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90. CHEMICAL WARFARE AGENT DISPOSAL PUBLIC HEALTH OVERSIGHT

Harvey W. Rogers
National Center for Environmental Health
Centers for Disease Control and Prevention (CDC)
Public Health Service
U.S. Department of Health and Human Services

Presented by:
Robert M. Gum, DO, MPH, FACPM
Colonel, U.S. Army
National Center for Environmental Health
Centers for Disease Control and Prevention (CDC)
Public Health Service
U.S. Department of Health and Human Services

INTRODUCTION

In 1969 and 1970, Public Laws 91-121 and 91-441 were enacted. These laws required the Department of Defense (DOD) to take certain actions regarding the management of chemical and biological warfare agents. In the interest of public health protection, the Department of Health and Human Services (DHHS formerly Department of Health Education and Welfare) was charged with reviewing the plans to transport, test, or dispose of any lethal agents. DHHS was mandated to evaluate any hazards associated with these activities, and recommend precautionary measures as needed to protect the public health and safety. Subsequent cessation of open-air testing of lethal agents, limited DHHS oversight to agent transport and disposal activities.

Since these laws were enacted, a major thrust of DOD's activities has been planning for the destruction of obsolete lethal agents and munitions. In 1985, Public Law 99-145 specifically required the DOD to develop a comprehensive plan that would result in the disposal of the largest source of obsolete chemical agents and munitions that is the existing stockpile of these materials. The plan was to evaluate and select appropriate disposal technology, evaluate and select locations to carry out disposal activities (on- site, regional, or single national disposal site and establish a schedule for carrying out the entire stockpile disposal activity.

Various agent/munition disposal technologies were considered including chemical neutralization techniques, emerging chemical destruction methods and incineration. Incineration was selected as the preferred alternative because it was applicable to a wide range of chemicals, it resulted in relatively complete destruction, and it was a mature technology. It was further decided that the incineration should be conducted on -site where the agents and munitions are stored to minimize the potential risk to the public that would be associated with moving such materials through public transportation corridors. The original disposal plan called for the stockpile materials to be completely destroyed by 1994. Because of the many uncontrollable delays and difficulties encountered, that deadline has been pushed back to 2007. As of November 2000 6805 tons of the 31,496 tons of stockpiled munitions have been destroyed.

Characteristics of Stockpiled Materials

Lethal chemical agents are often characterized by their mode of action, or impairment, on their intended victim. The chemicals in the U.S. chemical stockpile maintained by the

Army consist of "nerve agents" and "blister agents" or vesicants. Nerve agents are highly toxic chemicals that directly impair the central nervous system to thc extent that death may occur unless there is quick and adequate medical intervention following human exposure to these agents. Blister agents cause inflammation, blisters, and tissue destruction on the skin surface where it is readily absorbed. Blister agents can act internally via exposure by inhalation or ingestion. Blister agents are intended to be incapacitating; nevertheless, exposure to these agents can result in delayed casualties. Table 1 lists the major lethal chemical agents in the stockpile.

Table 1 - Stockpiled Agents	
Nerve Agents	**Blister Agents**
GB (Sarin)	H (Levinstein Mustard)
GA (Tabun)	HD (Sulfur Mustard)
VX	HN-1 (Nitrogen Mustard)
	HT
	L (Lewisite)

Under battlefield conditions, lethal chemicals were designed to reach their intended victims through air dispersion of droplets or vapors. Consequently, many of the stockpiled agents are contained in munitions that could effectively deliver and release the agents in the vicinity of enemy troops. Such munitions include rockets, projectiles, and land mines. Many of the munitions contain fuzes (detonation devices) and bursters (explosive charges) that were intended to fragment the casing and assist in dispersing agent in droplet or vapor form.

In addition to the stockpiled agent munitions, there is a considerable amount of agent stored in bulk form in "ton containers". Holding somewhat less than a ton of chemical agent, ton containers are the largest single items in the stockpile. The final item in the stockpile is dunnage. Dunnage consists of pallets, boxes, and cans used to store chemical munitions. It also contains agent-contaminated materials generated during disposal, such as protective clothing, charcoal filters, and other miscellaneous materials.

Disposal Considerations

As previously mentioned, incineration was selected as the preferred alternative for destroying the lethal chemical agents. Once the decision was made to use incineration, it was then necessary to decide how it would be implemented. That is, how many, and what types of incinerators would be needed, and where should they be located?

Any type of regional or single national incineration system would require that stockpiled agent and munitions be transported over considerable distances. Given the high hazard characteristics of these materials, and the possibility of a transportation mishap associated with such a large scale operation, the contingency planning was found to be untenable. Accordingly, it was agreed that it was in the best interest of public safety to conduct all stockpile materials incineration on-site where they are stored. This option not only limits material handling to a manageable task, but also assures that such handling occurs within the controlled confines of the installation where the agents are stored.

Once it was decided that on-site incineration would be used, it then remained to be decided just what kind of incinerators would be needed. This decision was based upon the physical and chemical characteristics of the overall stockpile waste mix.

Table 2 - Stockpile Locations	
Facility, State	**Agents Present**
Umatilla DA, Oregon	HD, GB, VX
Tooele AD, Utah	H, HD, HT, GB, VX, GA, L
Pueblo DA, Colorado	HD, HT
Pine Bluff Arsenal, Ark.	HD, HT, GB, VX
Newport AAP, Indiana	VX
Lexington BG AD, Kentucky	H, GB, VX
Aberdeen PG, Maryland	HD
Anniston AD, Alabama	HD, HT, GB, VX

There was pure liquid agent from the ton containers and drained from the rockets, projectiles and mines. This liquid had fairly high heat content and would behave as a fuel. There also would be drained metal parts from the rocket, and so forth, that would be contaminated with agent, but would contain very little fuel value. There would also be fuzes, bursters or other energetic and reactive materials that would need to be burned. Finally, there would be pallets, boxes, cans, filters, personal protective garb and other materials that could be lightly contaminated with agent, but would largely resemble industrial trash.

To address the variations in wastes to be incinerated, four different kinds of incinerators were called for. They include:

1. Liquid Waste Incinerator (LIC)
2. Deactivation Furnace System (DFS)
3. Metal Parts Furnace (MPF)
4. Dunnage Incineration (DUN)

Each incinerator is equipped with its own specialized materials handling system, control and monitoring system, and pollution abatement system.

Safety Considerations

When implementing the incineration program, both community and worker safety has been paramount to DHHS and the Army. Accordingly, implementation has been undertaken in a very conservative and deliberate manner. Table 3 contains an overview of some of the measures taken to help assure safe operations.

The safeguards outlined in Table 3 are broken into 3 categories: Procedural, Engineering, and Monitoring. Although the items are presented as discrete, in practical application they are often closely interrelated. For example, the continuous emissions monitoring is an integral part of the automatic waste feed shutoff (AWFSO) system. That is, if a monitored stack gas component goes above a predetermined acceptable limit, a signal will cause the AWFSO to activate. Furthermore, both of these particular provisions are required to operate a permitted hazardous waste incinerator, and therefore can be considered under the "regulatory compliance" activity.

Some of the items in Table 3 bear further explanation to illustrate how they can serve as safeguards to public health and safety. For example, the National Environmental Policy Act (NEPA) is an administrative requirement imposed on all major activities where federal monies are spent. For lethal agent incineration, NEPA requires that a detailed Environmental Impact Statement (EIS) be prepared for not only the concept of on -site agent incineration, but also each site-specific incineration facility as well. An EIS requires careful analysis of all actual and potential impacts that an activity will have on the surrounding environment and community. Typically, there is considerable overlap in measures that are identified to be protective of both the environment and public health. NEPA forces a comprehensive and structured review of all such issues early in the planning cycle for major federal projects.

Table 3 - Lethal Agent Incineration Safeguards

Procedural	Engineering	Monitoring
National Environmental Policy Act (NEPA)	Robotic material handling system	Operating parameters
Systemization	Specialized incineration systems.	Continuous emissions
Operational Verification Testing	Pollution Abatement System	Depot Area Ambient Air Monitoring Systems (DAAMS)
Preoperational Surveys and Inspections	Automatic Waste Feed Shutoff Systems	Automatic Continuous Air Monitoring Systems (ACAMS)
Extensive Training Personnel Protection	Controlled Air Handling	Visual Surveillance
Contingency Planning	Specialized Containment	Medical Monitoring
Test Burns (Stack Sampling)	Safety Interlocks	Quality Control Quality Assurance
Regulatory Compliance		

Systemization, operational verification testing, preoperational surveys, and test burns are all activities that are intended to assure that all incineration and support activities function as designed. For example, under systemization, furnaces may be operated on supplemental fuel only, while the performance of interlocks, emissions monitors and so forth are tested and fine tuned to perform up to specification. Preoperational surveys may be conducted before or during test burns as an outside audit to assure that standard operating procedures are in place and being followed, as well as, inspecting physical plant and support functions to assure that they are performing correctly.

Operational verification testing is designed to demonstrate an incinerator and materials handling systems readiness for various combinations of agent and munitions. Under all of these activities, it is typical that testing is first done with fuel only, followed by feeding a relatively safe agent simulant to the incinerator, and finally by feeding actual agent to the system. Concurrent with all of this is an intensive operator training program that allows operators to train under routine and contingency conditions in a full-scale prototype plant, complete with all robotic materials handling equipment.

A major safety tenet of the incineration of lethal agent is that agent must not be released to the air environment in an uncontrolled manner. For incineration, there are three ways that such releases can be anticipated to occur. The first is associated with the handling of agent and munitions to actually get them into the incinerator in the appropriate form. Munitions may require disassembly, or punching to be drained. Ton containers, likewise, have to be pumped of their contents. These processes have the potential for spills, leaks, or other uncontrolled releases of agent. Similarly, once the agent is in the incinerator combustion chambers, an overpressure condition can cause leaks or fugitive emissions of agent and other airborne partial-breakdown products of combustion. Finally, if the combustion chambers are overloaded or not operated properly, agent could pass through the pollution abatement system and out the stack. All of these release-potential situations point up the need for effective engineering measures to assure that such releases will not present a health or safety problem.

The first two of the above agent-releases scenarios would be considered as "fugitive emissions" released at ground level. If left unchecked, such emissions could have significant effect on site personnel, and with a large release, agent could conceivably migrate off-site into a nearby community. Recognizing the need for tight control over potential fugitive emissions, it was decided to design and build the facility so that all activities where fugitive emissions are reasonably likely to occur be located in enclosed space where air movement could be carefully controlled. The result of this decision is a carefully designed air-handling system that directs all plant air through banks of charcoal filters maintained with ample redundancy. These filters are monitored for agent continuously at several locations between individual filters. This allows for an ample margin of safety to replace filters before agent breakthrough to the external environment could possibly occur. The entire building and its processes are maintained at a negative pressure with respect to outside ambient air pressure, thus assuring that air leakage is directed into the controlled air handling system.

The agent stack-release scenario is primarily controlled through the provision of proper combustion conditions within the incinerator. This is assured by a combination of good system design, careful system operation by well-trained operators, and automatic systems monitoring and interlocks designed to allow agent feed only when all operating parameters are functioning as designed. Additionally, the incinerator stacks are equipped with real time agent monitors (ACAMS) tied into alarms to signal the event of agent detection. ACAMS are placed throughout the facility where agent is handled in order to provide complete monitoring of plant air. The ACAMS are supplemented with time-weighted-average monitors (DAAMS) that provide verification of the ACAMS and quantify potential releases. Both the DAAMS and ACAMS are subject to a rigorous quality control and assurance program that has been strongly influenced and reviewed by DHHS.

Current Status of Agent Disposal Program

As mentioned previously, this program has proceeded with caution and deliberation. Much of the actual incineration experience to date has been achieved at two facilities. The first facility, known as the Chemical Agent Munitions Disposal System (CAMDS) is located at Tooele Army Depot, Tooele, Utah. This facility consists of somewhat-less- than-full scale incinerators for each of the four major waste categories previously described. Each incineration system is complete with specialized material handling systems for safely feeding the waste into the incinerators, plus a complete pollution abatement system to treat incinerator combustion products. Specialized air handling systems and area agent monitors are provided throughout. The CAMDS operates under a hazardous waste operating permit issued by the State of Utah.

The major purpose of CAMDS has been to develop actual large scale operating experience for various agent/munitions combinations and with all system safeguards in place. This experience has been gained using the procedural safeguards described previously. Also much of the experience gained has served to help optimize the further development of full-scale facilities for other stockpile locations.

The first operating full-scale incineration facility was the Johnston Atoll Chemical Agent Disposal System (JACADS) located on Johnston Island in the Pacific Ocean. This facility, operating under an EPA hazardous waste permit, has extended and complemented