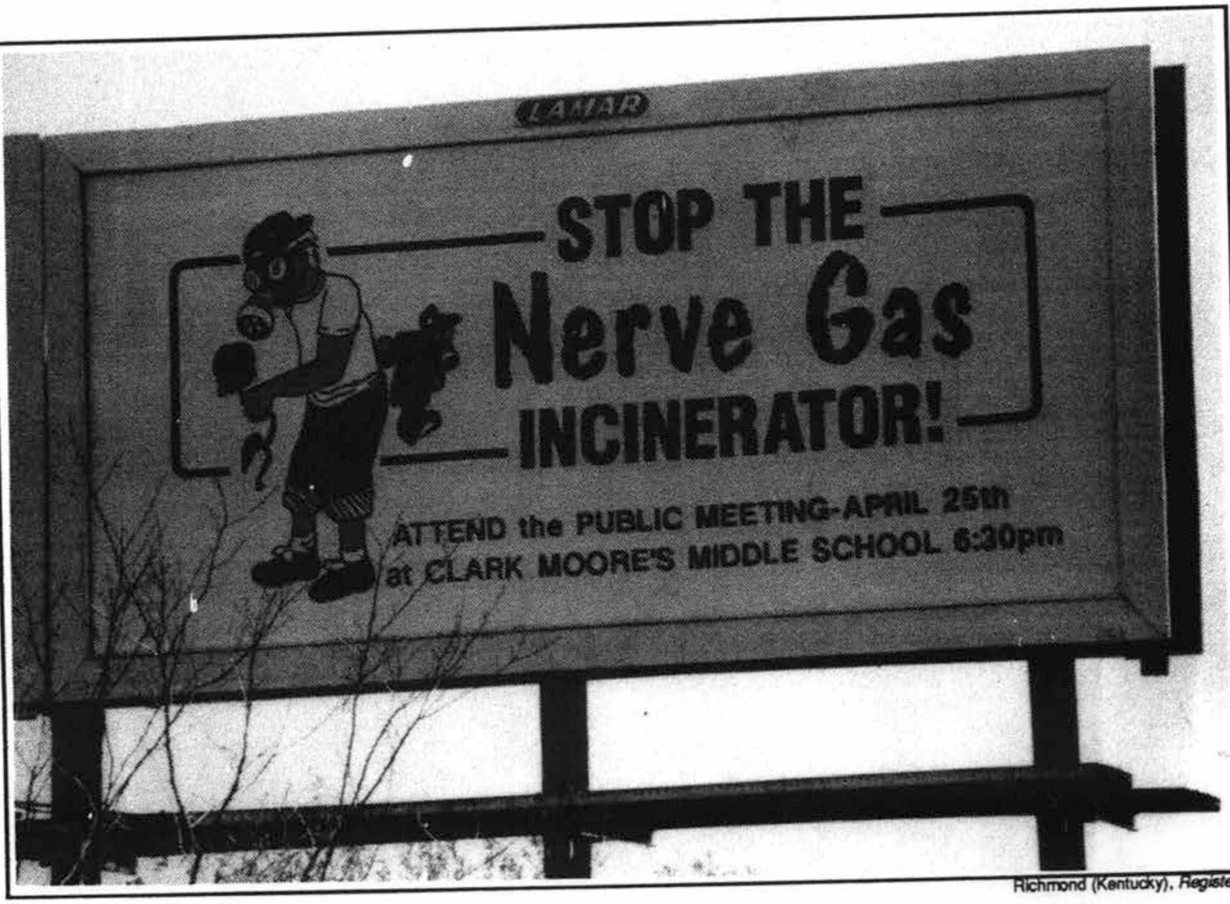
CHEMICAL WEAPONS DISPOSAL: THE THREAT AT HOME



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A sign of the times near Kentucky's Lexington-Blue Grass Army Depot

by Lenny Siegel

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Abbreviations Used Frequently in This Report:

CAMDS: Chemical Agent Munitions Disposal System (at Tooele Army Depot, Utah)
CW: chemical weapons (or sometimes chemical warfare)
DATS: Drill and Transfer System
DRE: destruction and removal efficiency
GAO: General Accounting Office (of the U.S. Congress)
GB: Sarin nerve agent
JACADS: Johnston Atoll Chemical Agent Disposal System

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SUMMARY

To the great relief of our entire nation, neither side attempted to use chemical weapons during the Persian Gulf War. However, Americans at home are threatened by thousands of tons of chemical weapons stockpiled over the last fifty years by our own armed forces. Within the next several years, the U.S. Army plans to incinerate almost 30,000 tons of unneeded nerve agent ("gas") and other chemical weapons (CW). One plant, on Johnston Atoll some 700 miles southwest of Hawaii, is already in operation, and additional incinerators are planned for eight domestic sites in Utah, Oregon, Arkansas, Colorado, Alabama, Maryland, Indiana, and Kentucky.

While the demilitarization and eventual disposal of these weapons is necessary, incineration will release dangerous quantities of extremely toxic substances, including dioxins and furans, into the environment. These substances cause cancer, liver disease, immune system disorders, birth defects, and a number of other serious health problems. Over time, the release of minute quantities of dioxins, furans, and other combustion products constitutes an unacceptable threat to both public health and the environment. These substances do not break down easily, and their potency is magnified as they accumulate in living tissue.

The Army claims that the risks of disposal are minimal, and it argues that the perfection of alternate disposal methods would take too long. Yet neither public safety nor the prospect of chemical arms control determined the Army's disposal schedule. Rather, the Army made a bargain with Congress in 1985, promising to burn ninety percent of the U.S. stockpile of *unitary* chemical weapons—that is, munitions in which the chemical agents are already mixed in their most deadly form. In exchange, Congress approved the production of a new generation of *binary* chemical weapons, munitions in which the chemicals would be stored separately, mixing to lethal form after firing.

In June, 1990, after the U.S. had amassed a small stockpile of binary munitions, President Bush signed a tentative agreement with the Soviet Union, in which both superpowers pledged to halt future CW production and dispose of the bulk of their CW stocks. While the dismantling of those weapons can be

accomplished within the agreement's timetable, neither country has demonstrated the technology to safely destroy the chemical agents.

Residents living in communities where disposal is to take place are organizing against incineration. In addition to the dangers of burning chemical weapons, the Army may use the incinerators to burn vast quantities of other waste munitions or military-generated hazardous waste, emitting the same deadly contaminants indefinitely.

The Army could eliminate the greatest risks of storage, such as explosion and leaks, by draining rockets and shells and storing the chemicals for disposal while alternate technologies are being tested. With proper research support, existing closed-loop industrial processes can be adapted to neutralize all forms of chemical agent in the U.S. stockpile. Those alternatives are likely to be safer, quicker, more portable, and cheaper than incineration.

Working with the local opponents of the Army's Chemical Stockpile Disposal Program and Greenpeace Action, the National Toxics Campaign Fund has developed the following four recommendations:

1. All plans to use incineration or any other open-ended disposal system should be halted at once.
2. The Defense Department should immediately expand its research and development of alternate chemical weapons demilitarization and disposal systems.
3. The U.S.-U.S.S.R. CW agreement should be interpreted or modified to establish separate timetables and procedures distinguishing the demilitarization—that is, disassembly so they cannot be used as weapons—of chemical munitions from the disposal of chemical agents.
4. Before treatment of chemical weapons is considered at any location, the Army should perform a site-specific environmental impact statement which considers the option of no on-site treatment or disposal.

THE THREAT AT HOME

For several months, the armed forces of the U.S. and our allies, as well as large civilian populations, lived with the threat of Saddam Hussein's chemical arsenal. In many parts of the U.S., Americans face a similar, though unintentional threat. The U.S. Army holds a stockpile of 30,000 tons of old chemical weapons (CW), including nerve and mustard agents,[1] that it never expects to use. For nearly a decade, the U.S. has been preparing to dispose of most of those weapons, which are stored at eight domestic Army bases and on Johnston Island in the Pacific, about seven hundred miles southwest of Hawaii.[2] Unfortunately, the Army has chosen a disposal method, incineration, that is likely to harm public health and the environment wherever it is employed. Yet it has failed to consider alternatives fully.

Chemical weapons, in some ways, are the ultimate toxic waste. They are dangerous to produce, dangerous to use, and with the Army's current technology, dangerous to destroy.

The Army Plans incinerators at all eight domestic CW storage locations.

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[1]Though chemical munitions are commonly known as poison *gases*, they are normally stored and released in liquid form—thus the term "agent."

[2]U.S. chemical weapons previously stored in Germany arrived at Johnston Island in November, 1990.

At first look, chemical weapon disposal is the ultimate NIMBY—that is, "Not in my back yard!"—issue. Indeed, nobody wants nerve gas stored in their neighborhood. Nobody wants it burned in their town. No one even wants the poison shipped to or through their state.

Yet many of the people who live in the toxic shadow of the nation's CW stockpile are more sophisticated. They are quick to point out that chemical weapons are a national, not a local problem. Growing numbers are opposing chemical weapons incineration in anyone's backyard. Many are demanding that the Army develop and test alternate means of chemical weapons demilitarization and disposal.

Incineration Poses Unacceptable Health and Environmental Risks

Though the Army incinerated chemical weapons during the 1970's, it did not put all of its eggs in the incinerator basket until 1982, when it selected combustion as the disposal method for its Chemical Stockpile Disposal Program. At the time, incineration seemed—to the Army, at least—like the quickest, cheapest, and simplest way to get the job done. It could take any waste, from wood treated with highly toxic preservatives to metal cannisters to nerve agent, throw it in an incinerator, and the hazards literally would go up in smoke.

By June 30, 1990, when the Army began its first full-scale incineration on Johnston Island, it was clear that the promise of incineration had long since evaporated. Originally, the Army told Congress that it could destroy ninety percent of its CW stocks by 1994. However, technical problems, regulatory and political obstacles, and funding that failed to keep up with costs forced the Army to win a three-year extension. Last year, the U.S. Congress's General Accounting Office (GAO) reported that the new legally mandated April 30, 1997 completion date could not be met. [3] Early this year, Assistant Army Secretary Susan Livingstone told Congress that the Army has already set back its target date for completion until July, 1999.[4]

Meanwhile, program costs are growing exponentially. GAO reported that the life-cycle cost of the disposal program, projected at $1.7 billion when approved by Congress in 1985, doubled to $3.4 billion by 1988. Livingstone said the life-cycle cost had jumped again to $6.5 billion, with the fiscal year 1992 request alone totalling $607 million.

[3]"Chemical Weapons: Obstacles to the Army's Plan to Destroy Obsolete U.S. Stockpile," U.S. General Accounting Office (GAO/NSIAD-90-155), May, 1990, p. 27, p. 19.
[4]"U.S. Unitary Chemical Weapons Won't be Destroyed Before July 1999, Army Says," *Inside the Army*, April 29, 1991, pp. 1-2.

Furthermore instead of one incinerator, the prototype Johnston Atoll Chemical Agent Disposal System (JACADS) consists of four incinerator systems, one each for packaging materials, metal parts, explosives, and chemical agents. Disposal entails four major steps. First, machines take apart the chemical munitions, removing explosives, draining chemical agents, and shearing the cannisters. Second, each waste stream is routed to its own furnace, where it is burned at high temperatures, creating toxic solid waste (ash), liquid waste (brine), and exhaust. Third, scrubbers treat the exhaust from each incinerator, cooling it, reducing the acidity, and filtering it to generate more toxic ash. Finally, liquid waste is dried, and the residue, as well as ash from the furnaces and scrubbers, is placed in containers for eventual disposal in a stateside hazardous waste landfill.

The Army is still banking on incineration, but since it designed its disposal program a growing body of scientific research has confirmed suspicions that the incineration of hazardous waste is unsafe. Despite refinements in incineration technology, such as liquid injection and rotary kilns, and pollution control devices such as smokestack scrubbers, incineration suffers from four fundamental flaws:

1. All hazardous waste incinerators emit quantities of unburned wastes and a stew of other chemicals produced in the combustion process. An Army study concluded that its chemical weapons incinerators would do the same.[5] Tests of incinerators have actually identified more than one hundred synthetic chemicals in smokestack emissions, and the total number of chemicals released has been estimated to number in the thousands.[6]

Among those emissions, found when organic—that is, carbon-containing—material is combusted with chlorine, are the polychlorinated dioxins and furans.[7] These ultratoxic chemicals persist in the environment for long periods, accumulating in the tissues of living things. Dioxins, the same impurities found in Agent Orange, are blamed for many of the health problems associated with exposure to herbicides in Vietnam. The most toxic form of dioxin (called 2,3,7,8-TCDD) is the most potent carcinogen ever tested on laboratory animals. Extraordinarily low doses are also known to cause birth defects, liver and kidney damage, immune suppression, neurological and developmental impairment, and

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[5]Kevin J. Flamm, "PICs, POHCs, and Chemical Agent Incineration," (draft). Office of the Program Manager for Chemical Munitions, Aberdeen Proving Ground, June, 1987, Report AMCPM-CD-TR-87118.

[6]"Standards for Owners and Operators of Hazardous Wastes Incinerators and Burning of Hazardous Wastes in Boilers and Industrial Furnaces; Proposed and Supplemental Proposed Rule, Technical Corrections, and Request for Comments," Environmental Protection Agency, 55 *Federal Register* 82, April 27, 1990. Pat Costner and Joe. Thornton, "Playing With Fire: Hazardous Waste Incineration," Greenpeace USA, Washington D.C., 1990.

[7]"Background Document for The Development of PIC Regulations From Hazardous Waste Incinerators," Draft Final Report, EPA Office of Solid Waste, October, 1989 (c).

reproductive dysfunction. The other types of dioxins and furans are generally considered to have the same effects as TCDD, though greater doses are required for the same effect.[8]

Though nerve agents themselves do not contain chlorine, chlorinated compounds are found in all CW incinerators. Mustard gas, decontamination solutions, and packaging materials contain chlorine, and purified seawater used as a coolant at JACADS is also likely to contain traces of sodium chloride—sea salt. Thus, the formation of dioxins and furans is inevitable. Furthermore, GB, one of the two major nerve gas agents in the U.S. inventory, contains fluorine, an element that reacts with organic material in ways similar to chlorine, creating similar but even less understood compounds.

The Army has promised to monitor the JACADS system for stack emissions of dioxins and furans, but thus far it has released no data on its findings. In fact, it has not disclosed exactly how and where it is taking its measurements. It is therefore impossible to estimate the health or environmental

Greenpeace/Dorreboom

Greenpeace activists take the protest to Johnston Island in the Pacific.

[8]"Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins," Environmental Protection Agency, EPA/600/8-84/014f, September, 1985.

impact of the incinerator and its successors in more populated areas. Perhaps more important, the Army has not explained how it will mitigate the releases if it finds that they exceed whatever arbitrary standard it adopts. Given its vast investment in the incinerator complex, it is unlikely that it will halt disposal activities. It may place more efficient scrubbers on the exhaust stacks, but that will just add to the hazardous solid waste that has to be shipped to landfills.

The CW incinerators, like other hazardous waste incinerators, can be presumed to emit other highly toxic compounds, such as hexachlorobenzene, octachlorostyrene, and polychlorinated biphenyls (PCB's), which also bioaccumulate—that is, collect in living tissue. If it meets its schedule and specifications, JACADS will also emit 52,000 pounds per year of particulate matter.[9]

2. The incinerators will create an undisclosed volume of ash and brine, which is dried before transfer. This waste contains unknown concentrations of heavy metals, salts, and organic compounds, including dioxins and furans, scrubbed from the exhaust stacks. In fact, traces of chemical agent may be found in the waste as well. Since the Ocean Dumping Act prevents the Army from sinking the wastes at sea, it is shipping them in containers to California, where they are already being buried at Waste Management Inc.'s Kettleman City landfill. Wastes from the eight domestic incinerator complexes, when built, will likewise be shipped to hazardous waste landfills. The Army promises a monitoring program to prevent the transfer of any agent-contaminated waste, but its only options are to store that waste on site or throw it back into the incinerator.

Land dumping hardly qualifies as safe "disposal." Over time, toxic substances inevitably leach into the groundwater or surface water, and escape into the air. In just a few decades of operation, many major hazardous waste landfills have already contaminated local groundwater.[10] It is likely the wastes from the CW incinerators will retain their toxicity longer than their containers remain sound. Pollution abatement for ash and brine, merely means changing the form, location, and timing of environmental contamination.

[9]The Army says JACADS will release 1.1 grams of particulates per second. The 52,000 pounds annual total is based upon 6,000 hours of operation. "Draft Second Supplemental Environmental Impact Statement," Department of the Army, 1990, p. 53.

[10]"Hazardous Waste Management System: Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities and Permit Program," Environmental Protection Agency, 46 *Federal Register* 11126-11177, February 5, 1981 (a); and "Standards Applicable to Owners and Operators of Treatment, Storage, and Disposal Facilities," Environmental Protection Agency, 46 *Federal Register* 28314-28328, May 26, 1981 (b).

Any program to destroy nerve gas and other chemical warfare agents will generate solid and/or liquid wastes. Incinerator waste, however, is particularly difficult to control, because it is an unknown mix of chemicals that includes extremely toxic compounds such as the dioxins and furans.

3. The extremely high temperatures at which the incinerator chambers operate, ranging from 1,600 degrees to 2,700 degrees F, stress the hardware and require constant monitoring and frequent maintenance. For example, during JACADS pre-disposal testing a hole burned through the secondary chamber in the incinerator for liquid agents. The rotary kiln for deactivating explosives warped, so it wouldn't properly rotate. It is not surprising, therefore, that mechanical problems forced the JACADS plant to shut down for 65 of its first scheduled 85 days of operation.[11] The system has been so unreliable, achieving only one third of its initial destruction rate goal, that the Army established a special engineering team to resolve operational difficulties and extended the initial phase of JACADS testing for three months.[12]

Failure to resolve such operational problems could be even more devastating. Commercial hazardous waste incinerators have suffered serious accidents.[13] At the CW disposal sites, an accident would be catastrophic.

4. As an open-ended system, the JACADS incinerator cannot entirely prevent the release of chemical agents. If there is an "upset" in the combustion process, significant amounts of chemical agent and an unknown mixture of combustion byproducts could be released before the problem is detected. There is no way to recapture accidental releases and put them back in the bottle. (On the other hand, closed-loop neutralization processes, discussed below, are much less likely to release hazardous substances during a system breakdown.) In December, 1990, the JACADS system detected a nerve gas leak, but its operators said it posed no health or environmental threat.

During routine operations, the Army concluded JACADS must run at 99.9999 percent (six nines) "destruction and removal efficiency" (DRE) to meet Federal emission standards for chemical weapons. The Army claims that it reached 99.99999 percent (seven nines) efficiency in a test burn at its

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[11] Wilson de Silva, "US Army Opens Pacific Chemical Weapons Burner to the Media." *Reuters News Reports*, October 31, 1990.

[12] "Serious Mechanical Problems Found in Army's Chemical Destruction Program," *Inside the Army*, April 29, 1991, pp. 2-3.

[13] In 1977, for example, a huge fire engulfed the Bridgeport, New Jersey incinerator of Rollins Environmental Services, "killing six people and covering the county with a toxic cloud formed by the uncontrolled burning of 45,000 gallons of [polychlorinated biphenyls]." See *From Poison to Prevention:A White Paper on Replacing Hazardous Waste Facility Siting with Toxics Reduction*, National Toxics Campaign Fund, 1989.

experimental facility in Utah in September, 1989.[14] While the reported level of efficiency reached under test conditions is impressive, trial burns represent carefully tuned, best-case operations. They should not be relied upon as a measure of incinerator efficiency, since it is improbable that anywhere near that level can be maintained constantly over a period of years. In the unlikely case that the Army maintains a DRE level of 99.9999 percent (six nines), two pounds of agent will be released out of each thousand tons burned.

The first two flaws, the release of toxic byproducts into the air and residue, are unavoidable. The other two problems, the risks inherent in high-temperature operation and the "open-ended" nature of the system, require a high level of competence and constant good luck to overcome. There is no room for human or machine error.

The federal government is also moving ahead with plans to incinerate chemical weapons production waste in Colorado and Arkansas.

In the past, the Army has incinerated mustard gas at the Rocky Mountain Arsenal, near Denver. Now, with EPA approval, it plans to incinerate four million gallons of liquid waste, primarily nerve gas and insecticide byproducts, that it pumped from Basin F, a vast leaking sludge pond that was possibly the most toxic spot in the country.

In the middle of Jacksonville, Arkansas, the EPA has approved the incineration of 28,500 barrels of herbicide production wastes, including at least 3,000 barrels containing high concentrations of dioxin. The Hercules-Vertac Superfund site shipped Agent Orange to Vietnam for military defoliation, a practice considered to be chemical warfare by most of the world. Trial burns are now being conducted at the site, but they have not yet met EPA standards.

The Army Holds a Huge Stockpile of Unusable Unitary Weapons

Since the first widespread use of chemical weapons during World War I, the United States has followed a policy of no first use. Although the U.S. did not ratify the 1925 Geneva Protocol outlawing the use of chemical weapons until 1975, it did adhere to its terms—at least for lethal chemical weapons.[15] Officially, American armed forces maintain a chemical warfare capability to deter adversaries from using such weapons against U.S. forces or civilians. The Army Chemical Corps has built up a formidable arsenal of chemical munitions, but since World War I the U.S. has not used lethal chemical weapons in combat.

The U.S. lethal chemical weapons stockpile today consists primarily of unitary weapons, ones in which the chemical components have already been mixed. They were manufactured between 1943 and 1969. Two of the most

[14] William Gruber, "The Chemical Stockpile Disposal Program," *EI Digest*, July, 1990, p. 10.

[15] Most countries, as well as the U.S. Congress, argue that the Geneva Protocol bans the offensive military use of riot control agents and herbicides, but as part of the ratification process, the Ford Administration listed instances where it believed it could employ such non-lethal chemical weapons.

common types are GB and VX, organophosphate "nerve gases" that disable the human nervous system's control of muscular action. An Army spokesman once explained, "What Raid does to roaches, nerve gas does to humans."[16]

GB, also known as Sarin, instantly vaporizes. When inhaled, it can kill within a minute. "The explosion of an artillery shell containing 6 pounds of GB will kill most unmasked personnel within an area approximately the size of two football fields..."[17]

VX is a liquid nerve agent that retains its (liquid) form and potency for days. One drop on the skin kills within minutes. In 1968, VX sprayed from a test aircraft at the Dugway Proving Ground in Utah accidentally slaughtered more than 6,000 sheep an average distance of thirty miles away.

The U.S. also possesses significant supplies of older mustard gas—the H series—which blister the skin. As demonstrated by Saddam Hussein, in high concentrations mustard gases also kill.

The current U.S. stockpile of unitary nerve gas weapons contains an estimated 7,600 tons of chemical agent in 1.4 million Howitzer shells, bombs, and spray tanks, as well as 4,000 tons of mustard gas in 1.25 million mortar and Howitzer shells. In addition, the Army holds 13,000 tons of mustard gas, 4,340 tons of GB, and 1,860 tons of VX in one-ton storage containers.[18] The Army says that only ten percent of the stockpile is suitable for combat in its present form. The rest consists of deteriorating shells, rockets without launchers, and chemical agents in bulk form.

In 1969, following the Utah sheep incident and growing opposition to the use of defoliants in Vietnam, President Richard Nixon ordered a halt to the production of lethal chemical weapons. Though Nixon called the use of chemical weapons "morally repugnant to the conscience of mankind,"[19] he made no plans to eliminate the American stockpile.

The Pentagon also recognized that chemical weapons—at least the unitary kind—are hard to store, handle, and transport. It proposed binary weapons, munitions containing two components that combine, when triggered, to form GB or VX. The separate chemical components are toxic, but they are safer than when they are combined. After the end of unitary weapon production, the Army

[16] David Morrissey, "The Return of Chemical Warfare," *The Progressive*, February, 1982, p. 26.

[17] Dr. Matthew Meselson, testifying at *Chemical and Biological Warfare*, hearing before the Committee on Foreign Relations, U.S. Senate, April 30, 1969, p. 5.

[18] Perry Robinson, "Review: World CW Armament," *Chemical Weapons Convention Bulletin*, Autumn, 1988, p. 15.

[19] "U.S. Chemical Weapons Production: Poisoning the Atmosphere," *Defense Monitor*, Volume XVIII, No. 2, 1989, p. 1.

obtained research and development funding for binary weapons, and the Reagan administration repeatedly sought funds for production. In 1985 Congress dropped its opposition, and in 1987, the U.S. manufactured the world's first binary weapons.

Both proponents and opponents of the new generation of chemical weapons agree that maintaining a vast stockpile of unitary chemical weapons does not make much sense. Chemical weapons trigger fear in the communities in which they are stored and through which they might travel. That is why Germany demanded that the U.S. remove its chemical munitions. Because the political consequences of moving unitary weapons to potential battlefields are enormous, even those munitions in working order have lost their deterrent power. It is likely that either the ninety percent of officially obsolete weapons or the full hundred percent will be demilitarized.

The public's fear is grounded in fact. Chemical weapons represent a continuing threat to public health and the environment. Each year, the Army discovers some 100 leaking munitions. Despite an ongoing program of containing or draining leaking weapons, about a thousand of the stockpile's five hundred thousand weapons are officially classified "leakers." Fortunately, in recent years, only a handful of Army employees have been exposed to escaping chemical agent.

Just maintaining the arsenal is costly. In 1983, the General Accounting Office GAO put the Army's annual chemical weapon storage costs, including security and safety expenses, at $180.7 million for all eight domestic storage sites.[20]

The Army, fully aware of both the physical and political dangers of maintaining such a large store of unitary weapons, made a bargain with Congress. In 1985 it testified that it could destroy its unwanted stocks by 1994. Congress took the Army at its word and mandated the destruction. In exchange, Congress funded the binary weapons program. Though technical problems, as well as continued opposition from members of Congress, delayed production, Defense Secretary Cheney certified to Congress last year that the U.S. has an adequate binary chemical munitions stockpile.[21]

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[20] "The Army's Program to Assure the Security and Safety of the Chemical Munitions Stockpile is Comprehensive and Effective," U.S. General Accounting Office (GAO/NSIAD-83-6), July 1, 1983.

[21] "News Chronology: May through August, 1990," *Chemical Weapons Convention Bulletin*, September, 1990, pp. 15-16. The Army later told the General Accounting Office that production was proceeding more slowly that expected at the time Cheney issued his certification, but GAO reports, "Army officials then told us that the existing binary chemical weapon stockpile was adequate because of the changing political situation in Europe and expectations of a U.S.-Soviet bilateral treaty agreement on chemical weapons. ("Chemical Warfare: DOD's Successful Effort to Remove U.S. Chemical Weapons from Germany," (GAO/NSIAD-91-105), February, 1991, p. 22.

Meanwhile, the end of the Cold War finally brought a breakthrough in negotiations, between the U.S. and Soviet Union, to restrict the production and possession of chemical weapons. On June 1, 1990 Presidents Bush and Gorbachev signed an agreement pledging to end chemical weapons production and to reduce each country's CW stockpile to 5,000 tons. The USSR currently stores about 40,000 tons, compared to the U.S. Army's 30,000 tons.[22]

The agreement requires both sides to destroy surplus chemical agents, weapons, and containers by the end of the year 2002, but it recognizes that either party may experience problems that may delay destruction.

Indeed, while the U.S. Army is attempting to prove its selected destruction method, the Soviets have not even chosen a technology. In March, 1990, the Soviet Defense Ministry submitted five alternative destruction plans to the Supreme Soviet.[23] Their only CW destruction plant, at Chapayevsk on the Volga River, was closed in 1989 following protests by local citizens.

It is not yet clear when the U.S.-Soviet agreement's provisions will take effect. The two nations are negotiating an inspection protocol, and each side's legislative branch must endorse the agreement. In anticipation of approval, however, Congress cut all funds for the production of binary weapons. The U.S. produced a reported 69 tons of binary shells before halting production in 1990.[24]

The Army Has Disposed of Chemical Weapons Before

Following World War II, the Army Chemical Corps disposed of captured and old chemical weapons by open burning, explosion, burial, and ocean dumping. In the late 1940's, 1950's and 1960's, the U.S. dumped old chemical munitions off the coasts of Alaska, California, and Florida by loading them aboard Liberty ships and scuttling the ships. At least four of those operations were part of Operation CHASE—for Cut Holes And Sink 'Em. Congress blocked this method in 1969-70, soon after it became public knowledge. The public, experts, and members of Congress all worried about the risks of transporting the weapons to the point of embarkation and their impact on the ocean environment after disposal. Even today, containers of old chemical weapons, such as arsenic-laced Lewisite, may pose a threat to the rich fisheries off Alaska's Aleutian Islands.[25]

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[22] Lois Ember, "Chemical Weapons Disposal: Daunting Challenges Still Ahead," *Chemical & Engineering News*, August 13, 1990, pp. 10-11.
[23] *ibid.*, p. 17.
[24] David C. Morrison, "No Easy Out," *National Journal*, May 11, 1991.
[25] See John Enders, "Chemical Arms Seethe Off Alaska," *Anchorage Times*, March 14, 1991, p. 1.

In response to public pressure, the Army began more controlled disposal operations. In the early 1970's, it incinerated more than 3,000 tons of bulk mustard gas at the Rocky Mountain Arsenal, near Denver.

From 1972 to 1976, the Army chemically neutralized more than 4,000 tons of GB at the Rocky Mountain Arsenal.[26] The process, which had worked well in the lab, proved slower than the Army anticipated; it produced large volumes of waste salts; and compared to earlier methods of disposal, neutralization was costly.

In 1979, the Army began testing a pilot Chemical Agent Munitions Disposal System (CAMDS) incinerator at the Tooele Army Depot, near Salt Lake City, Utah. By 1987, it had destroyed some 37,000 munitions containing GB.[27] The CAMDS incineration technology is the model for the entire CW disposal program, but the facility has had numerous problems. For example, in May, 1986 a drain apparently clogged, causing chemical agent to overflow to the floor within a containment area when. In January, 1987, nerve agent escaped into a work area.[28]

In 1982, the Army selected incineration as its demilitarization and disposal method for its entire Chemical Stockpile Disposal Program. In 1985, when Congress approved the program, the Army began to design a versatile, full-scale disassembly and incineration system, the Johnston Atoll Chemical Agent Disposal System (JACADS), three times the size of CAMDS. In December, 1987 Congress required that the Army evaluate full-scale disposal operations at JACADS before constructing similar facilities in the U.S. Consequently, the Army has not begun work yet at seven of the eight domestic sites. Only a new destruction plant at Tooele is exempt, because the facility has such large stocks that delay there would push back the completion date for the entire program.

Demilitarization Can Take Place Before Disposal

There is a fundamental problem in the Army's approach. It has placed all of its eggs and hundreds of millions of dollars in the incineration basket. In declaring the technology safe, it has left no option but abandonment of disposal should environmental contamination be proven. Short of a Bhopal-type catastrophic incident, always a possibility when nerve agent is stored or moved in

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26"The Army's Program to Assure the Security and Safety of the Chemical Munitions Stockpile," p. 14.

27Thomas Brew, U.S. General Accounting Office, "Department of the Army's Chemical Munitions Disposal Program," statement before the Subcommittee on Investigations, Committee on Armed Services, House of Representatives, March 4, 1987

28Hank Borys, "Chemical Weapons at Tooele: Can Disposal Program Work Safely," *The Desert Sun*, Summer, 1989, p. 9.

a populated area, it is unlikely that the Army will admit to any health or environmental problems that would disrupt the program.

Yet there are existing waste treatment technologies that could be adapted to chemical weapons disposal, probably at less cost than the mushrooming expense of incineration. The Army, however, has refused to fund any research into alternatives, and Congressionally mandated "cryofracture" research is just another form of incineration. Developing and proving other methods of chemical agent disposal could take a few years, but the delay need not threaten public health nor the progress of chemical arms control.

In the interim, 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. Furthermore, the continuing incidence of leaks is reduced, assuming the agent is placed in bulk containers that resist the corrosive strength of the agent. Long-term safety can be enhanced, as part of the demilitarization process, if the containers are stored within enclosed, *constantly* monitored buildings.[29]

Demilitarization, by definition, would also accomplish the goal of arms control. While drained chemical agent remains an environmental threat, it has little or no military significance. Though the U.S. or Soviet Union conceivably could use bulk agent to rearm, it makes no sense. It would be much easier and militarily much more effective to produce new chemicals for binary weapons, than to move the much more hazardous unitary agent into active munitions.

The U.S.-Soviet bilateral agreement does not distinguish between demilitarization and disposal of chemical weapons, except that it requires the

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The only alternative to the JACADS technology under official consideration is *cryofracture* and incineration, promoted by General Atomics and backed by the House Appropriations Subcommittee on Defense. In this "freeze, crush, and burn" method, entire munitions are cooled with liquid nitrogen to weaken the metal, desensitize the explosives, and solidify the chemical agents. They are then crushed and incinerated. Cryofracture is simpler and safer than reverse assembly at the front end, but the burning of all the components of the weapon simultaneously in the same incinerator increases the risk of creating and releasing unpredictable amounts of toxic compounds. By mixing in solid rocket fuel, for example, it provides an ample supply of chlorine for the formation of dioxins, furans, and other hazardous byproducts of incineration. The Army is working with General Atomics to demonstrate the components of a cryofracture system, and it has hired contractors to design a full demonstration facility for construction at the Tooele Army Depot.

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[29]We also recommend that the United Nations commission responsible for destroying Iraq's chemical weapons move quickly to demilitarize and store Iraq's chemical agent, but that it not initiate disposal until environmental sound methods are proven.

destruction of empty munitions. Thus, if either party experiences difficulty disposing of chemical agent, the entire timetable may be set back. On the other hand, if the agreement were interpreted or modified to require demilitarization on an inflexible timetable, the environmental or industrial problems of disposal would not hinder the goals of that accord or discourage the implementation of global CW arms control. Since there has been strong environmental opposition to disposal programs in both the U.S. and USSR, clarifying this aspect of the agreement before "ratification" seems politically viable.

The Army has the technology for demilitarization without incineration. First, the front-end of the JACADS plant—as opposed to the proposed cryofracture process—is essentially reverse assembly. GAO described the process: "In the processing rooms, munitions will be automatically disassembled and drained of chemical agents by computer-controlled machines. Rockets, projectiles, and land mines will be individually disassembled in rooms capable of containing accidental explosions. Rockets will be drained of liquid agents and mechanically sheared into seven segments. Machines will remove and slice projectile explosive components and then convey the nonexplosive projectiles to a bay where they will be drained of agents. Land mine disassembly machines will punch out booster explosives from land mines and then drain them of agents."[30]

For smaller jobs, the Army might employ an automated version of its Drill and Transfer System (DATS), a portable unit used since 1980 to collect and contain CW agent from leaking munitions. In this system, used at several domestic storage sites, "A mobile, air-tight chamber is set up in an isolated outdoor site.... Munitions are placed individually in the chamber, where a diamond-tipped drill bit carves a hole through the munition's metal wall to the warhead. The chemical agent is withdrawn through an inserted tube."[31]

Arthur D. Little, Inc. studied a rocket separation system design for the Army in 1985, proposing a demilitarization process similar to the front end of JACADS—that is, the mechanical steps without incineration. It found that this form of demilitarization posed no more of a threat to air quality than continued storage. It reported, "In the rocket separation concept there are essentially no sources of potentially significant air pollution releases, even under upset conditions. Processes such as evaporation of solutions used in the in-plant decontamination of rocket parts are closed cycle and at this time believed to be without potential for recurring upsets leading to atmospheric release."[32]

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[30] "Chemical Weapons: Stockpile Destruction Delayed at the Army's Prototype Disposal Facility," p. 32.

[31] David Morrissey, "Wiping Up Nerve Gas's Leaky Legacy," *San Jose Mercury News*, July 13, 1983, p. 9A

[32] The report notes that accidents could lead to agent release, but it did not attempt to quantify that risk for comparison with continued storage or incineration. Arthur D. Little, Inc., "M55 Rocket Separation Study," report to US Army Toxic and Hazardous Materials Agency (M55-OD-8), November 22, 1985, pp. 5-1, 5-2.

Neutralization of Chemical Weapons Is Feasible

Once the weapons are demilitarized, the bulk chemical agent can be stored safely until a safe method of disposal is found and tested. Though chemical munitions and agent must be handled with extreme care, they may prove easier to detoxify than hazardous industrial waste. The agents are relatively pure, or uniform, and the composition of each chemical is known.

The Army's original justifications for opposing disposal methods other than incineration, such as chemical neutralization, have all proven unfounded. Incineration is more complex, more costly, and if one includes design, construction, and downtime, much more time-consuming than originally believed. 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. In fact, the Army Missile Command is already pursuing similar work, developing alternatives to burning for the demilitarization of toxic solid rocket fuel.

The Defense Advanced Research Projects Agency, another branch of the Pentagon, is funding a small amount of CW disposal research over reported Army objections. In January, 1991, it announced a five-year, $9.28 million Supercritical Fluid Processing program.[33] The the National Toxics Campaign Fund learned, from Pentagon sources, that the Army was trying to block the program—on the assumption that it validated opposition to incineration—so Friends of the Earth, NTCF, Greenpeace, and the local opponents of incineration fired off a letter off to Defense Secretary Cheney urging that the program be retained. While the Supercritical Fluid Processing programs remains intact, with a slight change of emphasis, it still constitutes a minute fraction of what the military spends on CW demilitarization.

The proponents of incineration say that alternate disposal methods would require years of work before they could even be tried on a large scale, but the Army did in fact use a chemical process to neutralize a large quantity of GB weapons in the 1970's. New industrial methods, such as the introduction of catalysts and the construction of closed-loop systems, could easily make neutralization much more efficient and complete. Innovative disposal technologies could be adapted from other applications. For example, biodegradation techniques currently used in the routine treatment of industrial chemical wastes could be used to further treat the waste products of CW neutralization. Most important, closed-loop neutralization is inherently safer than open-ended

33 "Broad Agency Announcement (BAA) (DARPA BAA#91-05): Supercritical Fluid Processing for the Destruction of Toxic Chemicals," *Commerce Business Daily*, January 16, 1991, p. 2.

incineration. When a process is upset, hazardous products are contained, not released into the environment.

The Soviets, who have to meet the same agreement-imposed deadlines as the U.S. Army, have demonstrated an interest in American pollution-control and safety technology, but they will not incinerate their CW stockpile. Mikita Smidovich, who represents the USSR at the Geneva Conference on Disarmament., says, "Our experts tell us that although [neutralization] is slower and more waste is produced, it is more secure and safe from an environmental point of view."[34]

Since CW destruction requires the disposal of explosives, propellants, and three primary agent formulations, a comprehensive program is likely to require a mix of initial processes. Then, other methods would be used to further treat the byproducts of neutralization. Candidate technologies include biodegradation (using enzymes created by bacteria), photolysis (with light or ultraviolet radiation), plasma reactions (using electric arcs or microwaves), hydrolysis, oxidation, wet air oxidation, supercritical water oxidation, steam gasification, and electrochemical degradation. [35]

The effectiveness of each method is like to vary, depending upon the material requiring disposal. For example, hydrolysis, a chemical process, might be used to detoxify GB—that is, to remove the fluorine bond. Then, biodegradation, which is used by major chemical companies in wastewater treatment, could be harnessed to treat the residue, neutralized salts.

Before the Army adopted incineration, it experimentally neutralized 100-pound batches of VX to a remarkable efficiency of 99.999999 percent (eight nines) using acid chlorinolysis. This method, which it planned to scale up to neutralize greater quantities, used hydrochloric acid and chlorine gas to break the sulfur bond and detoxify the compound.[36]

Mustard gas could be destroyed using supercritical water oxidation, in which water, under extreme pressure at a high temperature, behaves like an organic solvent. The reaction products are water, carbon dioxide, and waste salts. It is a closed-loop process, in which remaining chemical agent is fed back into the reactor until it is completely broken down.

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[34]Ember, "Chemical Weapons Disposal," p. 19.

[35]The most complete, current description of alternate disposal technologies is Alfred Picardi, Paul Johnston, and Ruth Stringer, *Alternative Technologies for the Detoxification of Chemical Weapons: An Information Paper*, Greepeace International, May, 1991.

[36]"Support for the Delisting of Decontaminated Liquid Chemicals Surety Materials as Listed Hazardous Waste from Specific Sources," Army Chemical Research, Development, and Engineering Center, Aberdeen, Maryland, November, 1988, p. 4-13.

It is too soon to say which closed-loop processes best destroy each chemical agent in the U.S. stockpile, but there is every reason to believe that well-funded research could quickly develop and adapt methods that outperform incineration.

Why the Army Is Committed to Incineration

Other than the 1970's GB neutralization, none of these methods has been used to destroy chemical weapons. But they remain unproven because no one has tried to make them work. Why is the Army so reluctant to consider alternatives to incineration?

When the Army won approval for binary nerve gas production in 1985, it promised Congress to destroy ninety percent of its unitary stockpile by 1994. The deadline was not introduced by Congress or treaty, but offered by the Army itself. *The rush to incinerate was designed solely to eliminate a potential political difficulty for the binary weapons program.*

Now some leading arms controllers are warning that any delay in U.S. weapons disposal could derail the momentous U.S.-USSR progress toward outlawing chemical weapons. However, since the Soviets are still looking for an appropriate disposal technology and venue, it is unlikely that developing a new method or combination of methods would place the U.S. behind the Soviets in the "chemical arms disposal race."

The "one method fits all" mentality that originally led to the adoption of incineration gives the program additional momentum. Some hazardous waste consultants believe that once the unwanted CW stockpile is destroyed, the incinerators can be used—or at least modified to be used—to destroy other hazardous wastes. Influential members of Congress are pressuring the Army, which is investing billions of dollars in nine dispersed incineration complexes, to prepare to convert those operations.

The Army facilities that hold old chemicals weapons also contain large quantities of obsolete conventional munitions. Each year Defense Department-operated facilities—this excludes government-owned contractor-operated ammunition plants—generate an estimated 500,000 to 750,000 tons of hazardous waste, much of which is currently deposited in hazardous waste landfills. Even if military installations cut their waste streams drastically by employing pollution prevention methods, the cleanup of more than 11,000 hot spots, identified by the military as potential contamination sites, at nearly 1,900 domestic military installations is likely to generate huge volumes of contaminated soil and other hazardous waste over the next thirty years. *Four of the nine nerve gas storage* *installations are already on the "Superfund" National Priorities List, and the other four all have multiple cleanup sites listed.*

Contamination at foreign bases has not yet been publicly documented, but there is every indication that it is just as widespread. Since no community in the U.S. is likely to welcome large volumes of hazardous waste from U.S. bases overseas, the Pentagon may again turn to unpopulated Johnston Island to incinerate toxic wastes from abroad. All of the chemical weapons stored at the atoll were transported there from foreign bases.

Once the chemical weapons are burned, the combustion of military industrial wastes and other types of munitions at the disposal program incinerators is an attractive option as long as one believes incineration poses no threat to public health and the environment. But the hazards are great. The same air contaminants—dioxins, furans, and others—will be generated, and incinerator ash and brine will contain an even wider range of toxic contaminants.

The 1985 legislation authorizing the Chemical Stockpile Disposal Program specifically outlaws the use of the program's incinerators to dispose of other materials. In fact, it requires that the buildings and equipment be cleaned, dismantled, and disposed soon after the obsolete and excess unitary weapons have been eliminated. This provision probably helped the program through Congress, despite a National Academy of Sciences recommendation that post-disposal conversion be considered before final design. Today, however, faced with growing Pentagon environmental protection and restoration costs, Congress is changing its tune.

In late 1989, the House-Senate Appropriations Conference Committee directed the Army "to study the feasibility and desirability" of using the CW demilitarization facilities for other purposes. The Army hired the MITRE Corporation to conduct the study.

The MITRE team found that it was technically feasible to use the CW incinerators to destroy other chemical weapons-related waste, conventional munitions, propellants, hazardous wastes, municipal wastes, and contaminated soils. Under present economic circumstances, however, it generally recommends that the incinerators only be used to destroy non-stockpile chemical items, such as chemical weapons recovered from test ranges, and chemically contaminated structures and equipment. It suggests that the Pine Bluff Incinerator and CAMDS, the experimental Tooele system, be used to eliminate some conventional munitions. And it recommends no future use of incinerators proposed for Anniston and Lexington-Blue Grass.[37]

While the results of the MITRE study are somewhat heartening, once the CW stocks are gone incineration advocates are likely to propose again to keep the incinerators burning. The MITRE team based its conclusions on the current regulatory and political environment. If the EPA or state regulators crack down on the open burning of other explosive wastes, or if anti-incineration activists let their guard down, continued use of the expensive facilities remains a serious possibility.

Each Site Deserves a Study

The U.S. CW stockpile is currently located at eight Army facilities in the U.S., as well as Johnston Atoll. Johnston Island received munitions from Okinawa in 1971, just before Japan reassumed sovereignty over the island and its American bases, and last November it received a controversial shipment of chemical munitions from U.S. forces in West Germany. Congress will not allow the Defense Department to return these weapons to the United States.

Storage Site, State	Percent of U.S. Stockpile	Type of Agent
Tooele Army Depot, Utah	42.3%	GB, VX, Mustard, other
Pine Bluff Arsenal, Arkansas	12.0%	GB, VX, Mustard
Umatilla Depot Activity, Oregon	11.6%	GB, VX, Mustard
Pueblo Depot Activity, Colorado	9.9%	Mustard
Anniston Army Depot, Alabama	7.1%	GB, VX, Mustard
Aberdeen Proving Ground Maryland	5.0%	Mustard
Newport Army Ammunition Plant, Indiana	3.9%	VX
Lexington-Blue Grass Army Depot, Kentucky	1.6%	GB, VX, Mustard
Johnston Atoll	6.6	GB, VX, Mustard

[37] A.S. Goldfarb *et al*, Engineering Analysis for Future Use of Chemical Agent Demilitarization Plants: Feasibility and Desirability," MITRE Corporation, January, 1991.

When the Army received approval to incinerate the domestic CW stockpile, it considered three geographic alternatives: 1) a single national disposal site at Tooele, Utah, site of the prototype CAMDS incinerator and home to nearly half the domestic stockpile; 2) two regional sites, Tooele and the Anniston Army Depot, in Alabama; and 3) incinerators at each site.

Cost was not a major factor in evaluating the three options. With transportation expenses folded in, all three alternatives cost about the same.[38] Furthermore, Congress appears willing to pay more if it means that disposal can be carried out more safely or, at least, with less outcry.

The Army prepared a programmatic—that is, nationwide—environmental impact statement. In the EIS, the Army concluded that there were no serious risks, but it concluded that the risk of transporting nerve gas to national or regional sites, through numerous Congressional districts, was greater than the risk of on-site disposal. So in 1988, the Army decided to build incinerators at each site.

Warren Brunner

Neighbors of the Lexington-Blue Grass Depot tell the Army, "No incineration!"

[38]Henry Condor, U.S. General Accounting Office, "Demilitarization of the Chemical Munitions Stockpile," statement before the Subcommittee on Investigations, Committee on Armed Services, House of Representatives, July 25, 1986.

Local groups opposed to incineration consider the Army's process a breach of faith. During the programmatic study, the Army promised to conduct site-specific environmental reviews, considering the local risks at each facility. Now, however, it appears that the site-specific studies will only consider where at each facility the Army will build an incinerator, not whether an incinerator should be built.

This approach ignores the valid concerns of the people who live near the incineration sites. For example, 45,000 people live within a six-mile radius of the proposed incinerator at the Edgewood Area of the Aberdeen Proving Ground, in Maryland. Some 57,000 people live within a seven-mile radius of the Lexington-Blue Grass Army Depot in Kentucky. Common , one of several groups formed to oppose incinerator construction there, says "This area encompasses the cities of Berea and Richmond, and the daytime population is further increased by a private college, a state university, and a section of Interstate 75. Within a mile of the depot fence are an elementary school, a middle school, and a large shopping mall."

As the Army often points out, there is no absolutely risk-free way to store or dispose of chemical weapons. At a minimum, people at this and other locations deserve a closer look, a serious site-specific evaluation of the environmental risks. Such an approach could pit communities against each other, as transportation options are once again considered, but the Army might find citizens more open to CW disposal in their backyards if it develops a safe alternative to incineration.

Recommendations

America's arsenal of unusable chemical weapons should be destroyed safely as soon as possible. But public health and the environment should not be held captive to an arbitrary schedule defined by the political needs of the U.S. Army. In particular, we recommend:

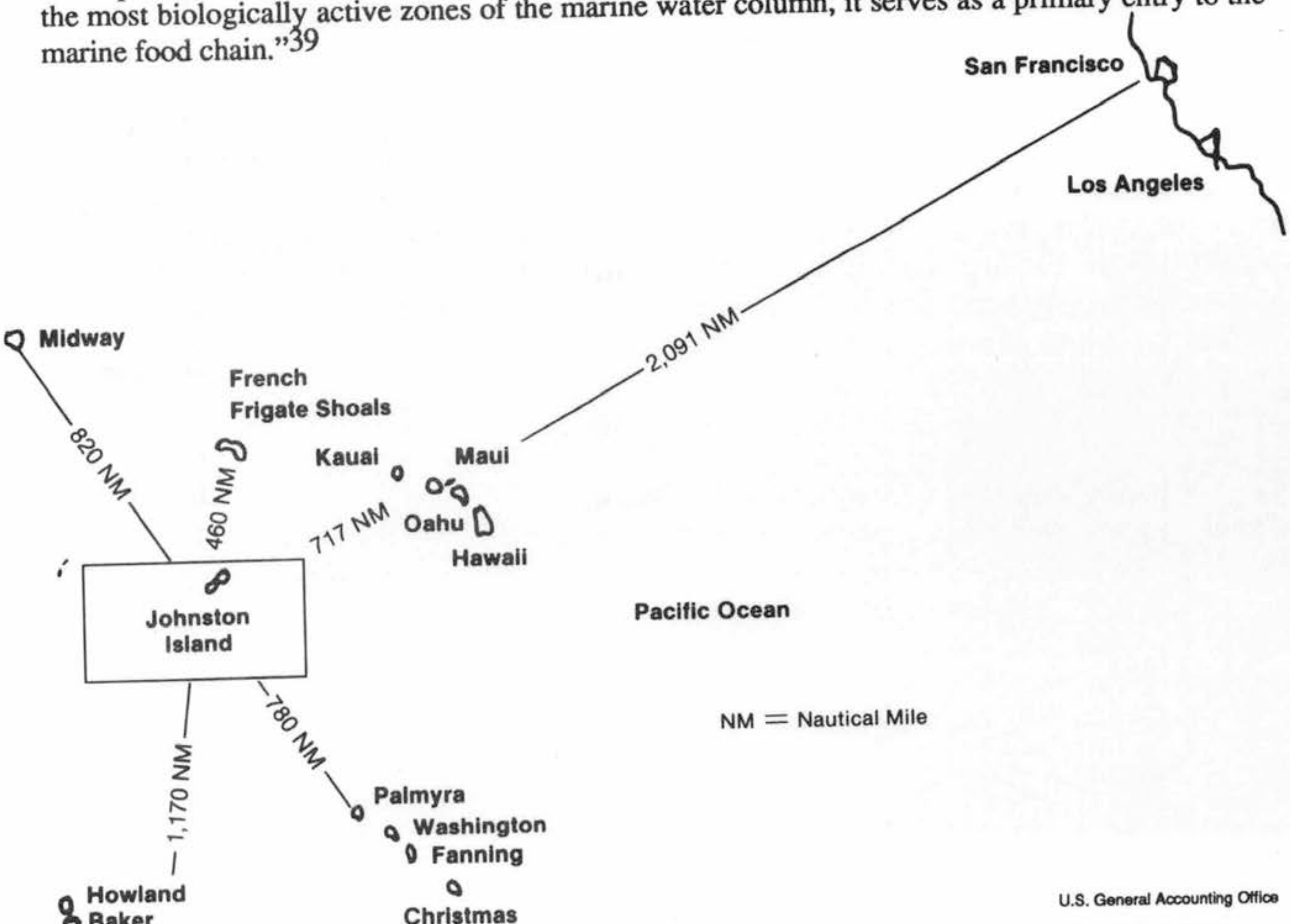
1. All plans to use incineration or any other open-ended disposal system should be halted at once.
2. The Defense Department should immediately expand its research and development of alternate chemical weapons demilitarization and disposal systems.
3. The U.S.-U.S.S.R. CW agreement should be interpreted or modified to establish separate timetables and procedures distinguishing the

demilitarization—that is, disassembly so they cannot be used as weapons—of chemical munitions from the disposal of chemical agents.

4. Before treatment of chemical weapons is considered at any location, the Army should perform a site-specific environmental impact statement which considers the option of no on-site treatment or disposal.

The Army selected Johnston Island, known to Pacific Islanders as *Kalama,* for chemical weapons incineration because it has no civilian population and because of a long tradition of using the Pacific Basin as a living laboratory. Since World War II, the U.S. has tested nuclear weapons in the South Pacific, and it has dumped chemical weapons, without treatment, off the coasts of Japan, Alaska, and California.

Other than commissioning a survey of the impact of incineration, it has ignored evidence that the JACADS system threatens the unique marine environment by depositing contaminants on the "microlayer" of the ocean surface. Greenpeace warns, however, "New scientific studies have documented the role of the sea surface microlayer in concentrating and recirculating toxic, persistent, bioaccumulative substances, such as the uncombusted chemicals and products of incomplete combustion released during incineration. Since the sea surface microlayer is also one of the most biologically active zones of the marine water column, it serves as a primary entry to the marine food chain."[39]



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[39]Alfred Picardi, "Greenpeace Review of JACADS Draft Second Supplemental Environmental Impact Statement," Greenpeace Pacific Campaign, February, 1990, p. x.