stockpile Emergency Preparedness Program.
- 11 August 1993 The Army opens the \$385 million Tooele baseline facility and soon begins to run tests of its equipment in preparation for trial burns to prove that the incinerators can meet stipulated pollution control standards.
- 25 August 1993 The Army certifies the safety of JACADS operations, clearing the way for the program to continue to receive congressional funds and allowing testing to begin at the Tooele facility.
- August 1993 The Army submits a congressionally mandated report on the physical and chemical integrity of the chemical weapons stockpile, stating that the stockpile can be safely stored until the year 2004.
- 9 September 1993 A mustard leak of approximately 100 gallons from a one-ton container is discovered at Tooele Army Depot. No apparent exposures or casualties result, and the amount of agent released is well below Environmental Protection Agency (EPA) levels of concern.
- 26 November 1993 The Army estimates that it will cost \$8.6 billion to destroy the U.S. chemical weapons stockpile.
- 30 November 1993 The Browder Amendment to the Defense Authorization Act requires that one other site must be scheduled for construction within a twelve-month period and that JACADS must comply with safety and environmental regulations for six months before construction can begin at the Anniston site.
- 4 February 1994 The NRC's Stockpile Committee issues recommendations on chemical demilitarization. The NRC concludes that the base-

- line incineration system has been demonstrated to be a safe and effective disposal process. Although supporting continued research on alternative technologies, the NRC states that the benefits of developing another successful technology are outweighed by the risk associated with the many additional years of storage needed to develop alternative technologies fully.
- 19–20 March 1994 The Chemical Weapons Working Group holds its third annual conference, developing a position paper on safe chemical weapons disposal alternatives to incineration, which is released shortly thereafter later at a press conference on Capitol Hill.
- 23 March 1994 The nerve agent GB is released from the common stack of the agent incinerator at JACADS. An investigation team concludes that operator error and improperly functioning gauges were the primary causes of the agent release. No injuries occur and the amount of agent released is well below EPA levels of concern.
- 8 August 1994 The Army announces that the propellant used in M55 rockets may have a longer safe storage life than previously predicted. However, the Army also notes that its risk assessment was based on low-probability, high-consequence events, such as tornadoes or an airplane crashes, that could cause catastrophic accidents during storage, transport, or disposal of the stockpile. The stability of the M55s and the degradation of the other stockpile munitions were not factored into the risk assessment.

Sources

- Annual Status Report on the Disposal of the Lethal Chemical Stockpile.* Department of the Army, 15 December 1986–15 December 15 1993.
- Flamm, Kevin, et al. *Chemical Agent and Munitions Disposal Summary of the U.S. Army's Experience.* SAPEO–CDE–IS–87005. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, 21 September 1987.
- Hardenbergh, Chalmers, ed. *The Arms Control Reporter.* “U.S. Chemical Weapons Chronology.” Cambridge, MA: Institute for Defense and Disarmament Studies, 1990–1993.
- Harvard/Sussex Program on CBW Armament and Arms Limitation. *The Chemical Weapons Convention Bulletin.* Cambridge, MA: Chronologies from issues 9–23.
- Kentucky Environmental Foundation. “Chemical Weapons Disposal Chronology.” Berea, KY: 1994.
- National Research Council. *Recommendations for the Disposal of Chemical Agents and Munitions.* Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program. Washington, D.C.: National Academy Press, 1994.

Shaw, Doug, ed. *Chemical and Biological Weapons Reader*. Washington, D.C.: U.S. Arms Control and Disarmament Agency, June 1994.

Siegel, Lenny. *Chemical Weapons Disposal: The Threat at Home*. National Toxics Campaign Fund, Military Toxics Network, June 1991.

Smithson, Amy E. "Chemical Weapons: The End of the Beginning." *The Bulletin of the Atomic Scientists* (October 1992): 36-40.

St. Pierre, Gregory W. *Johnston Atoll Chemical Agent Disposal System*. U.S. Army Chemical Materiel Destruction Agency, 3 September 1993.

Stockpile Destruction Cost Growth and Schedule Slippages Are Likely to Continue. GAO/NSIAD-92-18. Washington, D.C.: GAO, November 1991.

U.S. Army's Alternative Demilitarization Technology Report for Congress. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, 11 April 1994.

Appendix C: Selected Bibliography

Annotated by Maureen Lenihan

Army, Contractor Documents About JACADS

- Macrae, Scott R., et al. *Evaluation of the HD Projectile Test: Johnston Atoll Chemical Agent Disposal System Operation Verification Testing*. MTR-93W0000060. McLean, VA: Mitre, May 1993.
Describes the last of four operational verification tests at JACADS in which mustard agent was incinerated. Concludes that health and safety requirements were fulfilled, but production levels were below the optimal performance goals.
- Macrae, Scott R., et al. *Evaluation of the HD Ton Container Test: Johnston Atoll Chemical Agent Disposal System Operational Verification Testing*. MTR-93W0000002. McLean, VA: Mitre, April 1993.
Determines that all health and safety regulations were fulfilled in the third operational verification test at JACADS in which mustard agent was incinerated.
- Macrae, Scott R., et al. *Evaluation of the VX Rocket Test: Johnston Atoll Chemical Agent Disposal System Operation Verification Testing*. MTR-92W0000064. McLean, VA: Mitre, November 1992.
Describes the results of the second of four tests at JACADS in which M55 rockets containing the nerve agent VX were destroyed. Finds that the effort fulfilled both production goals and federal health and safety regulations.
- Menke, John L., et al. *Evaluation of the GB Rocket Campaign: Johnston Atoll Chemical Agent Disposal System Operation Verification Testing*. MTR-91W000039. McLean VA: Mitre, June 1991.
Describes the first operational verification test at JACADS in which M55 rockets containing nerve agent GB were destroyed. States that the effort did not meet production goals and raises safety concerns.
- The Mitre Corporation. *Summary Evaluation of the Johnston Atoll Chemical Agent Disposal System: Operational Verification Testing*. MTR-930000036. McLean, VA: Mitre, May 1993.
Concludes that although production goals were not fulfilled, JACADS satisfied all safety and environmental requirements during operational verification testing. Also recommends improvements for future baseline facilities.
- The Mitre Corporation. *Transportation of Chemical Agents and Munitions: A Concept Plan*. SAPEO-CDE-IS-87003. McLean, VA: Mitre, 30 June 1987.
Examines issues surrounding the transportation of chemical munitions with specific attention toward three disposal alternatives: 1) destroy the agents and munitions at their current storage installations; 2) move the stockpile to regional destruction centers at Anniston and Tooele Depot; and 3) move the stockpile to a national destruction center at Tooele. Also offers a transportation concept plan for on-site and off-site movement of chemical munitions.
- Southern Research Institute. *Results of the RCRA Trial Burn and TSCA Demonstration Burn of the Deactivation Furnace System With M55 VX Rockets At the Johnston Atoll Chemical Agent Disposal System*. Birmingham, AL: Southern Research Institute, 23 June 1992.
Presents the test procedures and results for the trial burn of rockets filled with VX in the deactivation furnace system at JACADS.
- Southern Research Institute. *Results of the RCRA Trial Burn With VX Feed For the Liquid Incinerator At the Johnston Atoll Chemical Agent Disposal System*. Birmingham, AL: Southern Research Institute, 23 June 1992.
Summarizes the field activities, chemical analyses, and data analyses associated with the trial burns for incineration of the nerve agent VX in the agent incinerator at JACADS. Also states that these operations were within RCRA permit parameters.
- St. Pierre, Gregory W. *Johnston Atoll Chemical Agent Disposal System: Chemical Agent Release From the Common Stack*. Aberdeen Proving Ground, MD: Department of the Army, March 1994.
Examines the release of nerve agent GB from the common stack during maintenance, not operation, of the agent incinerator at the Johnston Atoll baseline facility on 23 March 1994. Concludes that operator error and improperly functioning gauges were the primary causes of the agent release.

- United Engineers and Constructors. *RCRA Trial Burn Report For HD - Mustard Ton Containers - Metal Parts Furnace At the Johnston Atoll Chemical Agent Disposal System*. United Engineers & Constructors, 16 December 1992.
Summarizes the procedures and results of the fourth in a series of trial burns at JACADS. This trial burn encompassed the destruction of mustard agent HD in the metal parts furnace, demonstrating that it could operate within the permit parameters of the Resource Conservation and Recovery Act.
- U.S. Army Chemical Materiel Destruction Agency. *Environmental Report For the Johnston Atoll Chemical Agent Disposal System: Operational Verification Tests 1 & 2*. U.S. Army Chemical Materiel Destruction Agency, 3 September 1993.
Describes JACADS and asserts that although the prototype facility did not meet production goals, it fulfilled environmental and safety requirements during operational verification testing.
- U.S. Army Chemical Materiel Destruction Agency. *Johnston Atoll Chemical Agent Disposal System: Operational Verification Tests 1 & 2*. U.S. Army Chemical Materiel Destruction Agency, September 1993.
Describes the JACADS and two operational verification tests. It reports the success of the JACADS facility in meeting production goals while safeguarding workers, the public, and the environment.
- U.S. Army Chemical Materiel Destruction Agency. *Process Report For the Johnston Atoll Chemical Agent Disposal System*. U.S. Army Chemical Materiel Destruction Agency, 3 September 1993.
Describes the chemical weapons incineration process at JACADS and determines that the JACADS operations met or exceeded all of the safety and environmental compliance criteria. Also notes the need for improvements.
- U.S. Army Chemical Materiel Destruction Agency. *Safety Report For the Johnston Atoll Chemical Agent Disposal System*. U.S. Army Chemical Materiel Destruction Agency, 3 September 1993.
Discusses the U.S. Army's baseline facility at Johnston Atoll and the safety precautions incorporated into the incineration process.
- U.S. Army Environmental Hygiene Agency. *Health Risk Assessment No. 42-21-M1BE-93: Inhalation Risk From Incinerator Combustion Products: Operational Verification Testing - Phase 1 Johnston Atoll Chemical Agent Disposal System*. Aberdeen Proving Ground, MD: United States Army Environmental Hygiene Agency, undated.
Evaluates the possible cancer and other health risks from operation of the agent incinerator for destruction of nerve agent GB at JACADS. Reports that human health effects from the incinerator are substantially below levels of concern set by U.S. Government medical and scientific experts.
- U.S. Army Environmental Hygiene Agency. *Health Risk Assessment No. 42-21-MQ49-92: Inhalation Risk From Incinerator Combustion Products: Johnston Atoll Chemical Agent Disposal System*. Aberdeen Proving Ground, MD: United States Army Environmental Hygiene Agency, undated.
Assesses the possible cancer and other health risks from operation of the deactivation furnace system and agent incinerator at JACADS. Determines that the health risks from emissions of these two incinerators are below levels of concern set by U.S. Government medical and scientific experts.
- U.S. Army Environmental Hygiene Agency. *Health Risk No. 42-21-MIX6-93: Inhalation Risk From Incinerator Combustion Products: Operational Verification Testing - Phase 3 Johnston Atoll Chemical Agent Disposal System*. Aberdeen Proving Ground, MD: United States Army Environmental Hygiene Agency, undated.
Assesses the possible cancer and other health risks from operation of the metal parts furnace and agent incinerator for destruction of mustard agent HD at the JACADS. Reports that cancer and other health effects from the emissions of these incinerators are substantially below levels of concern set by U.S. Government medical and scientific experts.
- Zelikson, Jeffrey. Letter from the Director of the Hazardous Waste Management Division of the Environmental Protection Agency to Walter Busbee, Commander of the U.S. Army Chemical Materiel Destruction Agency and Temporary Authorization for Permit Modifications: Johnston Atoll Chemical Agent Disposal System, 28 July 1994.
States that the Army's temporary authorization request is approved because its objectives are to prevent the disruption of ongoing destruction activities and to facilitate changes to protect human health and the environment.

Other Army Documents

- Ambrose, James R. "Record of Decision: Chemical Stockpile Disposal System." Washington, D.C.: Department of the Army, 23 February 1988.
Explains the Army's decision to proceed with on-site disposal at eight locations throughout the United States based on the risk of transporting chemical agents through populated areas. Also states: 1) incineration will be the disposal method; 2) the program will not be completed by 1994; and 3) the Army is committed to creating an emergency response system at each site chosen.
- Brankowitz, William R.. *Chemical Stockpile Disposal Program: Chemical Weapons Movement History Compilation*. SAPEO-CDE-IS-87001. Aberdeen Proving Ground, MD: Office of the Program Manager for Chemical Munitions, 12 June 1987.
Provides the history of chemical weapons transport between 1946 and 1986.
- Carnes, S.A. *Site-Specific Emergency Response Concept Plans For the Chemical Stockpile Disposal Program: A Comparative Summary*. Oak Ridge, TN: Oak Ridge National Laboratory, December 1989.
Summarizes the Chemical Stockpile Emergency Preparedness Program at each of the eight Army installations storing chemical weapons and examines: 1) the site-specific risk for each site; 2) the methodology used to identify the emergency planning zones; 3) the differences between recommended protective actions at each site; and 4) the need for comprehensive command and control systems to facilitate protective action effectiveness.
- Federal Emergency Management Agency. *Chemical Stockpile Emergency Preparedness Program*. Washington, D.C.: Department of the Army, undated.
Describes the chemical weapons incineration program and the functions of the Chemical Stockpile Emergency Preparedness Program.
- Flamm, Kevin J. *Chemical Agent and Munition Disposal; Summary of the U.S. Army's Experience*. SAPEO-CDE-IS-87005. Aberdeen Proving Ground, MD: United States Army, 21 September 1987.
Summarizes the history of the U.S. Army's chemical weapons destruction program. Also summarizes the results of tests performed at the Chemical Agents Munition Disposal Program in Tooele, Utah.
- Fraize, Willard E., et al. *Risk Analysis Supporting the Chemical Stockpile Disposal Program*. SAPEO-CDE-IS-87014. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, December 1987.
Summarizes the results of the Mitre corporation's chemical stockpile disposal program risk assessment, the purpose of which is to estimate the public's risk of chemical exposure throughout the disposal program. Options considered include: 1) national destruction sites, 2) regional destruction sites, 3) partial relocation, 4) on-site destruction, and 5) do nothing.
- Harvey, Steven, et al. *Agent Neutralization: Hydrolysis of Sulfur Mustard*. Report to the Office of the Program Manager, Chemical Demilitarization. Aberdeen Proving Ground, MD: Geo-Centers, Inc., March 1994.
Details the results of a study on hydrolysis of mustard agent.
- Krummel, J.R., et al. *Chemical Stockpile Disposal Program: Review and Comment on the Phase I Environmental Report For the Anniston Army Depot, Anniston, Alabama*. Argonne, IL: Argonne National Laboratory, December 1989.
Examines site-specific data for Anniston, Alabama, and determines that on-site chemical weapons destruction is the best method of disposal.
- Krummel, J.R., et al. *Chemical Stockpile Disposal Program : Review and Comment on the Phase I Environmental Report For the Umatilla Depot Activity, Hermiston, Oregon*. Argonne, IL: Argonne National Laboratory, October 1990.
Reviews site specific data for on-site chemical weapons disposal at the Umatilla Depot, Oregon, and determines that on-site disposal is the preferred method for destroying the chemical weapons stockpile.
- Kuryk, B.A., et al. *M55 Rocket Separation Study*. Cambridge, MA: Arthur D. Little, Inc., 22 November 1985.
Provides a preliminary engineering design, cost estimates, risk assessment, and environmental analysis involved in separating the munition from the chemical agent in M55 rockets.

The Mitre Corporation. *Engineering Analysis For Future Use of Chemical Agent Demilitarization Plants: Feasibility and Desirability*. McLean, VA: Mitre, January 1991.

In response to a Congressional request, evaluates the desirability and feasibility of future uses for baseline facilities. Concludes that although some future uses are feasible, they are not necessarily desirable.

Program Manager for Chemical Demilitarization. *Non-Stockpile Chemical Materiel Program: Interim Survey and Analysis Report*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, April 1993.

Identifies the locations, types, and quantities of non-stockpile chemical material. Explains potential destruction options and discusses transportation alternatives.

Program Manager for Chemical Demilitarization. *Chemical Stockpile Disposal Program: Final Programmatic Environmental Impact Statement*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, January 1988.

Reviews the potential environmental impacts of destroying the U.S. chemical weapons stockpile. Also examines the options of on-site disposal, regional disposal, national disposal, partial relocation, and continued storage. Determines that on-site disposal involves the smallest environmental and health risks.

Program Manager for Chemical Demilitarization. *Disposal of Chemical Agents and Munitions Stored At Anniston Army Depot Anniston, Alabama: Final Phase I Environmental Report*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, July 1989.

Examines site-specific data for Anniston, Alabama, and determines that on-site chemical weapons destruction is the best method of disposal.

Program Manager for Chemical Demilitarization. *Disposal of Chemical Agents and Munitions Stored At Anniston Army Depot Anniston Alabama: Final Phase I Environmental Report Addendum*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, February 1990.

Documents population statistics and seismic activity information not included in the original Final Phase I Environmental Report.

Program Manager for Chemical Demilitarization. *Disposal of Chemical Agents and Munitions Stored At Tooele Army Depot Tooele, Utah: Final Impact Statement*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, July 1989.

Concludes that the Tooele stockpile can be safely incinerated in an environmentally sound manner and that continued storage would pose greater health and environmental risks than on-site disposal.

Program Manager for Chemical Demilitarization. *Disposal of Chemical Agents and Munitions Stored At Umatilla Depot Activity, Hermiston Oregon: Final Phase I Environmental Report*. Aberdeen Proving Ground, MD : Program Manager for Chemical Demilitarization, February 1990.

Examines new issues specific to on-site chemical weapons disposal at Umatilla, Oregon that were not considered in the U.S. Army's programmatic environmental impact statement. Concludes that on-site disposal remains a viable disposal method because population increases and a likely meteorological condition heighten the risks of continued storage and transportation.

Program Manager for Chemical Demilitarization. *U.S. Army's Alternative Demilitarization Technology Report For Congress*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, 11 April 1994.

Recommends: (1) continuing without delay with the baseline technology; (2) updating risk assessments; (3) evaluating and demonstrating carbon filtration; (4) contacting the governor of each stockpile state to identify a viable receiving site for neutralized products; (5) enhancing public outreach and involvement; (6) implementing and approving stockpile surveillance for M55 rockets; and (7) initiating a research and development program into two alternative technologies, neutralization followed by biodegradation, for potential use at bulk storage sites in parallel with the current program activities.

Sears, Mildred, et al. *Mitigation of Public Safety Risks of the Chemical Stockpile Disposal Program*. SAPEO-CDE-IS-87013. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, November 1987.

Discusses accident scenarios and recommends mitigation measures to reduce public risk for five chemical weapons disposal alternatives including continued storage, on-site disposal, transportation to a national or regional center, and selected transportation.

U.S. Army Chemical Materiel Destruction Agency. Risk Assessment Survey News Release. Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, 8 August 1994.

Announces that the preliminary results of the risk assessment with the M55 rockets indicate that the propellant used in M55s may have a longer storage life than previously thought. The stability of the M55 was not factored into the previous risk assessment supporting decisions about the stockpile destruction program.

U.S. Army Chemical Stockpile Disposal Program. *Safely Destroying America's Chemical Weapons*. Aberdeen Proving Ground, MD: U.S. Army Chemical Stockpile Disposal Program, undated.

Answers basic questions regarding the planned incineration of the U.S. chemical weapons stockpile.

Congressional Documents

U.S. Congress. *Public Law 102-484*. 102nd Congress, 23 October 1992. subtitle G, section 172, p. 2341.

Establishes Citizens Advisory Commissions for each state in which there is a low-volume chemical weapons stockpile site--Kentucky, Indiana, and Maryland.

U.S. General Accounting Office. *Chemical Warfare: DOD's Successful Effort to Remove U.S. Chemical Weapons From Germany*. GAO/NSIAD-91-105. Washington, D.C.: General Accounting Office, February 1991.

Reports that the Department of Defense transported chemical weapons from Germany to Johnston Atoll successfully and safely but at a higher cost than anticipated.

U.S. General Accounting Office. *Chemical Weapons Destruction: Advantages and Disadvantages of Alternatives to Incineration*. GAO/NSIAD-94-123. Washington, D.C.: General Accounting Office, March 1994.

Determines that the most promising alternative disposal technologies are still in the initial stages of development and could not be used to destroy the chemical weapons stockpile by the Congressionally mandated deadline of 31 December 2004. Also evaluates the advantages and disadvantages of the most promising disposal technologies.

U.S. General Accounting Office. *Chemical Weapons Destruction: Issues Affecting Program Cost, Schedule, and Performance*. GAO/NSIAD-93-50. Washington, D.C.: General Accounting Office, January 1993.

Reviews the results of the initial incineration tests at JACADS and the Department of Defense's efforts to obtain environmental permits. Determines: 1) the operation verification test results have improved, but the destruction rates are lower than anticipated; 2) public opposition to incineration is an obstacle to obtaining required permits; and 3) improvements are possible in the Army's efforts to handle the environmental permitting process.

U.S. General Accounting Office. *Chemical Weapons: Issues Involving Destruction Technologies*.

GAO/NSIAD-94-159. Washington, D.C.: General Accounting Office, 26 April 1994.

Determines that although there have been production problems at JACADS, there are no obstacles to destroying chemical agents within federal requirements. Alternative technologies are over a decade away from maturity. Moreover, no alternative technology by itself disposes of the munition, chemical agent, explosives/propellants, and dunnage.

U.S. General Accounting Office. *Chemical Weapons: Obstacles to the Army's Plan to Destroy Obsolete U.S. Stockpile*. GAO/NSIAD-90-155. Washington, D.C.: General Accounting Office, May 1990.

Obstacles to the U.S. Army's chemical stockpile disposal program include cost overruns, public opposition, and production delays.

U.S. General Accounting Office. *Chemical Weapons Stockpile: Army's Emergency Preparedness Program Has Been Slow to Achieve Results*. GAO/NSIAD-94-91. Washington, D.C.: General Accounting Office, February 1994.

Finds that the Chemical Stockpile Emergency Preparedness Program has not achieved its goal of preparing local communities to respond to a chemical emergency because program guidance is insufficient, acquisition of equipment has been delayed, and program management is weak.

U.S. General Accounting Office. *Chemical Weapons: Stockpile Destruction Cost Growth and Schedule Slippages Are Likely to Continue*. GAO/NSIAD-92018. Washington, DC: General Accounting Office, November 1991.

Asserts that increased costs and time delays should be expected in the Army's chemical weapons disposal program based on additional program requirements, wage increases, and technical problems.

Walker, Robert M. Statement by Robert M. Walker, Chemical Demilitarization Program. Subcommittee on Nuclear Deterrence, Arms Control and Defense, Senate Armed Services Committee. Washington, D.C., 26 April 1994.

Reviews the U.S. Army's chemical stockpile disposal program including operations at JACADS, alternative disposal technologies, and public opinion.

Warren, David R. "Chemical Weapons Storage: Communities Are Not Prepared to Respond to Emergencies." Testimony before the U.S. Congress. Washington, DC: General Accounting Office, 16 July 1993.

Determines that despite the Chemical Stockpile Emergency Preparedness Plan, communities lack the essential capabilities to respond to chemical accidents. Recommends: 1) the establishment of an accountable management structure within the Department of the Army; 2) a reevaluation of the Federal Emergency Management Agency's role in the program; 3) the creation of program deadlines; and 4) the establishment of strict accountability for program funds.

Documents From Environmental Groups, Baseline Opponents, and Local Citizens' Groups

Blackwell, Oris, et al. *Report of the Kentucky Community Study Group*. Aberdeen Proving Ground, MD: United States Army, November 1987.

Addresses the concerns of the citizens living near the Lexington Bluegrass Army Depot and requests that the chemical stockpile at Lexington be airlifted to Tooele for destruction.

Chemical Weapons Working Group. "Army Lied to National Research Council, Congress and Communities Exaggerated Chemical Weapons Arsenal Risks to Sell Incineration; Study Confused Days With Weeks in Projecting Safety Period." Press Release. Berea, KY: Chemical Weapons Working Group, 10 August 1994. Claims that the chemical weapons stockpile can be safely stored for more than 120 years and that the Army knowingly misled the National Research Council by stating that the stockpile could only be safely stored until 2004.

Chemical Weapons Working Group. "Citizens' Solution for Chemical Weapons Disposal." Berea, KY: Chemical Weapons Working Group, undated.

Critiques the Army's plan to destroy the U.S. chemical weapons stockpile through incineration. Recommends that the chemical agents be separated from the munitions and stored until a safer disposal technology is developed.

Costner, Pat. *The Army's Experience at Johnston Atoll Chemical Disposal System*. Washington, D.C.: Greenpeace, 11 April 1993.

Critically assesses the Army's chemical weapons incineration program on Johnston Island.

Costner, Pat. *Chemical Weapons Demilitarization and Disposal: Johnston Atoll Chemical Disposal System, GB and VX Campaigns*. Washington, D.C.: Greenpeace, 12 May 1993.

Cites a myriad of malfunctions and technical difficulties at JACADS including: 1) the impossibility of achieving an appropriate destruction and removal efficiency; 2) the high rate of malfunction in the analytical systems used to detect unburned chemical agents; and 3) the exposure of workers to dangerous chemical emissions.

Costner, Pat. *The Incineration of HD Agent At JACADS: MPF Trial Burn and LIC Demonstration Burn*. Washington, D.C.: Greenpeace, 17 March 1994.

Asserts that the metal parts furnace and the agent incinerator trial burn failed to meet Environmental Protection Agency regulations.

Costner, Pat, and Joe Thornton. *Playing With Fire: Hazardous Waste Incineration*. Washington, D.C.: Greenpeace, 1990.

Discusses the dangers of hazardous waste incineration, and recommends: 1) a moratorium on siting and permitting hazardous waste incinerators; 2) a ban on incineration of wastes containing metals, chlorine, or other halogens; and 3) the creation of a mandatory pollution prevention program.

EA Engineering, Science and Technology. *Chemical Stockpile Disposal Program*. Aberdeen Proving Ground, MD: United States Army, October 1987.

Written on behalf of the citizens in the area of Aberdeen Proving Ground, Maryland, this report addresses the health and environmental concerns related to incineration of chemical weapons and makes recommendations to maximize the safety of chemical weapons incineration at Aberdeen.

- Hardy, John T. *Review of Department of the Army Global Commons Environmental Assessment*. Bellingham, WA: Huxley College of Environment Studies Institute of Environmental Toxicology and Chemistry, 4 September 1990.
Critiques the U.S. Army's decision to transport chemical weapons from Germany to the Johnston Atoll baseline facility by sea based on potential consequences for marine environment.
- Heiser, B., et al. *Community Review Final Report: Disposal of Ton Containers of VX*. Aberdeen Proving Ground, MD: United States Army, October 1987.
Addresses the concerns of citizens living near the Newport Army Ammunition Plant, Indiana, and makes recommendations to maximize the safety of chemical weapons incineration at Newport. The study group did not recommend incineration as the best method of disposal due to possible health and environmental effects.
- Kentucky Chemical Demilitarization Citizen Advisory Response to the National Research Council Recommendations For the Disposal of Chemical Agents and Munitions*. Kentucky Chemical Demilitarization Citizens Advisory Commission, 25 February 1991.
Critiques the research methods and findings of the NRC's report on the potential alternatives to incineration of chemical weapons. Criticizes the NRC for recommending the continuation of the incineration program in spite of the need for further research and development of alternative technologies.
- Kentucky Chemical Demilitarization Citizens' Advisory Commission Report*. Kentucky Chemical Demilitarization Citizens' Advisory Commission, 15 December 1993.
Describes the function and activities of the Kentucky Citizens' Advisory Commission, establishes criteria for evaluating disposal options, and makes recommendations for the chemical weapons disposal program including further study of alternative technologies and increased citizen participation.
- The Kentucky Environmental Foundation. *The Citizen's Viewpoint: Citizen Perspectives on the Army's Plan to Build a Nerve Agent Incinerator in Madison County, Kentucky*. Berea, KY: The Kentucky Environmental Foundation, Common Ground, August 1991.
Presents statements taken from concerned citizens at an Army review meeting on 25 April 1991 regarding the proposed chemical weapons incineration site near Lexington, Kentucky.
- Maryland Chemical Demilitarization Citizens Advisory Commission. *Comments on the Recommendations For the Disposal of Chemical Agents and Munitions*. Maryland Chemical Demilitarization Citizens Advisory Commission, 21 February 1994.
Supports the use of neutralization to dispose of the chemical weapons stockpile of one ton containers of mustard agent stored at Aberdeen Proving Ground. Finds incineration of mustard gas unacceptable, and since Aberdeen is the most densely populated disposal site, recommends a physical inspection of the stockpile to ascertain the true conditions of the stockpile.
- Mohr, Scott C. *Critique of Incineration Proposal For Destruction of Chemical Warfare Agents*. Boston, MA: Physicians for Social Responsibility, 18 March 1994.
Critiques the proposed construction of eight chemical weapons incineration facilities due to the possible health effects of fugitive emissions.
- Picardi, Alfred. *Greenpeace Review of Johnston Atoll Chemical Agent Disposal System Draft Final Second Supplemental Environmental Impact Statement For the Storage and Ultimate Disposal of the European Chemical Munition Stockpile*. Washington, D.C.: Environmental Science and Assessment Services Inc., 9 July 1990.
Summarizes Greenpeace's objections to the destruction of chemical weapons at JACADS. Specifically notes: 1) incineration leads to dioxin exposure; 2) the U.S. Army has not comprehensively studied alternative destruction methods; and 3) the Army violated the National Environmental Policy Act process by transporting the chemical munitions through international waters.
- Picardi, Alfred, et al. *Alternative Technologies For the Detoxification of Chemical Weapons: An Information Document*. Washington, D.C.: Greenpeace International, 24 May 1991.
States that incineration of chemical weapons will lead to fugitive emissions that are harmful to both humans and the environment. Presents a series of alternative technologies could be used to destroy the U.S. chemical weapons stockpile, including biological, chemical, photochemical, electrochemical, neutralization, and thermal processes.

Program Manager for Chemical Demilitarization. *Chemical Stockpile Disposal Program: Final Report on the DPEIS and Other Drafts*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, October 1987.

Concerned Arkansas citizens recommend consideration of the on-site disposal alternative with the dual technology evaluation program for the destruction of chemical weapons.

Program Manager for Chemical Weapons. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement: Public Comments and Responses*. Aberdeen Proving Ground, MD: Program Manager for Chemical Demilitarization, January 1988.

Documents letters received from federal, state, and local agencies, nongovernmental organizations, and individuals regarding the Draft Programmatic Environmental Impact Statement.

Siegel, Lenny. *Chemical Weapons Disposal: The Threat At Home*. Boston, MA: National Toxics Campaign Fund, June 1991.

Argues that the U.S. Army's plans to incinerate the chemical weapons stockpile are flawed because: 1) incineration poses environmental and health risks; 2) neutralization is a safer method of disposal; and 3) the chemical weapons stockpile can be safely stored while alternatives are studied by removing the chemical agents from the munitions.

Sierra Club. "Sierra Club Analysis of Dr. Carl Peterson's Recommendations for the Disposal of Chemical Agents and Munitions." Pueblo, CO: Sierra Club, 26 May 1994.

Critiques a presentation from Dr. Carl Peterson in which he recommended incineration of the chemical weapons stockpile.

Sierra Club Board of Directors. "Chemical Weapons Resolution." Chevy Chase, MD: Sierra Club, 10 September 1993.

Reaffirms the Sierra Club's opposition to chemical weapons incineration and urges Congress to prohibit funds and research for purposes related to incineration.

Silton, Triana. "Out of the Frying Pan...: Chemical Weapons Incineration in the United States." *The Ecologist*, (January 1993):18-24.

Summarizes the U.S. Army's incineration plan and reports on grass-roots opposition to it.

Umatilla Citizen's Advisory Commission. *Umatilla Army Depot Activity, Hermiston, Oregon: Chemical Demilitarization Citizen's Advisory Commission*. Pendleton, OR: Bridges & Associates, 14 March 1993.

Exerpts questions and answers from the 14 March 1993 meeting of the Citizen's Advisory Commission regarding the use of neutralization versus incineration for the disposal of chemical weapons.

Umatilla Study Group. *Evaluation of the Draft Programmatic Environmental Impact Statement For the Destruction of Chemical Weapons At the Umatilla Army Depot and Other Army Facilities*. Aberdeen Proving Ground, MD: United States Army, October 1987.

Addresses the concerns of citizens living near the Umatilla Army Depot regarding the proposed chemical weapons incinerator and makes recommendations that would maximize the safety of chemical weapons incineration.

Vincent, Ross. "The Sierra Club and the Combustion Strategy: Incineration - A Fundamentally Primitive and Dangerous Technology." *EI Digest Industrial and Hazardous Waste Management*. Minneapolis, MN: Environmental Information Ltd, March 1994.

States that incineration must be replaced as a method of waste disposal.

Williams, Craig. Presentation to the Henry L. Stimson Center's Chemical Weapons Convention Implementation Project, Washington, D.C., 21 June 1994.

States: 1) citizens have not had enough input in the chemical weapons destruction program; 2) incineration is an unhealthy technology choice for both the environment and the public; and 3) the potential exists for the Army use the baseline incinerators after the chemical weapons destruction program is completed.

National Research Council Documents

National Research Council. *Alternative Technologies Forum*. Washington, D.C.: National Academy of Sciences, 30 June 1993.

Provides a transcript of the public meeting where the NRC's alternative technologies report was released and discussed.

National Research Council. *Alternative Technologies For the Destruction of Chemical Agents and Munitions*. Washington, D.C.: National Academy Press, 1993.

Examines various alternative destruction technologies. Recommends enhancing the emissions safety of whatever technology is eventually selected, specifically the addition of charcoal filters for baseline facilities.

National Research Council. *Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification Testing: Part I*. Washington, D.C.: National Academy Press, 16 July 1993.

Finds that incineration is capable of the safe disposal of the chemical weapons stockpile. States the U.S. Army should proceed toward operation at Tooele. Also recommends improvements for baseline facilities.

National Research Council. *Evaluation of the Johnston Atoll Chemical Agent Disposal System Operational Verification System*. Washington, D.C.: National Academy Press, 1994.

Reviews the performance of JACADS and determines that the baseline program is capable of safely disposing of the U.S. chemical weapons stockpile. However, finds that improvements including safety procedures and monitoring systems should take precedence over production schedules.

National Research Council. *Recommendations For the Disposal of Chemical Agents and Munitions*. Washington, D.C.: National Academy Press, 1994.

Concludes that the baseline incineration system has been demonstrated to be a safe and effective disposal process, but also recommends that carbon filters be added to the pollution control system. Finds that the benefits of developing another successful technology for agent destruction are outweighed by the risk of accidental agent release associated with the many additional years of storage needed for the development process. Nevertheless, also recommends that the Army examine the feasibility of using neutralization, the most promising technology, at Aberdeen and Newport where agents are stored in bulk containers, not munitions.

National Research Council. *Review of Monitoring Activities Within the Army Chemical Stockpile Program*. Washington, D.C.: National Research Council, 1994.

Finds that the system used to detect fugitive chemical emissions at Johnston Atoll should be improved prior to use at the continental U.S. sites.

Peterson, Carl R. "Disposing of Chemical Warfare Agents and Munitions Stockpiles." *Arms Control Today* (June 1994): 8-12.

States that at the present time there is no better method to chemical weapons disposal than incineration, and notes that continued storage of the chemical weapons stockpile poses greater health and environmental risks than incineration.

Peterson, Carl R. "Recommendations For the Disposal of Chemical Agents and Munitions." Statement Before the Subcommittee on Nuclear Deterrence, Arms Control and Defense Intelligence, Senate Armed Services Committee, United States Senate. Washington D.C., 26 April 1994.

Testifies regarding the NRC's recommendations for the U.S. chemical weapons destruction program. Reviews the potential methods of destroying chemical weapons and determines that incineration should continue simultaneously with research on alternative technologies.

Newsletters and Status Reports

The Henry L. Stimson Center. *The CWC Chronicle*. Washington, D.C.: The Henry L. Stimson Center.

A periodic newsletter about international and domestic events related to the implementation of the Chemical Weapons Convention.

Committee for National Security. "Chemical Weapons: Fact Sheet No. 1: Chemical Weapons Destruction and Disposal in the United States." Washington, D.C.: Committee for National Security, undated.

Committee for National Security. "Chemical Weapons: Fact Sheet No. 2: The Global Proliferation of Chemical Weapons." Washington, D.C.: Committee for National Security, undated.

Department of the Army. *Annual Status Report on the Disposal of the Lethal Chemical Stockpile*. Department of the Army, December 1985 to December 1993.

Describes the status and activities relating to the storage and destruction of the U.S. chemical weapons stockpile per order of Public Law 99-145.

The Kentucky Environmental Foundation. *Common Sense: A Newsletter of Common Ground*. Berea, KY: The Kentucky Environmental Foundation, March 1994.
Reports on baseline opponents' activities around the country.

U.S. Army Chemical Materiel Destruction Agency. *Chemical Demilitarization Update*. Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, April 1994.
Provides information regarding the U.S. Army's chemical weapons destruction program.

Videos

America's Defense Monitor. *Ridding the World of Chemical Weapons?* Washington, D.C.: Center for Defense Information, 28 August 1994.

Discusses the advantages and disadvantages of the Chemical Weapons Convention, concluding that the former far outweigh the latter.

America's Defense Monitor. *Stopping the Spread of Chemical And Biological Arms*. Washington, D.C.: Center for Defense Information, August 1991.

States that the spread of chemical and biological weapons is a danger.

Greenpeace. *The Rush to Burn*. Washington, D.C.: Greenpeace, 1993.

Argues the need to find a safer method of waste disposal than incineration, and focuses on grassroots opposition to incineration.

Stop the Incinerator: The Other Story. Environmental Video & Film Workshop, 1991.

Presents a series of interviews with scientific authorities and others who dispute the charges of incineration opponents.

U.S. Army Chemical Materiel Destruction Agency. *Safely Destroying America's Chemical Weapons: Systemization of the Tooele Disposal Facility*. Aberdeen Proving Ground, MD: U.S. Army Chemical Materiel Destruction Agency, June 1994.

Illustrates how components of the Tooele Disposal Facility are tested to ensure the proper functioning of human and mechanical elements.

Miscellaneous Documents

Brown, Mark. *Public Trust and Technology: Chemical Weapons Destruction in the United States*.

Washington, D.C.: The Committee for National Security, April 1993.

Examines the public's lack of trust in the U.S. Army's plan to incinerate chemical weapons and assesses the risks of delaying the chemical weapons incineration program in hopes of finding a better technology.

Chrostowski, Paul, et al. *Scientific Peer Review of Greenpeace's Position on Hazardous Waste Incineration Impacts In Its "Report on the Hazardous Waste Incineration Crisis" and "Playing With Fire."* Fairfax, VA: Clement International Corporation, 29 January 1992.

In a peer review of Greenpeace's *Playing With Fire*, determines that Greenpeace's analysis was not conducted according to established scientific methods.

Cudahy, James. *The Rest of the Story: Literature Research and Technical Review of the Greenpeace Report Playing With Fire*. November 1992.

Critiques the anti-incineration Greenpeace publication *Playing With Fire* and finds that the quotes and statistics used in the publication are inaccurate and misleading.

Department of National Defence. *Citizens' Environmental Protection Committee*. Alberta, Canada: Department of National Defence, July 1992.

Describes the operation of the Citizens' Environmental Protection Committee as a public review group for the Canadian chemical weapons incineration project, Swiftsure.

Department of National Defence. *Excerpts From Project Swiftsure Final Report*. Alberta, Canada: Department of National Defence, undated.

Focuses on the public communications program that facilitated the completion of Project Swiftsure, the Canadian chemical weapons incineration program.

Ember, Lois R. "Chemical Weapons Disposal: Daunting Challenges Still Ahead." *C & EN* (13 August 1990): 9-19.

Reports that the U.S./Soviet agreement to dispose of their chemical weapons by the year 2002 faces technology problems, public opposition, and unrealistic schedules.

"Environmentalists Attack As Politicized Report Pushing Incineration." *Defense Environment Alert* (26 January 1994): 4-5.

Reports that environmentalists believe the recommendations of the NRC were politically biased towards incineration.

Friedman, Lisa. Letter from the Associate General Counsel of the Solid Waste and Emergency Response Division at the Environmental Protection Agency (EPA) to Robert Hunter, the Associate General Counsel at the U.S. General Accounting Office, 21 October 1992.

States: 1) the permit to construct a chemical disposal facility at Anniston must be issued by the EPA and the Alabama Department of Environmental Management (ADEM), and ADEM must determine if site preparation work may begin; 2) the EPA did not give the Army permission to carry out the site preparation work; and 3) the Army was not consistent with the Resource Conservation and Recovery Act (RCRA) regulations when it began site preparation work.

Hunter, Robert. Letter from the Associate General Counsel at the General Accounting Office to William K. Reilly, Administrator of the Environmental Protection Agency, 24 July 1992.

Requests information regarding 1) whether the EPA is the proper authority to issue permits for construction of the chemical stockpile disposal facility in Anniston and to allow site preparation work to commence without a permit; 2) whether the EPA gave the Army permission to do the site preparation work at Anniston; and 3) whether the Army's actions in undertaking the site preparation work without a permit were consistent with the RCRA and federal regulations.

Jones, Kay H. "Diesel Truck Emissions, an Unrecognized Source of PCDD/PCDF Exposure in the United States." *Risk Analysis* 13, no. 1 (1993): 245-252.

Reports that transportation sources, most notably diesel trucks, will be responsible for five times the waste emitted by incinerators by the year 2000.

Koplow, David A. "How Do We Get Rid of These Things?: Dismantling Excess Weapons Under Arms Control Treaties." To be printed in *Northwestern Law School Journal*. Volume 89, 1994.

Asserts that environmentalism and arms control have now begun to intersect with public policy and that these competing concerns can only be accommodated temporarily and uncomfortably. Also examines earlier arms control agreements, the implications of the 1969 National Environmental Policy Act for the disposal of the chemical weapons, and the shortcomings in the proposed incineration program.

Koplow, David A. *Some Disassembly Required: Eliminating Chemical Weapons While Protecting the Environment*. Washington, D.C.: Lawyers Alliance for World Security, Committee for National Security, July 1994.

Discusses the issue of U.S. destruction of its chemical weapons stockpile in conjunction with the potential environmental consequences.

Lawyer's Alliance for World Security and Committee for National Security. *Citizen Attitudes on the Destruction and Disposal of Chemical Weapons Stockpiles: A Report from a Series of Community Dialogue Forums on Chemical Weapons Demilitarization*. Washington, D.C.: Lawyers Alliance for World Security, Committee for National Security, July 1994.

Summarizes the comments of speakers and participants at a series of forums in Hartford County, Alabama concerning the U.S. Army's plans to incinerate chemical weapons at the Anniston Army Depot.

McAndless, John. "Project Swiftsure Destruction of Chemical Agent Waste at Defence Research Establishment, Suffield." Paper Number 92-74.01. Presentation at the 85th Annual Meeting and Exhibition of the Air & Waste Management Association, Kansas City, MO, 21-26 June 1992.

Morrow, Edward, et al. *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants*. R-2569-DOE. Santa Monica, CA: RAND, 1981.

Examines the reasons for inaccurate estimates of capital costs and performance difficulties for first-of-a-kind process plants.

- Morrison, David C. "No Easy Out." *National Journal* (11 May 1991): 1100-1104.
Examines the advantages and disadvantages of the controversial U.S. Army plan to incinerate the chemical weapons stockpile.
- Pleus, Richard C., et al. *Health Effects of Hazardous Waste Incineration...More of the Rest of the Story*. Seattle, WA: Environmental Toxicology International, June 1994.
Critiques the 1990 Greenpeace report *Playing With Fire*. States that Greenpeace has no scientific basis for its allegations against incineration.
- Rogers, Harvey W. "Incinerator Air Emissions: The Bigger Picture." Submitted for Publication, May 1994.
Asserts that the general public is not given adequate information to reach an informed opinion about incineration. Provides technical analysis that disputes some of the assertions made by incineration opponents about baseline incinerators.
- Rouse, Lawrence E. "The Disposition of the Current Stockpile of Chemical Munitions and Agents." *Military Law Review* 121 (1988): 17-94.
States: 1) the original 1994 deadline for destruction of the United States chemical weapons stockpile was unrealistic; 2) incineration is safe and effective and more practical than trying to find alternative technologies; 3) and on-site disposal is more prudent than transporting chemical weapons through populated areas.
- Santoleri, Joseph J., et al. "Facts Or Myths: The Burning Issue of Incineration." Presentation at Air and Waste Management Association Meeting, Denver, CO, 13-18 June 1993.
Critique's Greenpeace's 1990 report *Playing With Fire*, argues that the Greenpeace analysis was not conducted according to generally recognized scientific methods and therefore would not yield a credible opinion.
- Yang, Yu-Chu, et al. "Decontamination of Chemical Warfare Agents." *Chemical Reviews*, volume 92, number 8, pg. 1729-1734.
Describes the chemical reactions of four major chemical warfare agents with existing field decontaminants and decontamination systems currently under investigation.