CDC Recommendations to the U.S. Army for Protecting Public Health During Chemical Weapons Elimination: Annual Report, Fiscal Year 2010

Environmental Public Health Readiness Branch

Division of Emergency and Environmental Health Services

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Executive Summary

The mission of the Centers for Disease Control and Prevention's Environmental Public Health Readiness Branch is to protect public health and safety by providing guidance to the U.S. Army's chemical weapons demilitarization program. CDC conducts reviews and makes recommendations to the U.S. Army's plans to destroy stockpile and nonstockpile materials. These reviews are conducted during design, startup, and operations of the facilities and processes used by the U.S. Army for disposal.

By the end of fiscal year (FY) 2010, the U.S. Army safely destroyed over 80% of the United States stockpile of chemical weapons and completed the disposal of all declared nonstockpile materials.

During FY 2010, CDC made 129 recommendations to the U.S. Army. These recommendations involved air monitoring (42.6%), process safety (33.3%), site closure (10.1%), medical programs (7.8%), and industrial hygiene (6.2%). In FY 2010, the U.S. Army accepted 80.0% (N=64/80) of CDC recommendations made across all sites and areas of concern.

CDC developed a method of classifying recommendations as either required (an action required to protect public health) or best practice (an action that would allow operation in a safer environment). Of the 27 required recommendations that had a documented U.S. Army response, 89.5% (N=34/38) were accepted. The remaining four recommendations were not accepted but the U.S. Army provided CDC with an acceptable alternative or justification.

Overview

Chemical Weapons Elimination - History of the Program

From World War I until the early 1970s, the United States disposed of chemical weapons by methods such as open-pit burning, land burial, or ocean dumping (National Research Council 1984). By the 1970s, the United States recognized that safer and more environmentally sound disposal methods were needed and that a large percentage of the aging chemical weapons stockpile required disposal. In 1986, Congress established the U.S. Army's chemical weapons demilitarization program to address this complex mission (Deparment of Defense Authorization Act 1985).

In 1997, the United States ratified the United Nations International Chemical Weapons Convention treaty. By participating in the treaty, the United States agreed to destroy its stockpile of aging chemical weapons—principally mustard agent and nerve agents—and other assorted facilities and materials associated with chemical weapons by April 29, 2007. The final destruction deadline was extended to April 29, 2012, at the Eleventh Session of the Conference of the States Parties to the Chemical Weapons Convention at The Hague on December 8, 2006 (Organisation for the Prohibition of Chemical Weapons 2006).

By the end of fiscal year (FY) 2010, the U.S. Army had safely destroyed over 80% of the United States stockpile of chemical weapons. Some highlights of FY 2010 include the following:

- Destruction of the entire 3,850 tons of chemical agent stockpiled at the Pine Bluff, Arkansas, facility.
- Destruction of 91% of the stockpile at Anniston, Alabama.
- Destruction of 50% of the stockpile at Umatilla, Oregon.
- Closure of the facility at Newport, Indiana.
- Destruction of all nonstockpile materials declared at the time the United States ratified the treaty, including more than 1,200 munitions of recovered chemical warfare materials.

The U.S. Army divided disposal operation into two primary components. The stockpile program disposes of the chemical weapons the nation stored as a deterrent against other countries. The nonstockpile program disposes of other facilities and materials associated with chemical weapons.

Stockpile Program

The U.S. stockpile of chemical warfare agents (nerve agents and vesicants/blister agents) was thought to have reached nearly 40,000 tons by the early 1960s. These chemical warfare agents were consolidated at nine U.S. sites in bulk containers or as munitions. Chemical agent disposal facilities (CDFs) were built at each of the nine stockpile storage sites to destroy the stockpiles using either incineration or neutralization.

In 1997, the U.S. stockpile consisted of approximately 30,500 tons of chemical warfare agents. As of the end of FY 2010, nearly 23,000 tons of chemical warfare agents had been disposed of safely. Operations

and planning continue for disposal of the remaining 7,500 tons. The Chemical Materials Agency (CMA) and the Assembled Chemical Weapons Alternatives (ACWA) are responsible for these activities.

Four of the nine CDFs have disposed of their chemical weapons and are closed or in the process of closure; three will soon complete chemical weapons disposal; and two are under construction (Figure 1).

Closed

- Aberdeen Chemical Agent Disposal Facility, Aberdeen Proving Ground, Maryland.
- Johnston Atoll Chemical Agent Destruction System, Johnston Atoll (Now called Johnston Island).

In closure

- Newport Chemical Agent Disposal Facility, Newport, Indiana.
- Pine Bluff Chemical Agent Disposal Facility, Pine Bluff, Arkansas.

In operation

- Anniston Chemical Agent Disposal Facility, Anniston, Alabama.
- Tooele Chemical Agent Disposal Facility, Tooele, Utah.
- Umatilla Chemical Agent Disposal Facility, Umatilla, Oregon.

Under construction

- Blue Grass Chemical Agent-Destruction Pilot Plant, Richmond, Kentucky.
- Pueblo Chemical Agent-Destruction Pilot Plant, Pueblo, Colorado.

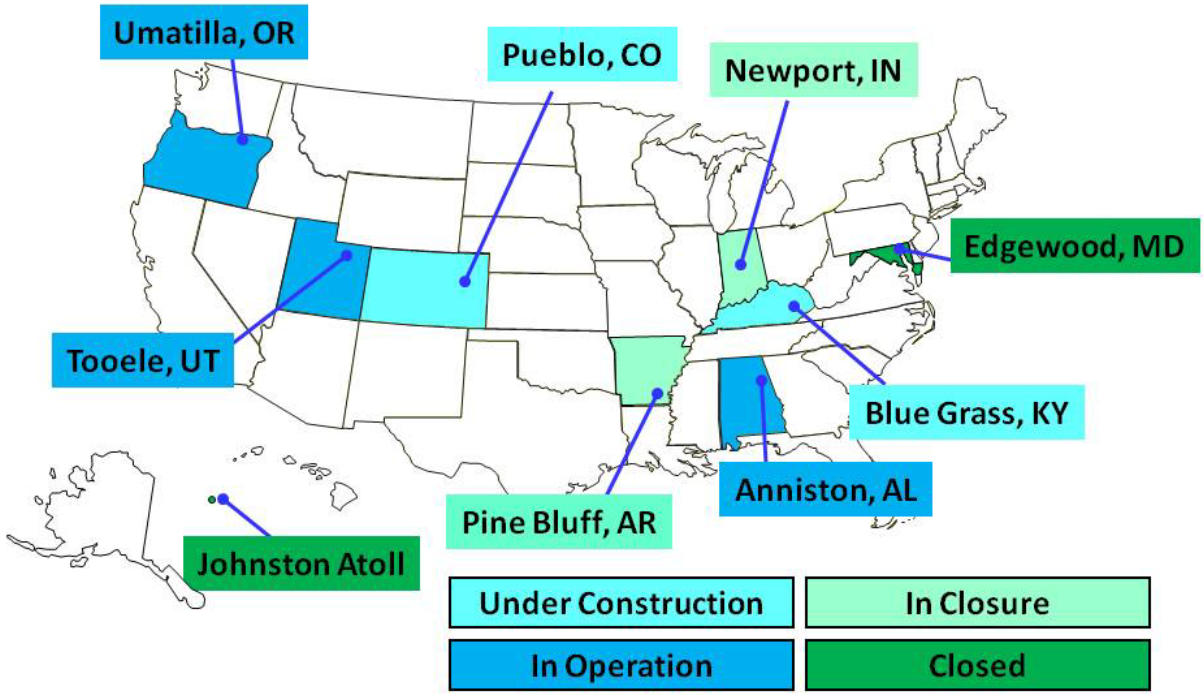

Figure 1: Location of Chemical Weapons Disposal Sites

Nonstockpile Program

The United States is also required by treaty to dispose of other chemical weapons related materials, called nonstockpile materials. Nonstockpile chemical warfare items include binary chemical weapons, former production facilities, miscellaneous chemical weapons materials, and recovered chemical weapons. More than 100 sites in the United States and its territories are estimated to have these materials (Figure 2). As these materials are recovered, they must be declared under the treaty and disposed of safely.

In the past, some chemical weapons were also disposed of in the ocean. From 1967 to 1970, Operation CHASE (Cut Holes and Sink 'Em) disposed of thousands of tons of unwanted chemical munitions by loading them on old ships that were then scuttled at sea (Carton and Jagusiewicz 2009). Other items were disposed of directly into the ocean from ships. Although there is no requirement to retrieve and destroy these munitions, the U.S. Army is exploring methods to address them (U.S. Department of Defense 2009).

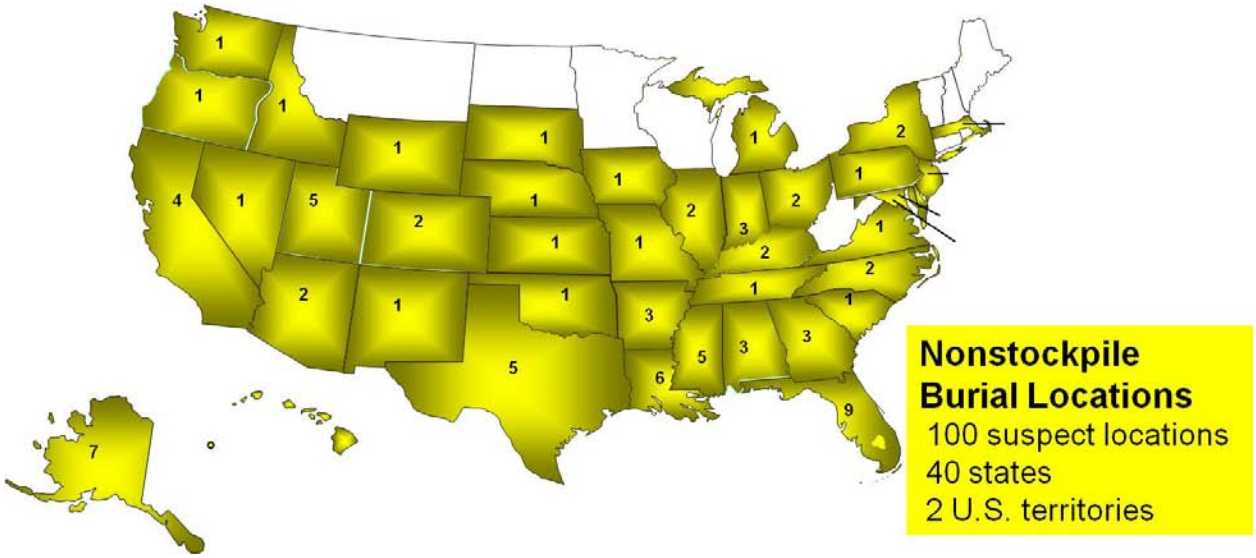

Figure 2: Nonstockpile Burial Locations

Chemical Weapons Destruction Status

When destruction began, the stockpile of chemical agents totaled more than 30,000 tons (Chemical Materials Agency 2011). The U.S. Army destroyed the first 3,500 tons (10%) of chemical warfare agent in 10 years. Because of better efficiency, increases in the number of sites, and more experience, that amount is now destroyed in less than 1 year. Table 1 shows the percentage of stockpile by site.

Table 1: Percentages of Original Stockpile Destroyed by Site

Location of Stockpile Facility	Technology Used	Percentage
Total original stockpile	Destroyed	84%
Pine Bluff, AR	Incinerated	100%
Tooele, UT	Incinerated	97%
Johnston Island	Incinerated	100%

Location of Stockpile Facility	Technology Used	Percentage
Anniston, AL	Incinerated	91%
Umatilla, OR	Incinerated	70%
Aberdeen, MD	Neutralized	100%
Newport, IN	Neutralized	100%
Blue Grass, KY (site under construction)	Neutralization	0%
Pueblo, CO (site under construction)	Neutralization	0%

CDC's Role in Oversight

The Centers for Disease Control and Prevention's (CDC's) Environmental Public Health Readiness Branch protects public health and safety by providing guidance to the U.S. Army's chemical weapons demilitarization program. CDC advises the U.S. Army and reviews and makes recommendations on plans for disposal of stockpile weapons and nonstockpile materials.

Public Laws 91-121 (1970), 91-441 (1971), and 99-145 (1986) required that the Department of Health and Human Services (HHS) provide public health review and oversight of the Department of Defense's plans and activities to test, transport, and dispose of chemical and biological weapons. U.S. Code 50, Section 1512 requires HHS to "… review particulars with respect to any hazards to public health and safety which transportation, testing, or disposal may pose and to recommend what precautionary measures are necessary to protect the public health and safety" (Chemical and biological Warfare Program 2010).

The CDC oversight mandate has a broad scope. It includes stockpile, nonstockpile, and emergency preparedness and response. The mandate for stockpile chemical weapons includes planning, operating, and closing disposal facilities. Nonstockpile materials includes these same aspects and may also include research and investigative techniques, recovery of materials, and storage of potential chemical weapons and agent. For emergency preparedness and response, CDC evaluates the ability of stockpile and nonstockpile sites to respond to an onsite incident. CDC also advises the Chemical Stockpile Emergency Preparedness Program (CSEPP) about training and exercises focusing on preparedness for mass causality emergencies. CSEPP is a partnership between the U.S. Army and the Federal Emergency Management Agency.

With respect to the U.S. Army's chemical weapons demilitarization program, CDC protects public health and safety by

- Evaluating engineering and procedural safeguards.
- Reviewing medical readiness.
- Evaluating chemical warfare agent monitoring systems.
- Partnering with state agencies and other public health professionals.

CDC Recommendations

After reviewing and evaluating U.S. Army plans, CDC develops recommendations for changes or improvements. CDC then provides these recommendations to the U.S. Army for consideration. CDC's recommendations to the U.S. Army fall in three categories:

- Required: must be addressed to protect public health.
- Best Practice: consideration will result in a safer environment.
- Observation: does not require a formal response.

Figure 3 shows the distribution of FY 2010 recommendations across these categories. Of CDC's 129 recommendations, 44.2% were in the best-practice category, 37.2% in the required category, and 18.6% in the observation category.

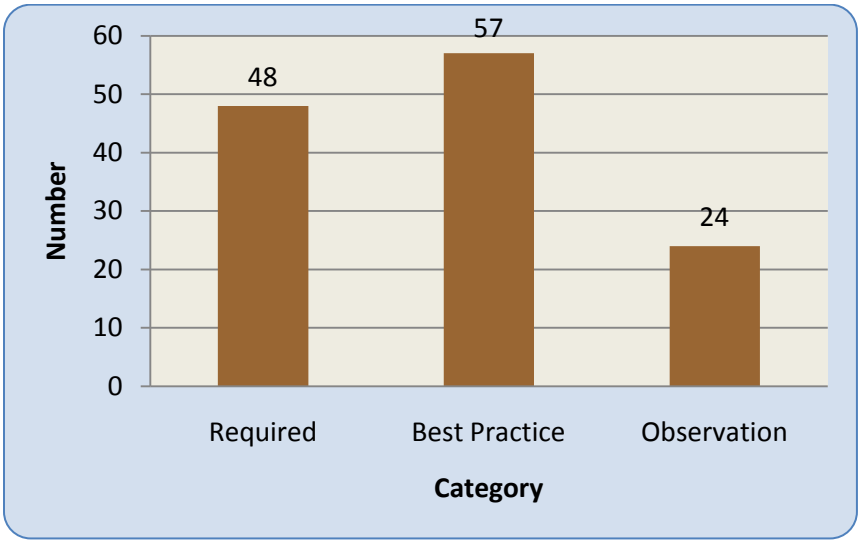

Figure 3: Number of Recommendations by Type

Examples of required recommendations from FY 2010:

- Site-specific recommendation for Umatilla CDF from the mustard exposure investigation: Umatilla CDF should continue to emphasize command and control and its sustainability.
- Programmatic recommendation from the mustard exposure investigation: Improve training programs to explain the specific hazards of HD (mustard) and the limitations of monitoring of the HD including potential impacts of interferents and distance from the source.

Examples of best-practice recommendations from FY 2010:

- Site-specific best practice for Umatilla CDF from the mustard exposure investigation: Umatilla CDF should try to schedule opportunities to provide personnel time to rest and recuperate from entries as practical.

- Programmatic best practice from the mustard exposure investigation: CMA staff should take the opportunity to review the DPE [demilitarization protective ensemble] entry for the HD (mustard) bottle filling as an example of a well conducted entry for Umatilla CDF DPE prior to the trial burn.

Example of an observation recommendation from FY 2010:

- Site-specific process safety observation note for Umatilla CDF: Mustard refresher training was conducted for plant personnel.

Focus Areas

CDC identified several focus areas with significant potential to influence public and worker health. During FY 2010, CDC made 129 recommendations to the U.S. Army in five focus areas (Figure 4):

- Air monitoring (42.6%).
- Process safety (33.3%).
- Medical programs (7.8%).
- Industrial hygiene (6.2%).
- Site closure (10.1%).

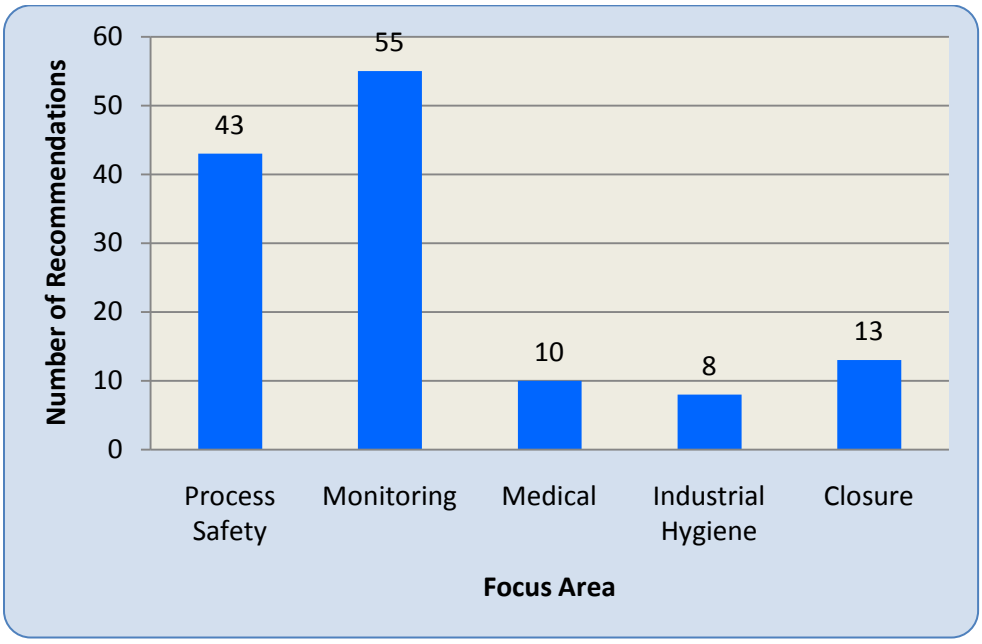

Figure 4: Number of Recommendations by Focus Area

Air Monitoring

Chemical weapons disposal facilities use air monitoring to ensure that chemical warfare agent concentrations are below levels of health or environmental concern. Monitoring is also used to track process effectiveness and to verify agent destruction.

CDC functions related to air monitoring include

- Recommending monitoring plans and concepts that are properly integrated with industrial hygiene and safety principles.
- Recommending laboratory quality control plans that are consistent with best laboratory practices.
- Evaluating quality control data generated throughout chemical weapons disposal and providing performance reports to the U.S. Army.
- Conducting onsite reviews of facility implementation of laboratory and monitoring systems.
- Recommending best practices for monitoring procedures.

Examples of CDC recommendations for monitoring include establishing airborne exposure limits published in the *Federal Register* (Centers for Disease Control and Prevention 2003, 2004).

Process Safety

Protection of the public is first and foremost in CDC's oversight of the destruction of chemical weapons. This was extended to include protection of workers with the focus on occupational health and safety and/or personal safety. As system designs became more complex, requiring more-sophisticated interlocks and control systems, it became apparent CDC must also focus on process safety.

Process safety is loosely defined as safeguards and actions to prevent serious incidents such as fires, explosions, and releases of hazardous chemicals in facilities that deal with hazardous materials. These hazardous materials would include items such as chemical agents, the chemicals used in processing, and chemical agent breakdown products (Occupational Safety and Health Administration 2011). In 2004, CDC began to develop process safety reviews to focus on these hazards and to aid in investigations.

In FY 2010, CDC made process safety recommendations after the mustard exposure at the Umatilla CDF. These recommendations represent CDC's holistic approach to improving process safety:

1. The focus on HD awareness should include not only training, but also should provide verification of understanding, updated procedures, and approaches as appropriate with respect to
    a. Reestablishing entry abort procedures and returning in higher level personal protective equipment (PPE) when an unknown liquid is present.
    b. Understanding and applying the limitations of monitoring and dermal hazard control. Always assume liquids of unknown origin are chemical agent even in the absence of monitoring alarm alerts. Employees should exercise caution in assuming an unknown liquid is not a chemical agent.
    c. Practicing and continually updating methods of contamination control.
    d. Ensuring PPE is appropriate and available for the entry.

e. Developing and practicing methods for immediate (or nearly immediate) patient treatment for dermal exposures that could occur while working in both DPE and Level C attire.

2. Noting common elements between a previous incident and this incident, efforts should include evaluation of upgrading work packages and be considered as part of the corrective action plan.

3. The site needs to improve its timeliness and ability to secure the scene after an incident and isolate items that could be potentially involved in the investigation.

4. The Field Office should increase its surveillance of the informal and formal log books or ban the use of the informal logs.

All of CDC's recommendations from the investigation were categorized as required or best practices. The U.S. Army accepted all of the recommendations.

Medical Programs

CDC's specialists in occupational and environmental medicine consult with the U.S. Army and relevant stakeholders to ensure that CDFs are built, operated, monitored, and closed according to high safety standards. Thse standards protect the health of workers and the public. CDC recommends airborne exposure limits for chemical warfare agents to protect the general population and the workers who dispose of chemical weapons. CDC also recommends guidelines for medical preparedness for communities near CDFs.

CDC evaluates the medical program at each CDF to ensure the staffing, clinic procedures, and clinic plans are able to address occupational medicine issues, including emergencies related to chemical agent disposal. If exposure to a chemical warfare agent occurs at a CDF, CDC assesses the situation to determine if the facility response was appropriate and timely. For example, CDC conducted a medical evaluation of the mustard exposure at Umatilla CDF in FY 2010. As a result of this medical evaluation, CDC made required recommendations regarding training in hazard recognition of unknown liquid and developing standardized clothing removal down to bare skin.

Examples of best-practice recommendations include the following:

- Accurate exposure reporting to facilitate medical diagnosis and treatment.
- Appropriate personal protective clothing based on job hazard.
- Development of decontamination procedures for liquid and contact hazards.
- Development of criteria to address dermal exposure hazards for workers.

Industrial Hygiene

CDC's industrial hygienist continually evaluates the industrial hygiene programs at each CDF. Industrial hygiene is the science devoted to the anticipation, recognition, evaluation, prevention, and control of environmental factors or stresses arising in or from the workplace that may cause sickness, impaired health and well being, or significant discomfort among workers or among citizens of the community.

Industrial hygiene programs cross many disciplines of occupational health, such as risk assessment, medical, and toxicology. These programs protect workers by identifying safe and proper engineering, administrative, and PPE controls.

In FY 2010, CDC's industrial hygienist made best-practice recommendations concerning the CDF heat stress programs. CDF workers generally operate in thick protective suits with respiratory protection devices. These PPE measures result in increased heat stress exposure to workers. Workers are medically monitored before and during operations to ensure they are not in jeopardy for injury related to heat stress. CDC's industrial hygienist recommended enhancement of postentry medical monitoring procedures to protect workers from the cumulative effects of working in increased heat-stress environments.

Site Closure

Closure is the process of decontaminating, dismantling, and demolishing the chemical agent disposal equipment and buildings. Closure includes considering the property's future use and restoring it according to the standards prescribed in the facility's environmental permit. As with chemical agent destruction operations, closure requires careful planning, development of procedural steps, and safety reviews before implementation.

Because the potential for chemical agent presence exists, CDC remains involved with closure activities. CDC

- Reviews closure-related programmatic and facility plans and procedures.
- Conducts site visits to observe and assess the safety and health implications of closure activities,
- Makes recommendations when appropriate.

In FY 2010 CDC made required recommendations applicable to closure at all sites. Examples of these recommendations included

- Decontamination methodologies regarding potentially chemical agent-contaminated piping, tanks, and ducts.
- Quality control procedures pertaining to waste and decontamination verification.
- Documentation of risk assessments.
- Air monitoring sample placement during verification of building decontamination.

An example best-practice recommendation was that consideration should be given to warming disposal plants for a period of time during closure as a way to desorb surface agent contamination.

Scope

CDC makes recommendations to only one site, to multiple sites, or to the demilitarization program as a whole. As Figure 5 shows, the majority of recommendations in FY 2010 were made at the site level; 59.7% were directed to only one site and 31.0% to multiple sites.

CDC made 9.3% of recommendations to the whole program. An example programmatic recommendation from FY 2010 follows:

> "CMA should reevaluate its Laboratory and Monitoring Quality Assurance Plan (LMQAP) requirements for sample line challenge frequencies; implementation of risk-based approaches should be considered so that sites are required to more frequently evaluate the processes that are more likely to fail."

A site-level recommendation is typically more specific, such as this example from FY 2010:

> "Immediate actions should be taken at PBCDF [Pine Bluff Chemical Agent Disposal Facility] to install two or more sampling stations adjacent to the ton container glovebox area to rapidly and to reliably detect any agent migration that may occur. With the current monitoring stations, significant dilution would occur prior to reaching sampling inlet points. PBCDF should consult with other disposal sites that have all implemented this practice."

Figure 6 shows the distribution of recommendations across the sites.

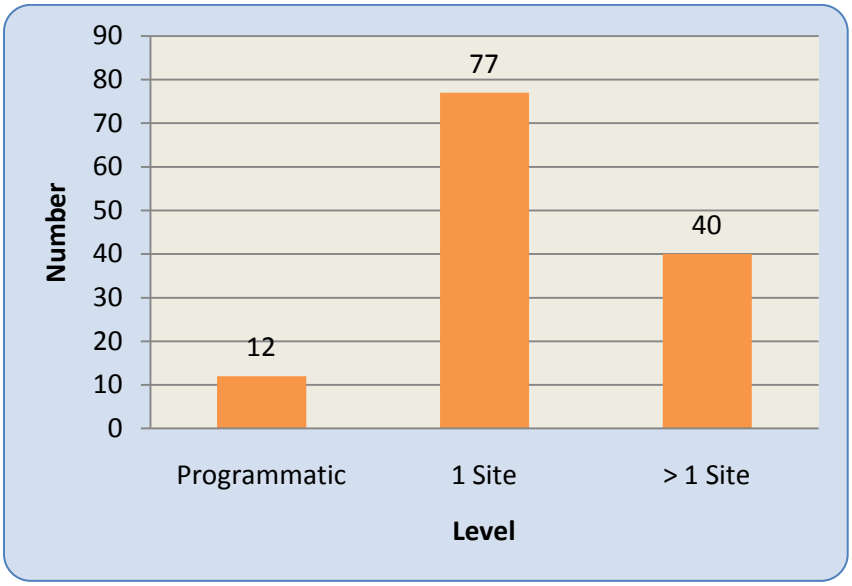

Figure 5: Breakdown of Level of Recommendations

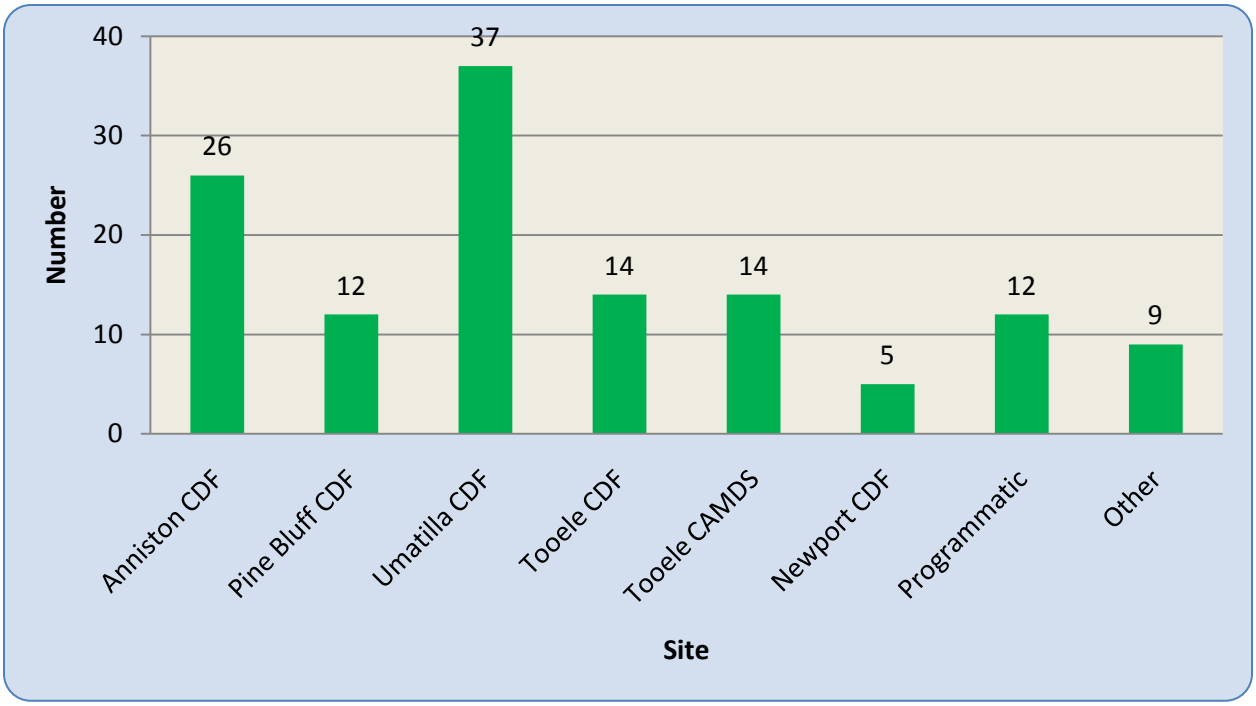

Figure 6: Number of Recommendations Made by Site

U.S. Army's Response to Recommendations

On receipt of CDC's required or best-practice recommendations, the U.S. Army has three options:

- Accept the recommendation.
- Not accept the recommendation but provide an acceptable justification or alternative.
- Not accept the recommendation.

Figure 7 shows how the U.S. Army responded to CDC required or best-practice recommendations made during FY 2010. The U.S. Army accepted 80.0% (N=64/80) of CDC's recommendations. [This total does not include the 25 required or best-practice recommendations still awaiting a response.]

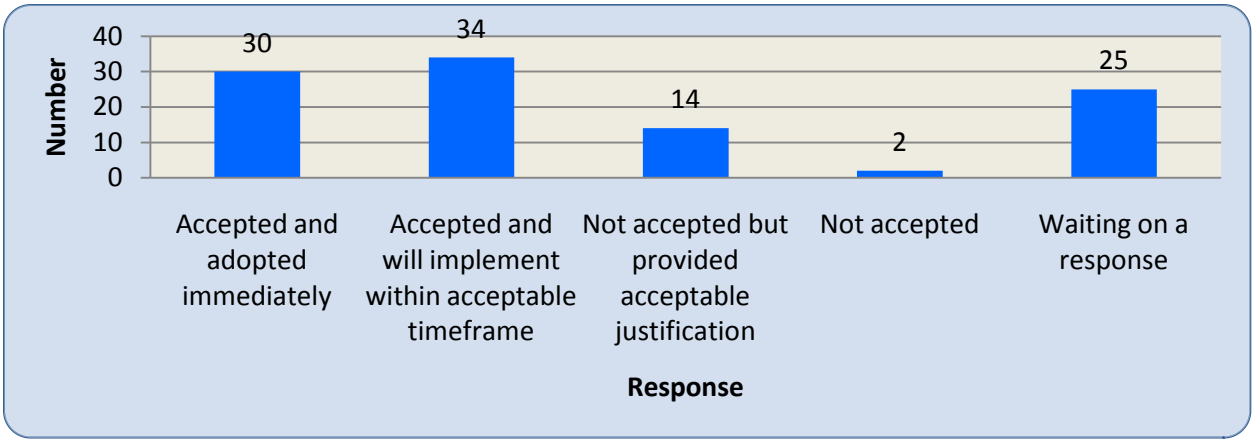

Figure 7: U.S. Army Response to Required and Best-practice Recommendations

The U.S. Army provided a justification and/or acceptable alternative for the 20.0% (16/80) of CDC required or best-practice recommendations not accepted. Only 2.5% (2/80) of CDC's required or best-practice recommendations were not accepted by the U.S. Army. As Figure 8 illustrates, those two unaccepted recommendations fell into the best-practices category, so CDC does not consider their acceptance essential to protecting public health.

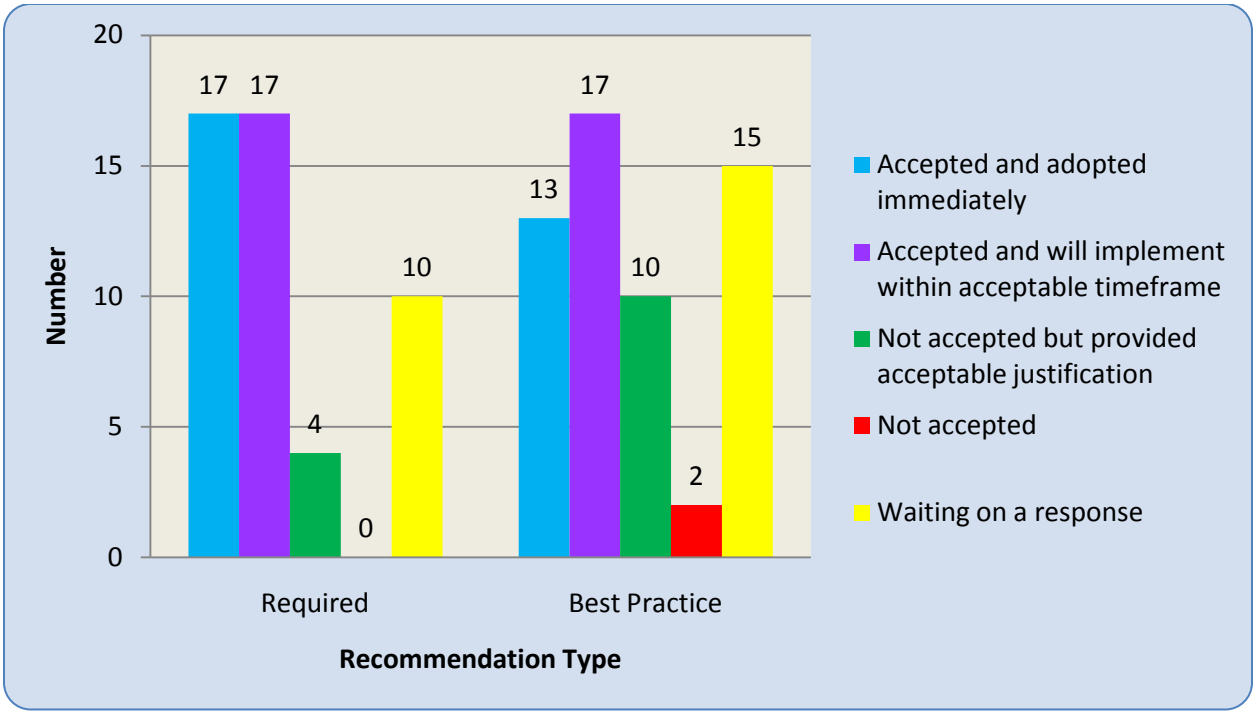

Figure 8: U.S. Army Response to Required and Best-practice Recommendations by Recommendation Type

Looking Forward

During FY 2011, most of the active incineration sites are scheduled to complete their mission, and the United States will approach 90% destruction of the stockpile. To accomplish the target of 90% destruction, the sites will use newly designed or modified equipment to deal with problematic issues. These issues include high mercury heels (sludge or buildup) in ton containers, leaking munitions that could not be processed with the originally designed equipment, and munitions that have complications with fuses and bursters or corrosion. These processes are first-of-a-kind (FOAK) for the U.S. Army and will require careful, yet timely, reviews and testing to ensure safety of both the public and workers.

During closure, and as the final decontamination and demolition or reuse of the sites begins, new challenges will surface that will put demands on the program and its stakeholders to ensure public and worker protection. These include new roles for workers, demolition of potentially contaminated equipment, decontamination of waste, and other challenges.

CDC will also continue oversight of nonstockpile activities as munitions and other chemical weapons-related materials are recovered. The U.S. Army is also developing means to address chemical weapons that were disposed at sea. These efforts will also require new approaches to ensure protection of public and worker health.

The ACWA program is accelerating efforts to complete construction at the remaining two CDFs and begin destruction of the remaining 10% of the stockpile. The ACWA program and CDC's oversight will focus on the many FOAK equipment and processes that will be incorporated in these systems. ACWA will use proven chemical processing technology, but this is the first time such technology will be used on munitions such as mortars, rockets, and projectiles. FY 2011 will be a watershed year and one that will demonstrate the commitment of the United States to the safe destruction of chemical weapons.

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