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AFGHANISTAN AND IRAQ

DOD Should Improve Adherence to Its Guidance on Open Pit Burning and Solid Waste Management

GAO-11-63

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Highlights

Highlights of GAO-11-63, a report to congressional requesters

AFGHANISTAN AND IRAQ

DOD Should Improve Adherence to Its Guidance on Open Pit Burning and Solid Waste Management

Why GAO Did This Study

From the start of military operations in Afghanistan and Iraq, the U.S. military and its contractors have burned solid waste in open burn pits on or near military bases. According to the Department of Defense (DOD), burn pit emissions can potentially harm human health. U.S. Central Command (CENTCOM) guidance directs the military's use of burn pits, and the Department of Veterans' Affairs (VA) provides healthcare and other benefits to veterans and their families.

GAO was asked to report on the (1) extent of open pit burning in Afghanistan and Iraq, and whether the military has followed its guidance; (2) alternatives to burn pits, and whether the military has examined them; and (3) extent of efforts to monitor air quality and potential health impacts.

GAO visited four burn pits in Iraq, reviewed DOD data on burn pits, and consulted DOD and VA officials and other experts. GAO was unable to visit burn pits in Afghanistan.

What GAO Recommends

Among other things, GAO recommends that the Secretary of Defense improve DOD's adherence to relevant guidance on burn pit operations and waste management, and analyze alternatives to its current practices. In commenting on a draft of this report, DOD said that it concurred with five of the six recommendations and partially concurred with the sixth. GAO addressed a DOD suggestion to clarify the sixth recommendation. VA reviewed the draft report and had no comments.

View GAO-11-63 or key components.
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What GAO Found

The military has relied heavily on open pit burning in both conflicts, and operators of burn pits have not always followed relevant guidance to protect servicemembers from exposure to harmful emissions. According to DOD, U.S. military operations in Afghanistan and Iraq generate about 10 pounds of solid waste per soldier each day. The military has relied on open pit burning to dispose of this waste mainly because of its expedience. In August 2010, CENTCOM estimated there were 251 burn pits in Afghanistan and 22 in Iraq. CENTCOM officials said the number of burn pits is increasing in Afghanistan and decreasing in Iraq, which reflects U.S. troop reallocations and efforts to install waste incinerators. Despite its reliance on burn pits, CENTCOM did not issue comprehensive burn pit guidance until 2009. Furthermore, to varying degrees, operators of burn pits at four bases GAO visited in Iraq were not complying with key elements of this guidance, such as restrictions on the burning of items, including plastic, that produce harmful emissions. DOD officials also said that, from the start of each conflict, operators routinely burned items that are now prohibited. The continued burning of prohibited items has resulted from a number of factors, including the constraints of combat operations, resource limitations, and contracts with burn pit operators that do not reflect current guidance.

Waste management alternatives could decrease the reliance on and exposure to burn pits, but DOD has been slow to implement alternatives or fully evaluate their benefits and costs, such as avoided future costs of potential health effects. Various DOD guidance documents discourage long-term use of burn pits, encourage the use of incinerators and landfills, or encourage waste minimization such as source reduction. DOD has installed 39 solid waste incinerators in Iraq and 20 in Afghanistan, and plans to install additional incinerators in Afghanistan. To date, source reduction practices have not been widely implemented in either country and recycling consists primarily of large scrap metals. DOD plans to increase recycling at its bases in Iraq, but recycling at bases in Afghanistan has been limited. Further, DOD has not fully analyzed its waste stream in either country and lacks the information to decrease the toxicity of its waste stream and enhance waste minimization.

U.S. Forces in Afghanistan and Iraq do not sample or monitor burn pit emissions as provided by a key CENTCOM regulation, and the health impacts of burn pit exposure on individuals are not well understood, partly because the military does not collect required data on emissions or exposures from burn pits. Army public health officials have, however, sampled the ambient air at bases in each conflict and found high levels of particle pollution that causes health problems but is not unique to burn pits. These officials identified logistical and other challenges in monitoring burn pit emissions, and U.S. Forces have yet to establish pollutant monitoring systems. DOD and VA have commissioned studies to enhance their understanding of burn pit emissions, but the lack of data on emissions specific to burn pits and related exposures limit efforts to characterize potential health impacts on service personnel, contractors, and host-country nationals.

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Abbreviations

APHC	Army Public Health Command
CENTCOM	U.S. Central Command
CJTF	Combined Joint Task Force
DCAA	Defense Contract Audit Agency
DCMA	Defense Contract Management Agency
DOD	Department of Defense
DOEHRS	Defense Occupational and Environmental Health Readiness System
FRAGO	fragmentary orders
ISAF	International Security Assistance Forces
KBR	Kellogg, Brown, and Root
LOGCAP	Logistics Civil Augmentation Program
MEG	Military Exposure Guidelines
MNC-I	Multi-National Corps-Iraq
MNF-I	Multinational Forces-Iraq
USARCENT	United States Army Central
USF-I	U.S. Forces-Iraq
USFOR-A	U.S. Forces-Afghanistan
VA	Department of Veterans Affairs
VOC	volatile organic compounds

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United States Government Accountability Office
Washington, DC 20548

October 15, 2010

The Honorable Bob Filner
Chairman
Committee on Veterans' Affairs
House of Representatives

The Honorable Russell D. Feingold
United States Senate

The Honorable Ron Wyden
United States Senate

The Honorable Tim Bishop
House of Representatives

The Honorable Carol Shea-Porter
House of Representatives

U.S. military operations in Afghanistan and Iraq generate about 10 pounds of waste per servicemember each day.[1] This waste may consist of plastic, Styrofoam, and food from dining facilities; discarded electronics; shipping materials such as wooden pallets and plastic wrap; appliances; and other items such as mattresses, clothing, tires, metal containers, and furniture.[2] The military must expeditiously handle this waste to avoid public health risks and other problems. Since the beginning of current military operations in Afghanistan in 2001 and Iraq in 2003, the Department of Defense (DOD) has disposed of waste in open burn pits, as well as in landfills and incinerators, on or near military installations. Generally, burn pits are either shallow excavations or surface features with berms used to conduct open burning. According to DOD, the oversight and operation of burn pits varies substantially across installations, with waste management decisions made largely by base commanders and carried out by military personnel, contractors, or a combination.

[1]The military services include the four armed services (Army, Navy, Marine Corps, and Air Force) but not other Department of Defense components or contractors.

[2]Military operations produce three principal types of waste: non-hazardous, hazardous, and medical. This report focuses on processes for handling non-hazardous waste at installations in Afghanistan and Iraq.

Figure 1: Burn Pit at Camp Taji, Iraq, January 2010

Source: GAO.

Burn pits help base commanders manage waste, but also produce smoke and harmful emissions that military and other health professionals believe may result in acute and chronic health effects to those exposed. Some veterans returning from both conflicts have reported pulmonary and respiratory ailments, among other health concerns, that they attribute to burn pit emissions. Numerous veterans have also filed lawsuits against a DOD contractor alleging that the contractor mismanaged burn pit operations at several installations in both conflicts, resulting in exposure to harmful smoke that caused these adverse health effects. DOD's response to concerns about burn pits has evolved over time. In May 2008, DOD health officials said that the study of emissions from the largest burn pit in Iraq did not indicate that burn pit smoke presented an elevated long-term health risk. In April 2009, DOD clarified this position and said burn pit emissions may cause problems for servicemembers with elevated individual susceptibilities, such as preexisting health conditions or genetic factors. DOD also noted that it would conduct testing and monitoring to determine the impacts.

Because U.S. environmental laws such as the Clean Air Act and the Solid Waste Disposal Act do not generally apply overseas, the military has developed policies and procedures to guide solid waste management during contingency operations.[3] In September 2009, the U.S. Central Command (CENTCOM)—the geographic combatant command whose area of responsibility includes Afghanistan and Iraq—developed policies and procedures to guide solid waste management in its area of responsibility, including minimum requirements for operating and monitoring burn pits. This guidance applies to military personnel and civilian contractors who operate burn pits in Afghanistan and Iraq. In addition, the military commands in Afghanistan and Iraq have developed burn pit guidance, designed to meet the unique needs of their respective areas of operation. In March 2010, DOD issued additional guidance that directs the commanders of the combatant commands (such as CENTCOM) to make a formal determination that no alternative disposal method is feasible before potentially harmful waste, such as tires, treated wood, or batteries, can be burned in open-air pits. The Defense Contract Management Agency (DCMA) and the Defense Contract Audit Agency (DCAA) work with the military commands in both countries to oversee contractors' adherence to relevant guidance. CENTCOM has also developed guidance for the implementation of waste minimization practices, including alternative methods of waste disposal and recycling.

This report responds to your request that we review burn pits in U.S. military installations in Afghanistan and Iraq. It addresses the following objectives: (1) determine the extent to which the U.S. military installations in Afghanistan and Iraq have used open pit burning and adhered to guidance governing their use; (2) identify alternatives to open pit burning and the extent to which DOD evaluated these alternatives; and (3) determine the extent to which U.S. forces have monitored the air quality, exposures, and potential health impacts of burn pit emissions in accordance with relevant guidance.

To address the first objective, we reviewed relevant DOD guidance and U.S. military records, and visited four burn pit sites in Iraq—Al Asad, Marez, Taji, and Warhorse. At each site visited, we observed burn pit

[3]The U.S. military commonly uses the term "contingency operations" to refer to activities in combat zones. Contingency operations include, among other things, any military operation that the Secretary of Defense designates as an operation in which members of the armed forces may become involved in military actions against an opposing military force. 10 U.S.C. § 101(13)(A).

operations and interviewed military officials, preventive medicine personnel, and contractors, and reviewed inspection reports conducted by DCMA. We considered several factors when selecting the locations of our site visits, such as whether the burn pit was managed by the military or a contractor and our ability to safely access the location. Our findings from the site visits are not generalizable to other bases that we did not visit. We were unable to observe burn pit operations in Afghanistan. To address the second objective, we reviewed DOD guidance and planning documents on current and future uses of alternatives to open pit burning, DOD waste disposal studies, and relevant literature. We also observed burn pit alternatives during our site visits in Iraq and discussed them with DOD officials and contractors. In addition, we interviewed DOD officials in the United States regarding alternatives to burn pits in Afghanistan and Iraq. To address the third objective, we analyzed data on ambient air sampling in Afghanistan and Iraq conducted from 2002 through 2010. We assessed the reliability of these data and determined that they were sufficiently reliable for the purposes of this report. In addition, we analyzed DOD air sampling, health risk characterization, and health surveillance documents; as well as documents from the Department of Veterans Affairs (VA). We also interviewed DOD officials regarding air sampling efforts and officials from VA and DOD regarding efforts to study the potential health impacts of burn pit emissions.

Lawsuits have been filed in federal court in at least 43 states in which current and former servicemembers have alleged, among other things, that a contractor's negligent management of burn pit operations, contrary to applicable contract provisions, exposed them to air pollutants that subsequently caused serious health problems.[1] The contractor has moved to dismiss the suits, arguing, among other things, that it cannot be held liable for any injuries that may have occurred to service personnel because its burn pit activities occurred at the direction of the military. We express no view in this report on any issue in this pending litigation involving burn pits. Moreover, because of the pending litigation, we did not evaluate whether the contractor has complied with the terms of its contract with respect to burn pit operations.

[1]For preliminary purposes, the suits have been consolidated in the federal district court in Maryland. *In re KBR Burn Pit Litigation*, RWT 09-md-2083 (D. Md.).

We conducted this performance audit from September 2009 to October 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes the manner in which the U.S. military is organized to carry out its missions, how the military uses contractors to perform many essential services during contingency operations, and the existing air quality in Afghanistan and Iraq.

U.S. Force Structure in Afghanistan and Iraq

The U.S. command structure in each nation has evolved over time. To perform its military missions around the world, DOD operates geographic combatant commands that conduct activities within assigned areas of responsibility. Combatant commanders oversee U.S. military operations that take place within their area of responsibility. CENTCOM extends from the Middle East to Central Asia, including Afghanistan and Iraq. In Afghanistan, American forces fought as part of the International Security Assistance Forces (ISAF), a multinational strategic unit. The Combined Joint Task Force (CJTF), which was subordinate to ISAF, was responsible for the command and control of operations throughout Afghanistan. In 2009, the U.S. troops' designation became U.S. Forces-Afghanistan (USFOR-A). According to administration estimates, as of September 2010, about 104,000 American troops, including 30,000 reinforcements that were announced in December 2009, were deployed in Afghanistan. The United States plans to begin withdrawing troops from Afghanistan in July 2011.

American forces fighting in Iraq originally came under a similar dual command structure. Multinational Forces-Iraq (MNF-I) was the strategic component. It housed a multinational staff that included logistics, procurement, intelligence, combat operations, and engineering, among other things. The engineering staff, with input from health officials, had responsibility for developing the policies that governed the management of solid waste in Iraq. In addition, Multi-National Corps-Iraq (MNC-I) constituted the operations component of the Iraq command structure. It, too, had a multinational staff that roughly paralleled the MNF-I staff,

although it focused more on day-to-day operational issues. On January 1, 2010, MNF-I and MNC-I merged to form U.S. Forces-Iraq (USF-I).[5] By August 31, 2010, about 65,000 American combat troops will have withdrawn from Iraq, reducing U.S. troop levels to about 50,000. The United States' presence in Iraq is scheduled to end no later than December 31, 2011.

Contracting Process

The U.S. military relies on civilian contractors to provide supplies and services, including managing some burn pits, in support of its contingency operations in Afghanistan and Iraq. Kellogg, Brown, and Root (KBR) has provided burn pit services in Iraq through the Logistics Civil Augmentation Program (LOGCAP) III contract. On April 18, 2008, DOD announced the Army had awarded LOGCAP IV contracts to DynCorp International, Fluor Intercontinental, and KBR. The transition of requirements from the LOGCAP III to the LOGCAP IV contracts is ongoing and will be used for combat support services in Afghanistan, including burn pit management.[6] KBR retains responsibility for burn pit support in Iraq, as well as a role in aiding the transition of LOGCAP III to LOGCAP IV in Afghanistan.

Typically, contractors such as KBR, DynCorp, and Fluor work under task orders. The task order process begins when a military customer, such as a commander in Afghanistan or Iraq, identifies a need, such as assistance in managing a burn pit. This need is documented in a task order statement of work, which establishes the specific tasks for the contractor, and the time frames for performance. In the case of contracting for burn pit support, the customer contacts its contract program management office (the contract office), which obtains a cost estimate from a contractor and provides the cost information to the customer. If the customer decides to use the contractor's services, the contract office obtains funding and finalizes the statement of work, and the contracting officer issues the task order and a notice to begin work. If the customer identifies a change in need, the process begins anew.

[5]Many of the initiatives discussed in this report were undertaken before the transition from MNF-I to USF-I. Actions or initiatives undertaken before January 2010 are attributed to MNF-I or one of its subordinates, e.g., MNC-I, as appropriate. Actions or initiatives taken after January 2010 or that are currently ongoing are attributed to USF-I.

[6]At present, the LOGCAP IV transition is in effect only in Afghanistan.

Additionally, the military services, as well as DCMA, perform contract management functions to ensure the government receives quality services from contractors at the best possible prices. Customers identify and validate the requirements to be addressed and evaluate the contractor's performance, and ensure that the contract is used in economical and efficient ways. The contracting officer is responsible for providing oversight and management of the contract. The contracting officer may delegate some oversight and management functions to DCMA, which may then assign administrative contracting officers to (1) provide on-site contract administration at deployed locations, and (2) to monitor contractor performance and management systems to ensure that the cost, product performance, and delivery schedules comply with the terms and conditions of the contract. DCMA administrative contracting officers may have limited knowledge of field operations. In these situations, DCMA normally uses contracting officers' technical representatives who have been designated by their unit and appointed and trained by the administrative contracting officer. They provide technical oversight of the contractor's performance, but they cannot direct the contractor by making commitments or changes that affect any terms of the contract.

Air Quality Conditions in Afghanistan and Iraq

Air pollution in Afghanistan and Iraq is generally high. For example, the level of particulate matter is higher in Afghanistan and Iraq than in the United States. Particulate matter includes coarse particles between 2.5 and 10 micrometers in diameter, as well as fine particles smaller than 2.5 micrometers. Particle pollution may contain a number of components, including acids, organic chemicals, metals, and soil or dust particles, according to the Environmental Protection Agency (EPA). The size of particles is directly linked to their potential for causing health problems. Both coarse and fine particles pass through the throat and nose and enter the lungs. Fine particles can also become deeply embedded in lung tissue. Health problems associated with particle pollution identified by EPA include irritation of the airways, coughing, or difficulty breathing; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. According to DOD, sources of particulate matter include dust storms, dust from vehicle disturbance of the desert floor, emissions from local industries, and open pit burning conducted by Afghans, Iraqis, and American troops.

Figure 2: Poor Air Quality at Camp Taji, Iraq, January 2010

Source: GAO.

The Military Has Relied Heavily on Open Pit Burning at Installations in Afghanistan and Iraq, but Burn Pit Operators Have Not Always Followed Relevant Guidance

Since the beginning of hostilities in Afghanistan (2001) and Iraq (2003), the military has relied heavily on open burn pits to dispose of the large quantities of solid waste generated at its installations, but CENTCOM did not develop comprehensive guidance on operating or monitoring burn pits until 2009, well after both conflicts were under way. Furthermore, our site visits and review of contractor documentation found that burn pit operators did not always comply with this guidance. In addition, DOD health officials said that many items now prohibited from burn pits, such as plastics, have been routinely burned at U.S. military bases from the start of each conflict.

DOD Has Relied Heavily on Burn Pits for Solid Waste Disposal in Afghanistan and Iraq

Prior to 2004, the military used burn pits exclusively to handle waste disposal needs in Afghanistan and Iraq. Beginning in 2004, the military began to introduce alternative waste disposal methods. For example, according to DOD officials, between 2005 and 2010, there was a large increase in the number of operational solid waste incinerators in both countries.[7] We discuss incineration issues and other alternatives to open pit burning in more detail in the next section of this report. Nonetheless, as of August 2010, burn pits remained an important waste disposal method for the U.S. military in both wars. According to DOD officials, the military's reliance on open burn pits is primarily the result of their expedience, especially in the early phases of both wars when combat operations were most intense.

Although senior DOD officials said virtually every U.S. military installation in both countries has used burn pits, it is difficult to determine the number of burn pits in use at any given time. First, CENTCOM does not routinely collect such data. In fact, to respond to our request for information, CENTCOM had to query individual base commanders to determine the number of burn pits in each country. In addition, the exact number of active burn pits in both countries varies with fluctuations in the number of bases. As U.S. troops leave Iraq and additional troops arrive in Afghanistan, these totals change. In November 2009, CENTCOM reported 50 active burn pits in Afghanistan and 67 in Iraq. However, by April 2010, those numbers had changed to 184 and 52, respectively. By August 2010, there were 251 active burn pits in Afghanistan and 22 in Iraq.

Bases in both countries also vary substantially in their size, resulting in varying amounts of solid waste. For example, large bases may house 5,000 or more U.S. servicemembers, as well as U.S. civilian contractors, while a patrol base may house only about 150 troops. Relatively small bases, such as patrol bases, are likely to rely on open burning for their solid waste disposal needs. Major bases, such as Bagram (Afghanistan) and Balad (Iraq), may employ alternatives, such as incinerators, to handle a substantial portion of their solid waste disposal.

[7]The United States' presence in Iraq is scheduled to end by December 2011. At that time, according to CENTCOM officials, incinerators remaining in Iraq will be transferred to the government of Iraq.

CENTCOM Did Not Develop Comprehensive Burn Pit Guidance Until 2009

Although DOD has long recognized the dangers of open pit burning—June 1978 waste management guidance states that U.S. personnel should not burn solid waste unless there is no other alternative, in part because of the environmental dangers it poses—CENTCOM and its subordinate commands did not provide comprehensive instructions on managing and operating burn pits or minimizing these dangers until 2009. Earlier guidance was largely limited to noting the inherent dangers of open burning and suggesting that various alternatives—such as landfills and pollution prevention—be used instead. For example, an Army Technical Bulletin on Guidelines for Field Waste Management, dated September 2006, notes that troops should use open burning only in "emergency situations," because it can lead to "significant environmental exposures." However, this bulletin provides only minimal guidance on employing open burning in emergency situations to lessen the acknowledged risks associated with open burning and avoid exposing U.S. servicemembers, civilian contractors, and local nationals to those risks.

According to a former senior military engineer stationed in Baghdad from 2005 to 2006, the lack of specific burn pit guidance may have been, at least in part, because the command structure in Iraq did not have the engineering expertise on-hand to develop such guidance, and because it was not clear organizationally which command unit—engineers or health professionals—was responsible for developing such guidance. As a result, MNC-I policies and procedures did not emphasize solid waste management. When MNC-I established a dedicated engineering staff in 2005, it began developing more comprehensive environmental policies for Iraq, with advice from the Army Public Health Command. According to the former senior military engineer, the dedicated engineering staff included about 100 engineers, with about 20 to 30 staff—including one environmental specialist—focusing on environmental guidance for Iraq. One of their points of emphasis was to develop limited instructions for operating burn pits.

In 2006, the engineering staff developed environmental policies to cover each of the environmental issues of concern, including hazardous and solid wastes, among other things. CENTCOM issued these policies as fragmentary orders (FRAGO) to U.S. forces operating in Iraq. The solid waste FRAGO included limited guidance on burn pit operations. These FRAGOs were consolidated into a single document entitled *MNC-I Environmental Standard Operating Procedure 2006* that discouraged the use of burn pits as a method of waste disposal. The development of this guidance also advanced some environmental practices, such as the segregation of waste to facilitate reuse and recycling efforts. However,

MNC-I Environmental Standard Operating Procedure 2006 did not include comprehensive policies for operating or monitoring burn pits.

In April 2009, MNC-I revised the 2006 guidance to standardize procedures for environmental compliance and to provide environmental guidance to U.S. forces and their support units, including civilian contractors, operating in Iraq. *MNC-I Environmental Standard Operating Procedure 2009* provides specific guidance for the handling of solid waste during contingency operations, including emphases on source reduction, waste minimization, and recycling as the most appropriate means of handling solid waste. It also describes burn pits as an expedient means to destroy solid waste during contingency operations. However, the guidance notes that open burning is explicitly forbidden unless the base commander authorizes it in writing. In addition, it provides guidance on siting burn pits, securing them, managing burn pit ash, and overseeing open burning, among other things. In particular, it details waste items prohibited from destruction in burn pits, including hazardous waste, batteries, tires, electronics, and appliances, among other things.

In September 2009, USFOR-A issued guidance to provide overarching environmental direction and best management practices for use during contingency operations in Afghanistan, including specific instructions for operating burn pits. According to senior military officers, the issuance of this guidance coincided with the arrival of a Joint Force Engineer Command in Afghanistan. Consistent with earlier waste disposal guidance, including *MNC-I Environmental Standard Operating Procedure 2006 and 2009*, USFOR-A guidance stipulates that open burning is the least preferred method of solid waste disposal and that troops should use it only until they can develop more suitable capabilities. According to this USFOR-A guidance, the ultimate goal for enduring bases in Afghanistan is to transition to composting and recycling, to nearly eliminate the need for all forms of incineration, including burn pits. Further, this guidance states that, while U.S. forces may use burn pits early in contingency operations as an expedient way to control waste, "open burning will not be the regular method of solid waste disposal." It also establishes several criteria to control and manage the air emissions associated with burn pit operations, including general guidelines for burning and a list of prohibited items. Some of the USFOR-A prohibited items mirror those from MNC-I. For example, both lists include hazardous waste, oils, and tires. However, USFOR-A guidance also includes pesticide containers, asphalt shingles, treated wood, and coated electrical wires, among other things, not specifically listed in the MNC-I guidance. The MNC-I guidance requires

plastics to be segregated for recycling, while the USFOR-A guidance explicitly bans plastics from burn pits.

Also in September 2009, CENTCOM issued Regulation 200-2 to provide environmental guidance and best management practices for U.S. bases in CENTCOM's area of responsibility during contingency operations. The regulation provides U.S. military and civilian personnel detailed guidance for managing environmental concerns, such as hazardous materials, regulated medical waste, spill response, and solid waste, among other things. According to CENTCOM officials, the regulation provides the minimal acceptable standards for solid waste disposal, including burn pit operations, for all U.S. bases under its command including those in Afghanistan and Iraq. The regulation applies to all CENTCOM elements engaged in contingency operations throughout CENTCOM's area of responsibility, including all servicemembers, DOD civilians, and DOD contractors. Generally, the regulation's requirements are more stringent than the nation-specific guidance contained in MNC-I and USFOR-A. For example, the regulation excludes more items from burn pits than the MNC-I or USFOR-A standard operating procedures.

According to CENTCOM officials, one of the main reasons for developing its 2009 regulation was to codify and expand the burn pit requirements in *MNC-I Environmental Standard Operating Procedure 2009* and *USFOR-A Standard Operating Procedure 2009*. CENTCOM officials said that a CENTCOM regulation carries more weight and, thus, is more easily enforced than subordinate commands' standard operating procedures. Further, CENTCOM's 2009 regulation states that subordinate command guidance may be used when base commanders deem "additional environmental guidance" necessary to "supplement" the regulation. As such, subordinate command guidance provides commanders in Afghanistan and Iraq flexibility to increase waste disposal requirements to meet unique needs in their respective areas of operation, as long as they meet the minimum direction in the regulation.

In October 2009, Congress enacted the National Defense Authorization Act (NDAA) for Fiscal Year 2010.[8] Section 317 of the act requires DOD to prescribe regulations prohibiting the disposal of covered waste in open-air burn pits during contingency operations except in circumstances in which the Secretary of Defense determines that no alternative disposal method is

[8]Pub. L. No. 111-84 (2009).

feasible. In March 2010, in response to section 317 of the NDAA, DOD issued Directive-type Memorandum (DTM) 09-032 prohibiting the disposal of covered waste in open-air burn pits during contingency operations except when the relevant commander of a combatant command makes a formal determination that no alternative disposal method is feasible.[9]

According to DTM 09-032, once the relevant field commander makes such a determination, the commander must forward the determination in writing to the Under Secretary of Defense for Acquisition, Technology, and Logistics so that it arrives within 15 calendar days of making the determination. The Under Secretary is to submit the determination to the Senate and House Armed Services Committees within 30 days of the commander's decision. The commander must also provide a justification to the Under Secretary to continue open-air burning for each subsequent 180-day period during which the base plans to burn covered waste in burn pits. The Under Secretary must also forward these justifications to the Senate and House Armed Services Committees.

The DTM 09-032 exception process may appear to institute less stringent controls over open-air burning than CENTCOM's 2009 regulation because it allows such burning when commanders deem it necessary, while the regulation does not authorize the disposal of prohibited items in burn pits under any circumstances. However, a senior DOD official said despite the prohibitions in CENTCOM's 2009 Regulation, information gathered from field commanders led him to conclude that disposal of prohibited items in burn pits had become routine at many bases in Afghanistan and Iraq. According to this senior official, the DTM 09-032 exception process may provide incentives for field commanders to seek and employ alternatives to burn pits rather than have them attempt to justify continued burning. As of July 2010, no field commanders in Afghanistan or Iraq had sought permission to burn covered waste in burn pits.

According to a senior DOD official, the DTM is a worldwide policy that applies to all DOD components, including CENTCOM. As a result, CENTCOM must comply with DTM 09-032 and to the extent CENTCOM's 2009 regulation does not conflict with the DTM, any additional measures in the regulation. The DTM directive for a commander of a combatant

[9]DTM 09-032 defines "covered waste" as hazardous waste; regulated medical waste; tires; treated wood; batteries; compressed gas cylinders; fuel containers; aerosol cans; polychlorinated biphenyls; petroleum, oils, and lubricants; asbestos; mercury; foam tent material; and any item containing any of these items.

command to make a formal determination that there is no feasible alternative to disposing of covered waste in a burn pit and the associated congressional notification applies only to wastes covered under the DTM. However, burn pit management in CENTCOM's area of responsibility must adhere to both documents. Thus, for example, CENTCOM's 2009 regulation's list of items prohibited from burn pits remains in effect, even though it is not identical to the list of covered wastes in the DTM.

Table 1 compares the key elements of burn pit guidance developed by MNC-I, USFOR-A, CENTCOM, and DTM 09-032 that are relevant to the issues Congress identified in NDAA section 317.

Table 1: Comparison of MNC-I, USFOR-A, CENTCOM, and DTM Burn Pit Guidance Relevant to Issues Congress Identified in the FY 2010 NDAA

Guidance elements	MNC-I (2009)	USFOR-A (2009)	CCR 200-2 (2009)	DTM (2010)
Burn pits recognized as producing unhealthy air emissions		●	●	●
Pre-burn activities				
Examine and sort waste to ensure prohibited items are not present	●		●	
Waste minimization/recycling required or strongly encouraged	●	●	●	
Duration of burn pit use				
Burn pits are expedient in early phases of contingency operations		●	●	●
Burn pits are to be used as contingency operations begin, but use must be terminated as soon as practical			●	
Long-term use of burn pits is discouraged		●	●	●
General burning guidelines				
Burn pits should be sited so prevailing winds carry smoke away from occupied areas	●	●	●	●
Minimize amount of dirt to reduce smoldering		●	●	
Upon completion of burn, pit should be extinguished to limit smoldering		●		
Minimize wet waste to reduce smoldering—never more than 25 percent of total			●	
Monitoring requirements				
Burn pit emissions should be monitored		●	●	●
Monitored emissions should include: dioxins, polycyclic aromatic hydrocarbons, volatile organic compounds, carbon monoxide, hexachlorobenzene, and particulate matter		●	●	
High levels of pollutants must be analyzed to determine cause and resolution		●	●	
Potential exposure to unhealthy emissions should be documented		●	●	
Burn pit ashes must be secured and tested for hazardousness		●	●	

Guidance elements	MNC-I (2009)	USFOR-A (2009)	CCR 200-2 (2009)	DTM (2010)
Items specifically prohibited from burn pits				
All hazardous waste/material	●	●	●	●
Petroleum, oil, and lubricant products		●	●	●
Rubber		●	●	
Tar paper		●	●	
Asphalt shingles		●	●	
Tires	●	●	●	●
Treated wood		●	●	●
Pesticides/pesticide containers		●	●	
Asbestos-containing material		●	●	●
Coated electrical wires		●	●	
Plastic		●	●	●
Aerosol cans	●		●	●
Gas cylinders	●		●	●
Fuel cans				●
Explosives			●	
Batteries	●		●	●
Appliances	●		●	
Electrical equipment	●		●	
Regulated medical waste	●		●	●
Paint and paint thinners/strippers			●	
Any material that creates unreasonable amount of smoke, fumes, or hazardous air pollutants		●	●	
Unexploded ordnance			●	

Source: GAO analysis of DOD data.

Note: MNC-I 2009, USFOR-A 2009, and the CENTCOM 2009 regulation each define "hazardous waste" to include any waste exhibiting any of four hazardous characteristics: ignitability, corrosivity, reactivity, or flammability. Thus, wastes in the above table that exhibit these characteristics would be banned from disposal in burn pits even if they are not specifically discussed in the relevant guidance document. Similarly, the DTM adopts the Resource Conservation and Recovery Act statutory definition of hazardous waste, which includes wastes that pose a health or environmental threat because of concentration, or physical, chemical, or infectious characteristics. 42 U.S.C. § 6903(5).

DOD Has Not Ensured That Burn Pit Operators Consistently Follow Key Health Protection Provisions of CENTCOM Regulation 200-2

DOD and CENTCOM officials, as well as senior military officers, acknowledged that U.S. forces have not always adhered to relevant guidance, and that prior to 2009, many items CENTCOM's 2009 regulation now prohibits from burn pits, including regulated medical waste, hazardous waste, and substantial quantities of plastic, were routinely disposed of in burn pits. However, according to these officials, options for waste disposal, other than burning, were limited early in both wars. This was particularly true when combat operations were under way, as troop safety and mission success outweighed environmental concerns. DOD officials said that, as threat levels decreased, the military began working to replace burn pits with more environmentally sound methods of waste disposal.

Between January and March 2010, we determined that, to varying degrees, the four burn pits we visited at bases in Iraq—one operated by military personnel and three operated by contractor personnel—were not managed in accordance with CENTCOM's 2009 regulation.[10] For example, we determined that operators at all four of these burn pits burned varying amounts of plastic—a prohibited item that can produce carcinogens when burned. For example, Al Asad appeared to have only trace amounts of plastic in its burn pit. At Warhorse, despite some limited waste sorting efforts, a burn pit operator said they did not segregate plastic from the waste stream. We found similar variability in the bases' use of incinerators. For example, Al Asad and Taji had solid waste incinerators in operation to supplement their burn pits, but Marez and Warhorse did not. Although all four bases had programs in place to sort waste prior to burning in an effort to avoid burning prohibited material, or to remove anything that could be used against U.S. forces, Al Asad and Taji devoted more resources to sorting waste than Marez and Warhorse. This variability in meeting the key health protection provisions of the CENTCOM 2009 regulation means many U.S. personnel—military and civilian—may face greater risks from burn pit emissions in their day-to-day activities.

[10]Our visits to these four bases predated DOD's issuance of DTM 09-032 prohibiting the disposal of covered waste in open-air burn pits during contingency operations, except through a formal determination that no other disposal method is feasible.

Figure 3: Burn Pit at Camp Warhorse, Iraq, February 2010

Source: GAO.

Note: This photograph shows the Warhorse burn pit immediately prior to U.S. personnel setting it afire in February 2010. The pit contains electric wire, plastic, and unopened trash bags—all prohibited from burn pit disposal under CENTCOM's 2009 regulation or *MNC-I Environmental Standard Operating Procedure 2009*.

Table 2 provides our analysis of each base's adherence to CENTCOM's 2009 regulation health-related burn pit provisions.

Table 2: Examples of Four U.S. Bases' Implementation of the CENTCOM Regulation's Burn Pit Health Provisions, as of March 2010

CENTCOM Regulation 200-2 Guidance Element	AL ASAD contractor	MAREZ contractor	TAJI contractor	WARHORSE military
Pre-burn activities				
Examine and sort waste to ensure prohibited items are not present	●	●	●	●
Duration of burn pit use				
Burn pits are to be used as contingency operations begin, but must be replaced by incinerators when practical	○	○	○	○

General burning guidelines				
Burn pits should be sited so prevailing winds carry smoke away from occupied areas	[b]	[b]	○	●
Monitoring requirements				
Burn pit emissions should be monitored	○	○	○	○
Monitored emissions should include: dioxins, polycyclic aromatic hydrocarbons, volatile organic compounds, carbon monoxide, hexachlorobenzene, and particulate matter	○	○	○	○
High levels of pollutants must be analyzed to determine cause and resolution	○	○	○	○
Potential exposure to unhealthy emissions should be documented	○	○	○	○
Alternatives in use				
Incinerators	●	○	●	○
Recycling program	●	●	●	●
Landfill	●	●	○	●
Prohibited items				
All hazardous waste/material	●	●	[a]	●
Petroleum, oil and lubricant products	●	●	[a]	●
Rubber	●	●	[a]	●
Tar paper	●	●	[a]	●
Asphalt shingles	●	●	[a]	●
Tires	●	●	[a]	●
Treated wood	●	●	[a]	●
Pesticides/pesticide containers	●	●	[a]	●
Asbestos-containing material	●	●	[a]	●
Coated electrical wires	●	○	[a]	●
Plastic	○	○	○	○
Aerosol cans	○	○	[a]	○
Paint	○	○	[a]	●
Batteries	●	○	[a]	○
Appliances	●	●	[a]	●
Electronics	●	○	[a]	○
Regulated medical waste	●	●	[a]	○
Unexploded ordnance	○	●	[a]	○

●= Implemented in accordance with CENTCOM Regulation 200-2

○= not implemented in accordance with CENTCOM Regulation 200-2

Source: GAO observations and analysis.

[a]KBR officials at Taji said the company does not maintain data on items burned in the Taji burn pit because it is not contractually required to do so. However, KBR employees told us they do burn plastic at Taji.

[b]Data not available. Neither our observations nor interviews with burn pit managers at these locations were able to determine the extent to which they implemented these aspects of CENTCOM Regulation 200-2.

The variability in implementation of CENTCOM's 2009 regulation at the bases we visited stems from several causes. First, environmental officials at one of the four Iraq bases we visited—Warhorse—said they were unaware of the regulation and its requirements for burn pit operations. The two servicemembers who managed the Warhorse burn pit said they used a standard operating procedure document provided to them when they began managing the burn pit in August 2009. According to one of the servicemembers, the main purpose of this guidance was to direct their dealings with contractors delivering waste to the burn pit. Without an awareness or understanding of relevant guidance, burn pit operators are severely limited in their ability to minimize the risks of exposure to potentially harmful burn pit emissions.

Second, adherence to the regulation and other guidance is difficult, according to DOD officials, because many of the supplies arriving on U.S. bases are either made of, or packaged in, materials that are prohibited from burn pits. For example, drinking water arrives in plastic bottles, shrink wrapped in plastic. We discuss procurement issues in more detail later in this report.

Third, the contractor operating the burn pits at two bases we visited did not have contracts reflecting current guidance. According to a senior representative of this firm, the *MNC-I Environmental Standard Operating Procedure 2006* is the guidance referenced in its burn pit contract. Thus the company provided Iraq burn pit management activities in the context of that guidance, which contains less stringent requirements than the CENTCOM 2009 regulation. According to the contractor's representative, the company prepared plans, which DOD reviewed and approved, based on the MNC-I 2006 guidance. However, DOD officially requested the contractor incorporate *MNC-I Environmental Standard Operating Procedure 2009* into its operations. According to Army contracting specialists, such contract modifications are typically long and tedious, often requiring months of negotiations. As of June 2010, DOD and the contractor had yet to finalize this update, at least in part because the contractor believed the new guidance would require activities beyond the scope of existing task orders.

Finally, another reason for the differences in implementation of the regulation is disparities in the resources devoted to burn pits and in the commitment shown by base commanders and environmental officers. For example, all four of the burn pits we visited had programs to sort incoming waste to avoid burning of prohibited items and to remove anything that could be used against U.S. forces. However, the amount of resources devoted to this activity varied substantially. At Al Asad, for example, a commissioned officer oversaw all burn pit and incinerator activities. At this base, an Iraqi contractor under U.S. servicemembers' supervision sorted waste before it went into the burn pit, segregating certain waste for recycling, such as large plastics, metals, wood, mattresses, rubber, and reusables (such as furniture). This process required a crew of 15 to 20 people and took all day. Some sorting also occurred before waste arrived at the burn site. For example, contractor personnel sorted dining facility waste at the dining facility; then, wet waste went directly to the landfill and recyclables went directly to the recycling area. Essentially, only dry and combustible materials, such as wood and paper, went into the Al Asad burn pit, although according to the officer-in-charge, there were a few instances when small amounts of prohibited items, such as plastic, slipped through and were burned.

Figure 4: Local Contractor's Personnel Sorting Solid Waste, Camp Taji, Iraq

Source: GAO.

In contrast, at Warhorse, a warrant officer oversaw the burn pit with a staff of five enlisted servicemembers. Warhorse did not employ local contractors to assist in sorting the daily waste. As a result, according to the warrant officer in charge, sorting the base's solid waste each day was a challenge. While they attempted to sort and segregate the waste each day, the warrant officer in charge said the job was simply too large for five people. They had no machinery or equipment with which to move the waste, so they performed a cursory visual inspection. Further, the official said that the staff had other responsibilities at the burn site; therefore, they sorted waste for only about 2 hours per day.

Our visit to Al Asad demonstrated that strong leadership and adequate resources can enhance a base's ability to meet the provisions of CENTCOM's 2009 regulation, and thereby help protect personnel from exposure to potentially harmful burn pit emissions. For example, the commissioned officer in command of Al Asad's burn pit is an environmental engineer, professionally trained for the task. None of the staff in charge of the other three burn pits we visited had such training. In addition, with the local contractor's staff, servicemembers at Al Asad had

ample personnel on site to meet most of the regulation's provisions, including the implementation of the waste disposal alternatives.

Alternatives to Open Pit Burning Include Source Reduction, Recycling, Incinerators, and Landfills, but DOD Has Not Evaluated Their Benefits or Costs

Alternative waste management practices, such as source reduction, recycling, incinerators, and land filling, are alternatives for managing DOD's wartime waste stream, decreasing its volume and potential toxicity, and reducing the potential health impacts of burn pits at U.S. bases in Afghanistan and Iraq. However, DOD has not evaluated the benefits and costs of these waste management alternatives relative to its existing practices, leading to a lack of key information to manage its solid waste.

Source Reduction, Recycling, Incinerators, and Landfills Are Alternatives to Open Pit Burning

Source reduction and recycling—also referred to as waste minimization—and the use of incinerators and landfills are alternatives for managing the waste stream, decreasing its volume and potential toxicity, and reducing the potential health impacts of burn pits.[11] Senior DOD officials and guidance we reviewed described a successful approach to solid waste management as first characterizing the waste stream to identify its contents and volumes of materials and then evaluating ways to integrate these waste management alternatives.[12] DOD guidance discourages long-term use of burn pits and encourages the use of incinerators and landfills instead. CENTCOM's 2009 regulation and Army Regulation 200-1 provide

[11]Source reduction differs from recycling as it pertains to reducing the waste stream at the source, to include procurement policies and the way products are used and reused according to the United States Army Center for Health Promotion and Preventive Medicine's (CHPPM) Technical Guidance 197, Guide for Developing Integrated Solid Waste Management Plans at Army Installations, December 1999.

[12]Waste stream characterization is the basis for all solid waste management decision-making and involves identifying each element of the waste stream, identifying the primary source of each element, and measuring the amounts generated for each, according to the U.S. Army Center for Health Promotion and Preventive Medicine, Technical Guidance 197. The Department of the Army Pamphlet 40-11 (DA Pam 40-11) states that preventive medicine personnel support the Army in integrating its solid waste management plans and solid waste characterization surveys to identify and evaluate source reduction and recycling opportunities.

definitions of waste management alternatives. Source reduction, which differs from recycling, is defined as any practice reducing the amount of contaminants entering the waste stream. Recycling is the process by which materials, otherwise destined for disposal, are collected, reprocessed or remanufactured, and eventually reused. CENTCOM's Regulation 200-2 defines an incinerator as any furnace used in the process of burning solid or liquid waste for the purpose of reducing the volume of the waste by removing combustible matter with emissions passing through a stack, duct or chimney. A solid waste landfill is defined as a discrete area of land or an excavation used to dispose of non-hazardous waste. Table 3 illustrates the solid waste management practices implemented at U.S. bases in Iraq at the time of our visit.

Table 3: Waste Management Practices at U.S. Bases in Iraq

	Al Asad	Marez	Warhorse	Taji[a]
Source reduction	O	O	O	O
Recycling				
- Scrap Metal	●	●	●	●
- Aluminum	●	●	O	O
- Plastic	●	O	O	O
- Other[b]	O	O	O	O
Solid waste incinerator(s)	●	O	O	●
Landfill/burial				
- Lined	●	O	O	O
- Not Lined	●	●	O	●
Burn pit(s)	●	●	●	●

● YES O NO

Source: GAO analysis of our site visits to U.S. bases in Iraq between January and March 2010.

[a]Military personnel from Taji contacted us after our site visit and reported that a recycling contract for plastic, wood, cardboard, aluminum, paper, small appliances, tires, construction debris, and mattresses had been approved with operations scheduled to begin in April 2010.

[b]Other includes tires, glass, wood, mattresses, appliances, and electric wire.

Although DOD has partially characterized the waste stream at Bagram, Kandahar, and Camp Victory, it has not fully characterized the waste stream at any of its bases in either Afghanistan or Iraq as outlined in Army

technical guidance.[13] DOD has also been slow in implementing waste management alternatives because other logistical and operational priorities took precedence over environmental programs, according to CENTCOM officials. Specifically, DOD has not widely implemented practices such as source reduction and recycling at its bases in either country, despite the fact that units subject to the *MNC-I* and *USFOR-A Environmental Standard Operating Procedure* issued in 2009 were strongly encouraged to implement such practices. Source reduction involves more than base command decisions; it also includes procurement policies and processes that encompass a broad and complex cast of DOD logistics and acquisition communities. Yet many of the materials from DOD's supply chain that end up in DOD's waste stream may adversely impact base commanders' efforts to minimize waste, especially waste that CENTCOM's 2009 regulation prohibits in burn pits. For example, in March 2010, CENTCOM officials said USF-I tasked a contractor to begin evaluating ways to reduce the amount of solid waste generated at base dining facilities in Iraq, such as plastic utensils, plates, and containers. The content of these materials is incompatible with DOD's guidance on burn pit requirements because of the large volume of plastic that remains in the waste stream. However, no decisions to limit procurement of these materials and reduce this waste had been made as of July 2010.

DOD's recycling practices at its bases in Afghanistan and Iraq were also limited and primarily involved large scrap metals. Our site visits to the four U.S. bases in Iraq found that only Al Asad recycled both aluminum and plastic materials in addition to scrap metal. CENTCOM officials and military personnel said that both Afghanistan and Iraq lacked markets for plastic and other recyclable materials, and military officers at one base we visited in Iraq said plastic materials from some U.S. bases in Iraq were transported to Kuwait and Lebanon for recycling. However, our review found that such markets may exist in Iraq. For example, military personnel at Al Asad said that aluminum and plastic were purchased by a Iraqi contractor and sold for profit in Iraq. Further, a May 2010 USF-I recycling plan called for initiating recycling contracts at seven bases in Iraq in

[13]U.S. Army Center for Health Promotion and Preventive Medicine Technical Guidance 197 states that waste stream characterization is the basis for solid waste decision-making at Army installations and involves identifying each element of the waste stream, identifying the primary source of each element, and measuring the amounts of each element generated.

support of USF-I's plan to eliminate the use of burn pits in Iraq.[14] These contracts are to include the recycling of aluminum, appliances, cardboard, plastic and wood materials and were expected to be implemented in September 2010, according to USF-I officials. USF-I officials reported that recycling these additional materials will reduce solid waste generated at U.S. bases by 30 percent, supporting a USF-I goal to eliminate the use of burn pits in Iraq by December 31, 2010. Table 4 identifies materials recycled at U.S. bases in Iraq as of June 2010.

Table 4: Recycled Materials at U.S. Bases in Iraq as of June 2010

Base name	Scrap metal	Aluminum	Plastic	Cardboard	Other[a]
Adder	●	●	●	O	O
Al Asad	●	●	●	O	O
Balad	●	●	●	●	O
Bucca	●	●	O	O	O
Delta	●	●	O	O	O
Echo	●	O	O	O	O
Falcon	●	●	O	O	O
Hammer	●	O	O	O	O
Kalsu	●	●	O	O	O
Marez	●	●	O	O	O
McHenry	O	O	O	O	O
Ramadi	●	●	O	O	O
Speicher	O	●	●	O	O
Sykes	●	●	●	O	O
Taji	●	O	O	O	O
Warhorse	●	O	O	O	O
Warrior	●	O	O	O	O
Victory	●	●	●	●	O

● = YES

O = NO

Source: GAO analysis of Iraq site visits and USF-I recycling data as of June 2010.

[14]U.S. bases in Iraq included in the recycling contract plan developed in May 2010 include Al Asad, Bucca, Delta, Echo, Kalsu, Irbil, Marez, and Warrior. In September 2010, USF-I awarded three recycling contracts—Al Asad, Marez, and Warrior.

[a]Other includes tires, glass, wood, mattresses, appliances, and electric wire.

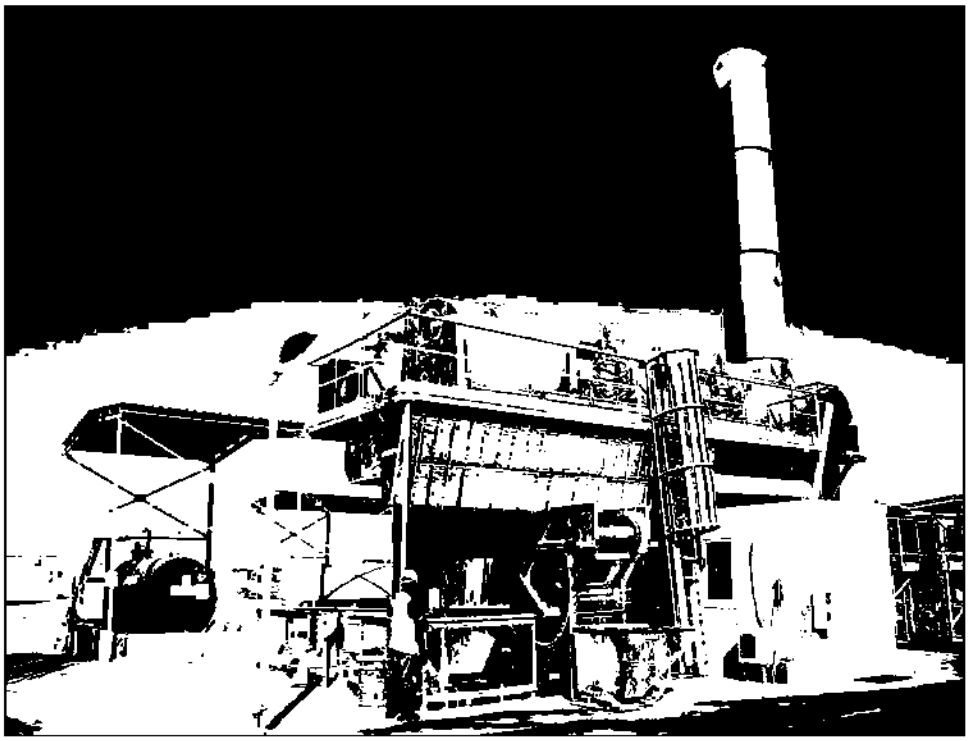
U.S. bases in Afghanistan have not developed recycling programs to the extent that such programs have been developed in Iraq. Larger bases in Afghanistan, such as Bagram Air Field and Kandahar Air Field, have implemented recycling programs for plastic bottles, aluminum cans, cardboard, paper, steel, wood, and other plastics such as flatware and cereal cups, according to USFOR-A reports. However, USFOR-A officials said that there is little recycling occurring at its other bases because they are often located in remote areas lacking an infrastructure to support markets for recycled materials. CENTCOM officials said that it is often easier to burn waste than to implement an efficient recycling program, which would include managing a sorting facility, sorting the solid waste, locating markets for recycled products, and having trained environmental officers at a base.

As mentioned above, DOD has begun relying more heavily on incinerators as an alternative to burn pits. For example, between 2005 and 2010, the number of solid waste incinerators installed in Iraq under LOGCAP grew from 2 to 39. In Afghanistan, the number increased from 1 to 20 between 2003 and 2010. According to DOD officials, incinerators are the best combustive alternative to open burn pits because of their (1) enclosed combustion chambers that provide a more complete burn, (2) ability to reduce large volumes of waste, and (3) ability to handle multiple waste streams.[15] However, despite the more controlled process for burning waste, incinerators may also produce potentially harmful emissions. There are three main types of incinerators: solid waste, regulated medical waste, and hazardous waste incinerators. Burn boxes, a type of incinerator device designed for wood waste materials, are also used at some locations. However, burn boxes differ from solid waste incinerators because they do not contain a dual combustion chamber or a stack for dispersing emissions and are not designed for solid waste, such as food or plastic.[16] Figure 5 illustrates a solid waste incinerator.

[15]Solid waste, regulated medical waste, and hazardous waste streams can be maintained separately and disposed of in separate incinerators specifically designed to handle each type of waste stream.

[16]A burn box is also referred to as an air curtain or Munson Burner.

Figure 5: Solid Waste Incinerator, Camp Al Asad, Iraq



Source: GAO.

Note: This solid waste incinerator contains a dual combustion chamber and a stack for dispersing smoke emissions, and is capable of combusting 30 tons of solid waste per day.

DOD officials reported challenges using incinerators in Afghanistan and Iraq, stating that incinerators were expensive and posed acquisition, logistical, and operational challenges. Regarding acquisition, DOD purchased more than 40 solid waste and medical waste incinerators for U.S. bases in Afghanistan and Iraq between 2003 and 2005. However, according to senior DOD officials, approximately 100 construction projects initiated under LOGCAP III were suspended by DOD in 2005, including the installation of 11 incinerators in Iraq, because DOD identified a lack of internal spending controls on LOGCAP III projects. This led to incinerators remaining uninstalled at bases in Iraq for approximately 5 years, until March 2010 when the USF-I engineer command ordered the installation of the 11 incinerators by July 2010. As of August 2010, there were 39 solid waste incinerators installed in Iraq, according to LOGCAP data. Two of the four bases we visited in Iraq had solid waste incinerators on-site, all of which were supported by LOGCAP. At Taji, solid waste

incinerators began operation in February 2009, and at Al Asad, solid waste incinerators began operation in April 2009. According to CENTCOM officials, once the United States' presence in Iraq ends, all solid waste incinerators will be transferred to the government of Iraq.

Logistically, challenges included the transportation of incinerators, the availability of land to install them, and the life-expectancy and size of a base, which fluctuates, according to senior DOD officials. For example, in Afghanistan, CENTCOM officials said that incinerators arrived by ship in Pakistan and were loaded onto contractor vehicles for delivery to U.S. bases. CENTCOM officials also reported that the lead time to get an incinerator to a U.S. base in Afghanistan ranged from 6 to 8 months, and that there were operational concerns as well. For example, once an incinerator arrived, it had to be inspected, set up, and operated by trained personnel. CENTCOM officials said that there is generally a training program for operating personnel to complete before operations begin. In addition, DOD officials said that U.S. military servicemembers did not operate incinerators, and that operations were left primarily to contractors. Senior DOD officials said that many bases conduct incinerator operations 24 hours a day.

In early 2010, USFOR-A developed plans to use incinerators at its bases in Afghanistan and, as of June 2010, there were 20 solid waste incinerators operational and 46 awaiting installation, as well as 11 burn boxes that were operational and 2 awaiting installation. DOD data also show that 114 additional solid waste incinerators should arrive incrementally in Afghanistan by the end of calendar year 2010. The types of incinerators installed at bases in Afghanistan differ from those at bases in Iraq; they are smaller, with burn rates ranging from 1 to 20 tons per day, and most are portable.[17] The portability provides USFOR-A commanders with the flexibility to relocate incinerators as bases close or as generated waste capacities fluctuate.

In Iraq, our site visits found that incinerators and burn boxes were not always operated according to CENTCOM's 2009 regulation and instead were operated according to the MNC-I guidance documents issued in 2006 and 2009. The incinerators at Taji were operated by a LOGCAP contractor under the *MNC-I Environmental Standard Operating Procedure 2006*.

[17]Burn rates for solid waste incinerators installed at U.S. bases in Iraq range from 20 to 72 tons per day.

However, the *MNC-I Environmental Standard Operating Procedure 2006* does not include specific guidance on incinerator operation and maintenance, prohibited items, or methods for testing and disposing of incinerator ash.[18] Though not required under the 2006 guidance, military personnel at Taji reported that preventive medicine personnel routinely tested the incinerator ash and submitted samples to the Army Public Health Command for laboratory analysis, assessment, reporting, and data archiving. At Al Asad, we observed that incinerators were operated in accordance with *MNC-I Environmental Standard Operating Procedure 2009*, which provides additional guidance on incinerator operation and maintenance, prohibited items, and methods for testing and disposing of ash.

USFOR-A officials and a DOD environmental plan completed in March 2009 reported that burn boxes in Afghanistan are used to combust various types of solid waste, including wet waste and wood products.[19] Burn boxes were designed to burn certain, but not all, wood products. However, CENTCOM's 2009 regulation provides that incinerators and burn boxes must be used in accordance with the manufacturers' instructions. For example, the DOD environmental study reported that burn boxes at Bagram Air Field were used to combust hundreds of tons of solid waste per day from January to July 2008. The use of burn boxes to combust solid waste conflicts with recommendations made by the CENTCOM Surgeon and the Army Public Health Command that burn boxes be replaced with incinerators designed for solid waste. The recommendation by the Army Public Health Command was the result of an environmental assessment of burn boxes at Camp Bondsteel, Kosovo, in 2001, which determined that the burn boxes used to combust wet waste and plastic materials produced air emissions that exceeded the long-term military exposure guidelines for coarse particles and concluded that burn boxes should be replaced with appropriate incinerators designed for solid waste.

Landfills can facilitate the use of incinerators by providing an alternative disposal option for certain items that hinder efficient combustion and providing a location for disposal of incinerator ash. For example, landfills are used at larger U.S. bases in Afghanistan and Iraq to dispose of solid

[18]The 2006 guidance does include a limited discussion of incinerator ash resulting from regulated medical waste.

[19]The AOR Environmental Component Plan, March 2009, was prepared for United States Army Central (USARCENT) by a DOD contractor.

waste, including ash from incinerators as well as various non-combustible items such as dining facility waste. Senior DOD officials said that disposing of dining facility waste in landfills removes the waste from burn pits and incinerators, which improves combustion. For example, military personnel at Al Asad said that dining facility waste was diverted to a landfill and reported that both the incinerators and the burn pit improved their burn efficiency as a result. In addition, DOD officials reported that larger bases also diverted the overflow of solid waste—initially sent to incinerators—to a landfill because the amount of solid waste generated at larger bases exceeded the incinerators' capacity. However, challenges with landfills include the availability of land, high water tables, scavenging, and the need for proper lining to prevent waste materials from seeping into surrounding soil and possibly contaminating ground water, according to DOD officials. Three of the four bases we visited in Iraq used a landfill to dispose of solid waste, although only Al Asad used a lined landfill.

DOD Has Not Evaluated the Benefits and Costs of Waste Management Alternatives and Compared Them with Its Existing Practices

In April 2010, as part of its requirements under the National Defense Authorization Act for Fiscal Year 2010, DOD reported to Congress that during military operations, open air burning will be the safest, most effective, and expedient manner of solid waste reduction until current research and development efforts produces better alternatives. DOD officials added that burn pits are the most cost-effective waste management practice and that incinerators are the best combustive alternative. However, DOD has not evaluated the benefits and costs of the waste management alternatives and compared them with the benefits and costs of its existing practices or taken into account all the relevant cost variables, including the environmental and long-term health impacts that burn pits could have on servicemembers, civilians, and host country nationals.

We discussed the costs of burn pits and solid waste incinerators with DOD contract management officials, military officers in both countries, and other DOD officials to determine the extent to which DOD has analyzed these costs. We determined that DOD does not have complete information on costs to procure, install, operate, and maintain incinerators during contingency operations. In addition, DOD has not comprehensively analyzed alternative waste management practices, including the short and long term costs associated with their use. For example, overall cost figures are not readily apparent in the information submitted by LOGCAP contractors because burn pit and incinerator costs are combined with other waste management costs, by site, and because these data are not centrally managed or tracked. Although the military can request that

contractors break out burn pit and incinerator cost data to facilitate cost analysis, no such analyses have been completed. Without comprehensive cost data and analysis, DOD does not have a sufficient basis to conclude that burn pits are the most cost-effective waste management practice or that incinerators are the best alternative to the use of burn pits.

DOD officials said that, during wartime, environmental planning, including the management of waste, is not always a high-priority because of the operational and logistical pressures, safety and security risks, and the overall lack of resources available initially to manage waste. Furthermore, DOD officials reported that base planning and resource investment decisions are difficult, including planning and implementing resources to manage waste, because bases are in constant flux during wartime operations.

Neither U.S. Forces in Afghanistan nor Iraq Have Monitored Burn Pit Pollutants as Directed, and the Health Impacts of Burn Pit Exposure on Individuals Are Not Well Understood

USFOR-A and USF-I have not established systems to sample or monitor burn pit emissions, as directed by CENTCOM's 2009 Regulation. While systems to monitor burn pits have not been established, preventive medicine and other personnel collected ambient air samples on many bases, some of which have active burn pits. However, in part because DOD and VA lack information on burn pit emissions and individuals' exposure to burn pits, the potential health impacts of burn pit emissions on individuals are not well understood.

Neither USFOR-A nor USF-I Monitor Burn Pit Pollutants as Required by a Key CENTCOM Regulation

Neither USFOR-A nor USF-I systematically samples burn pit air pollutants, as directed by CENTCOM's 2009 regulation. Among other things, this regulation directs the establishment of systems to sample or monitor pollutants emitted from burn pits and incinerators and the documentation of potential exposures. Further, when burn pit sampling shows high levels of certain pollutants, the regulation directs relevant officials to determine the cause and identify solutions. Additionally, the regulation identifies substances that should be considered for sampling from burn pits at least yearly. These substances and the health risks they pose as described by EPA or the Agency for Toxic Substances and Disease Registry include:

- Carbon monoxide—an odorless gas produced from burning various fuels that can cause dizziness, confusion, nausea, fainting, and death, if exposed to high levels for long periods of time, according to EPA.

- Dioxins—a class of chemicals that result from combustion and have been characterized by EPA as likely to cause cancer.

- Particulate matter 10 and 2.5—coarse and fine particle pollution described earlier.

- Polycyclic aromatic hydrocarbons—a group of chemicals that result from incomplete burning and can cause cancer in humans from long-term exposure through breathing or skin contact, according to the Agency for Toxic Substances and Disease Registry.

- Hexachlorobenzene—a chemical by-product classified by EPA as a probable human carcinogen that may also damage the liver and cause skin lesions.

- Volatile organic compounds (VOC)—gases emitted from paints, solvents, fuels, and other products that, according to EPA, may cause eye, nose, and throat irritation; headaches, loss of coordination, and nausea; and damage to the liver, kidneys, and central nervous system. Some VOCs are also suspected or known to cause cancer in humans, according to EPA.

Since 1978, DOD has recognized that burning waste in open pits is not environmentally acceptable. Some DOD guidance, such as DOD Instruction 6490.03 (2006) and the Joint Staff Memorandum MCM 0028-07 (2007), established provisions to identify and assess all potential occupational and environmental hazards, including documenting and characterizing the risks associated with potential environmental exposures. However, these documents preceded CENTCOM's 2009 regulation and do not specifically direct U.S. forces to establish systems to sample or monitor burn pit pollutants.[20]

Regarding monitoring, officials with CENTCOM and the Army Public Health Command (APHC)—one of three service health surveillance

[20]In September 2006, U.S. Forces-Afghanistan issued environmental guidance stating that American regional commanders in that country *should consider* establishing a system to monitor pollutants emitted from burn pits.

centers that provide support and technical guidance to USFOR-A and USF-I on environmental sampling—said, from a technical standpoint, monitoring burn pit emissions during contingency operations may not be possible, practical, or generally warranted from the standpoint of characterizing health risks.[21] They noted the health risk assessment process requires ambient monitoring data at the locations where people are exposed to all hazards, regardless of source, and sampling only at locations proximate to burn pits would not meet this need. Nevertheless, the CENTCOM regulation specifically directs the establishment of a sampling or monitoring system to sample or monitor pollutants emitted from burn pits, and to document potential exposures. In describing the status of monitoring efforts and related challenges, a senior DOD official said historic and current policy and guidance did not provide adequate details to ensure U.S. forces systematically collect burn pit emissions data in either country.

APHC officials also said the regulation's monitoring provisions parallel U.S. domestic environmental regulations, which focus on monitoring and ensuring compliance with specific thresholds for various pollutants.[22] However, the military does not approach emissions monitoring from that perspective. Rather, the military conducts exposure-based monitoring; that is, monitoring at locations where personnel may be exposed. To assess the potential health risk due to such exposures, the military uses Military Exposure Guidelines (MEG) which do not provide absolute limits on servicemembers' exposure to specific substances. MEGs are chemical concentrations representing estimates of the level above which certain types of health effects may begin to occur in some individuals after continuous exposure for the duration reflected by the MEG. Thus, MEGs provide guidelines for various exposure time frames and health effect severity levels based on the concentration of chemical substances detected during ambient, or outdoor, air monitoring. According to DOD technical guidance, MEGs are an important tool to assist preventive

[21]According to a senior APHC official, APHC assumed a lead role in providing CENTCOM with support and technical guidance regarding environmental exposures because APHC is comparatively larger than other service health surveillance centers, and a large number of the bases in Iraq are managed by the Army. Preventive medicine personnel may include Army or Navy preventive medicine personnel, Air Force bioenvironmental engineers, or other servicemembers assigned by commanders to perform preventive medicine tasks.

[22]Compliance monitoring is an oversight process designed to determine conformity with an environmental regulation.

medicine or other trained personnel in evaluating estimated levels of risk to servicemembers from chemical exposures during deployments.

APHC officials said that instead of establishing systems to monitor burn pit emissions, ambient air monitoring should have been required. Such information, according to the officials, could provide information on the overall air quality to which servicemembers are exposed, including emissions from burn pits. APHC officials said that when CENTCOM's 2009 regulation was being drafted, they advised CENTCOM officials that compliance monitoring of burn pits would be difficult to implement, but that their feedback was not incorporated in the final version of the regulation. Given the disconnect between the sampling methodology proposed by APHC and the requirements included in the CENTCOM regulation, it is unclear whether the appropriate sampling will be done to collect data needed to understand servicemembers' potential exposure to burn pit emissions and to identify and minimize potential health risks to servicemembers.

While Systems to Monitor Burn Pit Pollutants Have Not Been Established, Preventive Medicine and Other Personnel Have Collected Ambient Air Samples

While systems to monitor burn pit pollutants directly have not been established, preventive medicine and other personnel in Afghanistan and Iraq collected thousands of ambient air samples from at least 293 locations to conduct occupational and environmental health assessments, among other things.[23] APHC officials said ambient air samples were collected from areas where routine servicemember exposure was anticipated. APHC officials said in some instances, samples were collected near burn pits if servicemembers were continually located in the area. Although samples may be taken near the burn pit, APHC officials said it was difficult to determine whether the pollutants collected originated from burn pits or another source, such as windblown soil, auto exhaust, or nearby industrial sources. As a result, ambient air monitoring alone cannot establish burn pits' contribution to air quality problems.

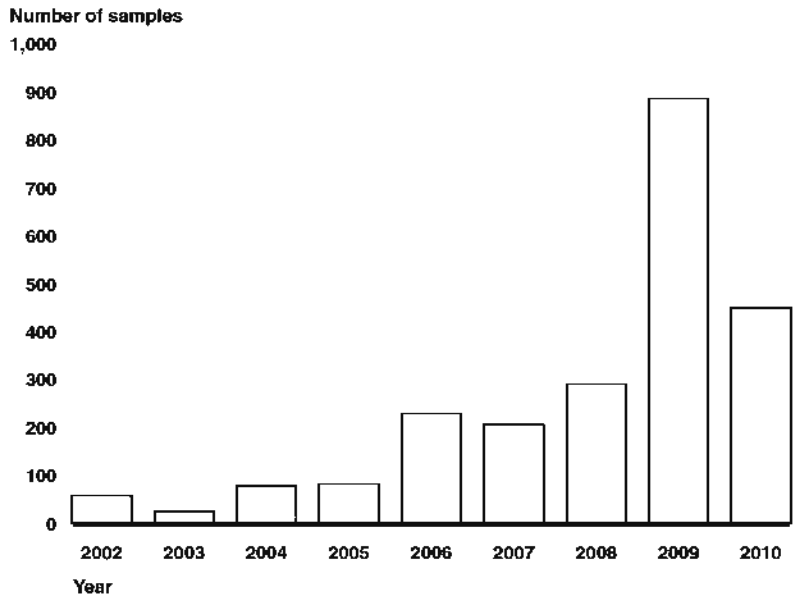
[23]Occupational and Environmental Health Site Assessments are used to identify and document exposure issues that may affect the health of deployed servicemembers. Deployment Occupational and Environmental Risk Characterizations document the identification and assessment of chemical hazards that pose potential health and operational risks to deployed servicemembers. Among other things, these assessments provide information on the sources of potential hazards; the population potentially exposed; and the sampling data (air, soil, or water) used to develop risk estimates. Given the location and time specific nature of the information and data used to develop risk estimates, the results of screening health risk assessments may not necessarily be generalizable across locations.

After ambient air samples are collected, they are sent to APHC for laboratory analysis and inclusion in the Defense Occupational and Environmental Health Readiness System (DOEHRS), an information system that stores environmental monitoring data, among other things. According to APHC officials, the specific substances and siting of the air samples collected vary by location, depending on factors such as the size of the base, potential environmental hazards, the personnel available to collect samples, and the professional judgment of the personnel involved in the sampling. If the concentrations of certain substances cause concern, preventive medicine personnel may recommend additional monitoring. Further, if a known environmental hazard, such as a burn pit, is present, APHC officials said that sampling may be adjusted to reflect the type of emissions expected from the potential hazard. For example, we reviewed air sampling data from Taji and Warhorse that the Army Center for Health Promotion and Preventive Medicine (now called APHC) collected in 2008 to help gauge the occupational and environmental health risk associated with deployments at these bases. The substances sampled at these bases differ substantially from one another.[24]

In our analysis of DOEHRS data provided in July 2010, we determined that since 2002, 2,285 ambient air samples were collected in Afghanistan, and since 2003, 5,723 ambient air samples were collected in Iraq. Figures 6 and 7 provide information on the number of ambient air samples collected in each country by year. In both countries, the largest number of ambient air samples were collected in 2009. In Afghanistan, the number of ambient air samples collected in 2009 was nearly twice the number of samples collected in 2008. In Iraq, more ambient air samples were collected in 2009 than any other year, although the difference between 2008 and 2009 was only 19 percent.

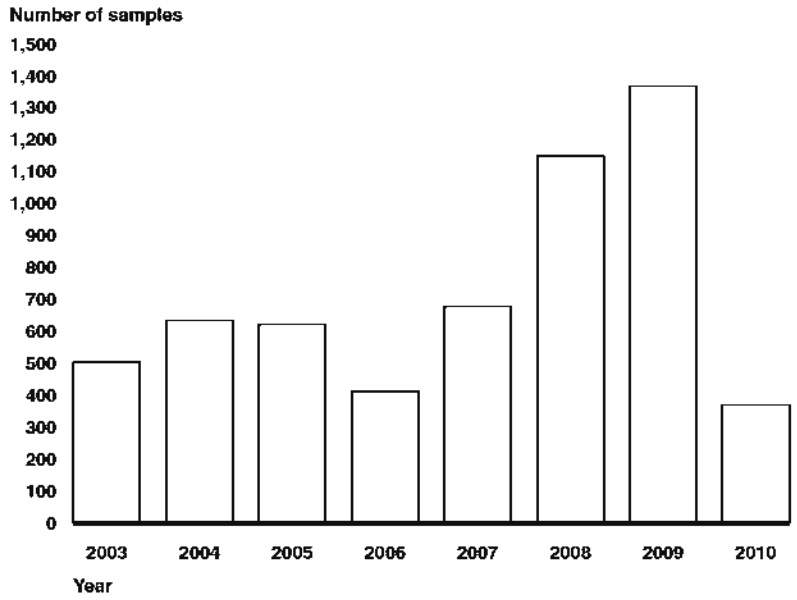
[24]At Taji, the sampled substances included carbon tetrachloride; benzene; hexane; toluene; 1,4-dichlorobenzene; ethylbenzene;1,2,4-trimethylbenzene; methylene chloride; and decane; among others. At Warhorse, the sampled substances included chromium, antimony, manganese, zinc, coarse particulate matter, arsenic, cadmium, and lead, among others.

Figure 6: Number of Ambient Air Samples Collected in Afghanistan, by Year



Source: GAO analysis of DOEHRS ambient air sampling data.

Figure 7: Number of Ambient Air Samples Collected in Iraq, by Year



Source: GAO analysis of DOEHRS ambient air sampling data.

Each ambient air sample may include various numbers and types of substances. The substances collected include volatile organic compounds, metals, and particulate matter.[25] Other substances, such as polycyclic aromatic hydrocarbons and pesticides, were also collected. At the bases we visited in Iraq, the collected substances included metals and particulate matter. These substances partially correspond to the list of potentially harmful substances that CENTCOM's 2009 regulation suggests sampling.

Our analysis of the DOEHRS data also determined that several substances listed in CENTCOM's 2009 regulation were infrequently collected, or not collected at all. For example, we determined that dioxins were collected at only two locations in Afghanistan and only one location in Iraq. According to APHC officials, there were several reasons for sampling dioxins infrequently. For example, APHC officials said this was because specially trained personnel are needed to collect those samples, the equipment used to collect the samples requires continuous power and meeting those power needs in contingency areas is difficult, and laboratory analysis of dioxin samples can cost several thousand dollars per sample. Additionally, APHC officials said that the results of a health risk assessment conducted at Joint Base Balad did not show levels of dioxins that would suggest further sampling was needed at other locations.[26] We also determined that carbon monoxide—another substance the CENTCOM regulation states should be considered for monitoring around burn pits—was not sampled in either Afghanistan or Iraq. According to an APHC official, the instrument needed to collect ambient carbon monoxide samples is sophisticated, expensive, and requires specially trained personnel to operate. Additionally, the only instrument in CENTCOM's area of responsibility was in Kuwait, although DOD said it was procuring additional carbon monoxide monitors for use in Afghanistan and Iraq.

[25]Metals, such as arsenic, can cause respiratory irritation and lung cancer among other things, depending on the level and length of time exposed. We describe the health concerns with the other substances elsewhere in this report.

[26]The APHC and the Air Force Institute for Operational Health jointly developed a health risk assessment of the ambient air associated with Joint Base Balad that was intended to collect pollutants expected to be emitted by the burn pit. Ambient air samples were collected from January 2, 2007, through April 21, 2007, and in May 2008. The substances sampled included dioxins, polycyclic aromatic hydrocarbons, volatile organic compounds, and PM10. Because of ongoing litigation, we express no view in this report on any aspect of this Balad study.

The results of ambient air sampling by APHC showed approximately 6.6 percent of the 30,516 tests for substances from the samples collected in Afghanistan exceeded relevant 1-year MEGs.[27] In Iraq, approximately 3.9 percent of 111,647 of such tests showed exceedances of relevant 1-year MEGs. According to APHC officials, exceeding a 1-year MEG in one sample or periodically over time does not necessarily imply that the servicemembers at that location will suffer negative health impacts because the MEGs were designed to protect against continuous exposures of up to 1 year in duration. Tables 5 and 6 provide the number of MEG exceedances by country and the substances sampled, and show that levels of fine and coarse particles almost always exceeded 1-year MEGs. Importantly, fine particles—which can become deeply embedded in lung tissue and are associated with numerous health conditions described above—were the substance that most often exceeded the MEG.

Table 5: Number and Percentage of MEG Exceedances in Afghanistan by Analyzed Substance

Substance name	Number of MEG exceedances per substance	Total times substance tested	Percentage of tests that exceeded MEGS
Coarse particles	1,117	1,223	91.3
Fine particles	883	915	96.5

Source: GAO analysis of DOEHRS ambient air sampling data.

Notes: Includes samples from sites with and without burn pits. In addition to the substances listed above, several substances exceeded MEGs less than 10 times: acrolein, benzene and manganese.

Table 6: Number and Percentage of MEG Exceedances in Iraq by Analyzed Substance

Substance name	Number of MEG exceedances per substance	Total times substance tested	Percentage of tests that exceeded MEGS
Coarse particles	3,183	3,373	94.4
Fine particles	980	1,009	97.1
Acrolein	62	181	34.3
Benzene	34	956	3.6
Lead	21	4,330	.5

[27]According to DOD, all relevant 1-year MEGs represent those levels of exposure at which negligible health effects are expected.

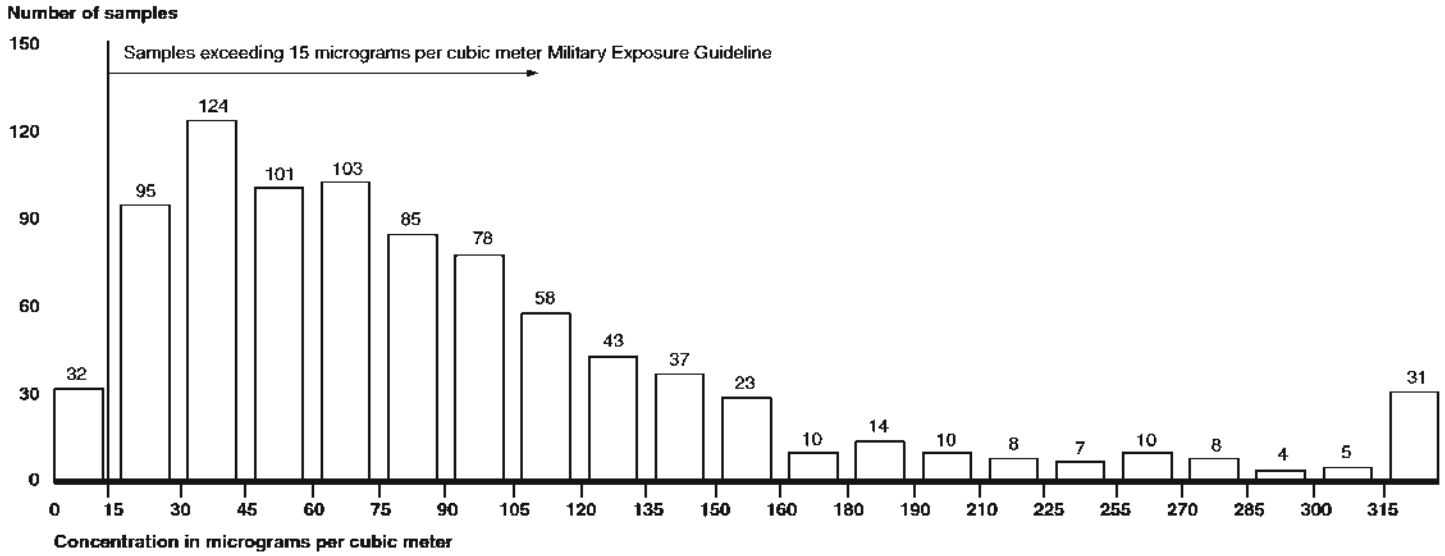
Substance name	Number of MEG exceedances per substance	Total times substance tested	Percentage of tests that exceeded MEGS
Vanadium	15	4,329	.35
Manganese	11	4,329	.25

Source: GAO analysis of DOEHRS ambient air sampling data.

Notes: Includes samples from sites with and without burn pits. In addition to the substances listed above, several substances exceeded MEGs less than 10 times: 1,2-Dibromo-3 Chloropropane, antimony, arsenic, barium, beryllium, cadmium, chromium, Hexachlorobutadiene, Hexane, Naphthalene, nickel, and Vinyl acetate.

Figures 8 and 9 illustrate the distribution of fine particle test results relative to the MEG, and show that many test results from sampling in each nation exceeded the MEG by a substantial margin.

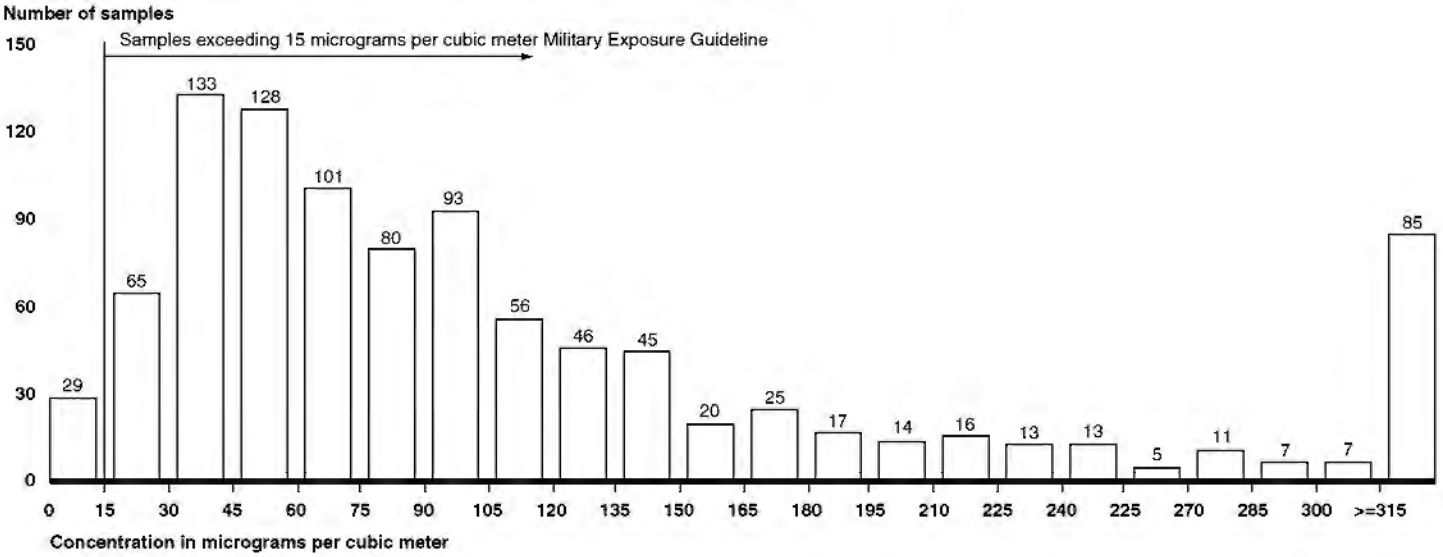
Figure 8: Fine Particle Test Results in Afghanistan Relative to Military Exposure Guidelines



Source: GAO analysis of DOEHRS ambient air sampling data.

Notes: Height of bars indicates number of samples between indicated concentration levels. Includes samples from sites with and without burn pits.

Figure 9: Fine Particle Test Results in Iraq Relative to Military Exposure Guideline



Source: GAO analysis of DOEHRS ambient air sampling data.

Note: Height of bars indicates number of samples between indicated concentration levels. Includes samples from sites with and without burn pits.

DOD and VA Did Not Have Information on Individuals' Exposure to Burn Pits

DOD does not systematically collect detailed information regarding individual servicemembers' burn pit exposure. Similarly, VA does not focus on collecting or tracking health outcomes associated with exposure to burn pits. In the absence of data and information on burn pit emissions and individuals' burn pit exposure, the potential health impacts of burn pit emissions on individuals are not well understood.

According to DOD guidance, it is the military's responsibility to document and evaluate occupational and environmental health hazards during deployments, which includes accomplishing specific health surveillance activities before, during, and after deployments.[28] Such surveillance includes identifying the population at risk through questionnaires and blood and other samples and recognizing and assessing potentially

[28]Joint Staff Memorandum MCM 0028-7; DOD Instruction 6490.03. Health surveillance is the regular or repeated collection, analysis, and interpretation of health-related data to identify and monitor potential health risks to a population and inform interventions to prevent, treat, or control disease and injury.

hazardous health exposures and conditions, among other things.[20] Table 7 provides examples of the military's health surveillance activities.

Table 7: Examples of Selected Health Surveillance Activities Executed by Force Commanders or the Armed Services

Deployment phase	Activity
Before deployment	• Draft a deployment health risk assessment that identifies deployment specific health threats and appropriate protective measures. • Ensure servicemembers complete pre-deployment health questionnaires. • Collect blood samples from servicemembers for inclusion in the DOD serum repository.
During deployment	• Develop and implement plans to inform servicemembers of health threats and countermeasures. • Conduct occupational and environmental health site assessments at locations such as bases, to identify sources of hazardous exposures that may affect the health of personnel. • Document exposures and related monitoring data in servicemembers' deployment health records.
After deployment	• Ensure servicemembers complete post-deployment health questionnaires and that questionnaires are reviewed by a medical provider, who refers servicemembers for additional care as needed. • Collect post-deployment blood samples from servicemembers who were sampled before deployment for inclusion in the DOD Serum Repository. • Provide debriefings that, among other things, inform servicemembers of occupational or environmental exposures they may have experienced.

Source: GAO analysis of DOD health surveillance guidance.

Servicemembers may document exposure to burn pit emissions in several ways. For example, their responses to questions in post-deployment health questionnaires, which have a question related to environmental exposures, can establish a possible exposure to such emissions. In addition to health surveys, servicemembers may report any health issue they think resulted from an environmental exposure, including burn pits, to their military medical provider for documentation in the servicemembers' medical record. However, these surveillance efforts do not collect data on specific individuals' level of exposure to burn pit emissions. Senior DOD officials said that systematically collecting data on individual level exposures would require servicemembers to wear a collection device—which they said is beyond current technological capability. Senior VA officials said its efforts to properly care for veterans and handle their claims would be enhanced if DOD collected more individual, or population-level, data on

[20]DOD Instruction 6490.03.

exposure to burn pits.[30] According to senior VA officials, such data are needed to understand the link between environmental exposures and health outcomes.

According to VA officials, there are no VA health surveillance activities that focus on collecting or tracking health outcomes associated with veterans' potential exposure to burn pits. According to a senior VA official, its surveillance of emerging health issues is driven by concerns veterans report at its healthcare centers. Veterans' potential exposure to burn pits may be documented through encounters with the VA health care system when veterans receive acute or routine medical care. However, enrollment in VA health care is optional, and not all veterans choose to participate. Additionally, veterans who served in Iraq or at locations that support Operation Iraqi Freedom may report concerns regarding environmental exposure, including to burn pits, through the Gulf War Registry. The registry is a data system established after the first Gulf War to identify possible diseases resulting from military service in areas of Southwest Asia. Participation in the registry is voluntary, and not all Gulf veterans choose to participate. Additionally, VA officials said they were developing a survey, which it will administer to about 60,000 randomly selected veterans in 2010, that seeks to identify health concerns among Operation Enduring Freedom and Iraqi Freedom veterans and will provide veterans with an opportunity to report any concerns they have regarding environmental exposures, including burn pits. VA officials said they expect the survey's results to be available in 2011.

DOD and VA Have Sponsored Studies to Better Understand the Health Impact of Servicemembers' Exposure to Burn Pit Emissions

The U.S. Army Center for Health Promotion and Preventive Medicine (now the Army Public Health Command) and the Air Force Institute for Operational Health (now the U.S. Air Force School of Aerospace Medicine) jointly conducted the studies of Joint Base Balad, described earlier, in response to concerns expressed by servicemembers about the possible health impacts of their exposures to burn pit emissions and to gain a better understanding of the situation at Balad. As noted above, we express no view in this report on the Balad studies because of ongoing litigation.

[30]VA officials suggested that data collection efforts could target populations that are more frequently exposed to burn pits, such as servicemembers posted to guard towers adjacent to burn pits.

Other studies have been initiated in response to concerns over servicemembers' exposure to burn pit emissions expressed by Congress, the VA, and DOD leadership. For instance, in October 2009, the Acting Deputy Assistant Secretary of Defense for Force Health Protection and Readiness directed the Armed Forces Health Surveillance Center (AFHSC) to assist in efforts to understand the health effects associated with exposure to burn pit smoke by conducting additional epidemiological studies. In response to this directive, AFHSC expects to release a report in fall 2010 that presents the findings of several studies on burn pit exposure. One of these studies will compare acute and long-term health care utilization among servicemembers deployed to Korea, at one of four locations within CENTCOM, and the health care utilization of never-deployed servicemembers based in the continental United States. The outcomes the study will examine include:

- post deployment visits with medical staff for respiratory, circulatory and cardiovascular disease, ill-defined conditions, and sleep apnea;
- self-reported responses on post-deployment health assessments forms; and
- visits with medical staff for respiratory conditions while deployed in the CENTCOM area of responsibility.

AFHSC is using data from DOD's Defense Medical Surveillance System and the Theater Medical Data Store, a medical information system that provides access to servicemembers' battlefield medical treatment records, among other things.

As another part of AFHSC's fall 2010 report, the Naval Health Research Center (NHRC) will compare health outcomes in servicemembers who were exposed to burn pits at Joint Base Balad, Contingency Operating Base Speicher, and Camp Taji; and servicemembers who had not been exposed to burn pits.[31] The health outcomes this study will examine include:

[31]The study defined servicemembers as exposed if they were known to have served at least one deployment within a 5-mile radius of the Joint Base Balad, Coalition Operating Base Speicher, or Camp Taji burn pit.

- birth outcomes in offspring of military personnel;
- chronic and newly reported respiratory symptoms and conditions;
- chronic multisymptom illness; and
- the incidence of newly reported lupus and rheumatoid arthritis.[32]

Regarding the first health outcome, NHRC will use data from DOD's Birth and Infant Health Registry, which collects data to establish the prevalence of birth defects and evaluate the associations of various birth outcomes with specific exposures, such as deployment, among infants born to military families. NHRC will also rely on data from the Millennium Cohort Study to examine the three other health outcomes. The Millennium Cohort Study is an ongoing DOD evaluation of the long-term health impacts of military service and has 140,000 participants who are active duty and Reserve or Guard servicemembers.

In addition, officials from the APHC, U.S. Air Force School of Aerospace Medicine, the Navy and Marine Corps Public Health Center, and Naval Health Research Center are collaborating on an environmental health air surveillance plan to better understand the health risks of burn pits to servicemembers at specific locations in Afghanistan and Iraq. According to APHC officials, the purpose of the environmental health surveillance plan is to help quantify health risks from the air quality at particular locations with burn pits, but is not intended to provide a definitive determination of the burn pit-specific contribution to the overall health risk or to generate data to predict the future health of individual servicemembers. In July 2010, DOD officials said that prospective locations in Afghanistan have been selected for the environmental health surveillance plan. APHC officials said they anticipate implementing the environmental health surveillance plan at the selected locations in early 2011. After implementing the environmental health surveillance plan and adjusting it based on lessons learned, APHC officials said the plan could be adapted to other locations.

Finally, according to senior VA officials, the VA commissioned the Institutes of Medicine to study and issue a report by spring 2011 on the

[32]Chronic Multisymptom Illness is the presence, for 6 months or longer, of one or more the following: general fatigue, mood and cognitive abnormalities, and musculoskeletal pain.

potential health impacts of burn pit exposure. As of June 2010, the scope of the Institute of Medicine study had not been defined. However, in its charge to the Institute of Medicine, the VA encouraged the Institute to examine the impacts of burn pits throughout Afghanistan and Iraq.

Conclusions

The Department of Defense and its forces in Afghanistan and Iraq have increased their attention to solid waste management and disposal in both conflicts in recent years, including issuing comprehensive guidance on burn pit operations and pursuing some alternatives, such as installing incinerators at some bases. However, burn pits remain a significant waste disposal method in each conflict and the overall incidence of exposure of service personnel, contractors, and host country nationals to burn pits and any related health outcomes is unclear. This is largely because of the expedience of burn pits, a lack of awareness of current guidance, and the fact that some contracts for burn pit operators do not reflect the most recent guidance. Furthermore, the fact that DOD and its forces in Afghanistan and Iraq have not implemented a more comprehensive air sampling and monitoring plan leaves DOD and other affected stakeholders without the benefit of potentially useful information on emissions that could help in characterizing risks from burn pit emissions and possibly determining whether pollutants detected in ambient monitoring stem from burn pits or other sources. Progress in implementing this plan and better understanding any health risks from burn pits has been hindered by unresolved concerns among Army public health officials about the feasibility of adhering to CENTCOM's provisions for burn pit sampling and monitoring. In addition, by not characterizing its waste stream to identify its contents and opportunities for decreasing its toxicity and volume, DOD lacks information necessary to better incorporate waste minimization alternatives such as source reduction and recycling. Finally, while DOD has made limited progress in implementing alternatives to open pit burning, such as the installation of incinerators and new recycling contracts, it has not analyzed the feasibility or benefits and costs of alternatives relative to those of its current practices. As a result, DOD lacks the information it needs to make informed decisions about waste management practices that efficiently and effectively achieve public health objectives.

Recommendations for Executive Action

To help DOD decrease environmental health risks to service personnel, contractors, and host country nationals, GAO is making six recommendations to the Secretary of Defense. Specifically, GAO

recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to:

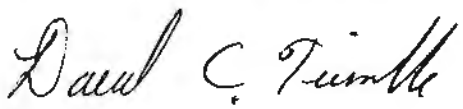
- Comprehensively implement relevant guidance related to burn pit management and operations.
- Review and update contracts for burn pit operations to ensure that they reflect the most recent guidance.
- Monitor burn pits in accordance with current guidance or, if current guidance needs revision or is insufficient, direct CENTCOM to consult with the Office of the Secretary of Defense and other relevant parties to revise or develop the necessary guidance.
- Analyze the waste stream generated by U.S. forces in each conflict and seek to identify opportunities for using materials that are less hazardous when burned and strategies for minimizing waste.
- Improve their adherence to guidance on solid waste management practices and further pursue waste prevention through the re-use and recycling of materials.
- Analyze the relative merits—including the benefits and costs—of alternatives to open pit burning, taking into account important considerations such as feasibility and the potential health effects of open pit burning.

Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Defense and the Department of Veterans Affairs. In its written response, included as appendix II, DOD said that it concurred with five of the six recommendations and partially concurred with the recommendation that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to monitor burn pits in accordance with current guidance. In commenting on the report, DOD said that guidance for burn pit operations affects all combatant commands—not just U.S. Central Command—and that Central Command and the Army Public Health Command should consult with the Office of the Secretary of Defense if current guidance for monitoring burn pits requires revision. We agree with involving the Secretary of Defense in any such changes to guidance for monitoring burn pits and revised the recommendation accordingly. DOD also provided technical comments, which we addressed as appropriate. The Department of Veterans Affairs said they appreciated the opportunity to comment on the draft and had no comments.

We are sending copies of this report to the appropriate congressional committees, Secretaries of Defense and Veterans Affairs, and other interested parties. In addition, the report will be available at no charge on GAO's Web site at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or trimbled@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



David C. Trimble
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

This report addresses the following objectives: (1) determine the extent to which the U.S. military installations in Afghanistan and Iraq have used open pit burning and adhered to guidance governing their use; (2) identify alternatives to open pit burning and the extent to which the Department of Defense (DOD) evaluated these alternatives; and (3) determine the extent to which U.S. forces have monitored the air quality, exposures, and potential health impacts of burn pit emissions in accordance with relevant guidance.

To address the first objective, we reviewed relevant DOD guidance and U.S. military base records from 2001 to April 2010. From January to March 2010, we also visited four burn pit sites in Iraq—Al Asad, Marez, Taji, and Warhorse—to determine the degree to which burn pit operators adhered with guidance governing the use of burn pits at those sites. We observed burn pit operations and interviewed military officials, preventive medicine personnel, and contractors at each site visited. In addition, we reviewed inspection reports conducted by the Defense Contract Management Agency for each of the four sites. We considered several factors when selecting the locations of our site visits, such as the number of personnel at each installation, whether the burn pit was managed by the military or a contractor, whether an incinerator was present, and our ability to safely access the location. Our findings from the site visits are not generalizable to the other bases we did not visit. We also attempted to observe burn pit operations in Afghanistan, using the U.S. Central Command's most recent list of active burn pits to select several potential sites, including Bagram Air Base, among others. In December 2009 when we arrived at Bagram to conduct observations, U.S. military personnel told us the burn pit was closed. However, we later learned this information was incorrect, as the Bagram burn pit remained operational until February 2010. Because of this and because of security and logistical issues, we were unable to observe burn pit operations in Afghanistan.

To address the second objective, we reviewed DOD guidance and planning documents on current and future uses of alternatives to open pit burning, DOD waste disposal studies, and relevant literature. We also observed burn pit alternatives during our site visits in Iraq and discussed these alternatives and their potential for future use with DOD officials and contractors. In addition, we interviewed DOD officials in the United States regarding alternatives to burn pits in Afghanistan and Iraq, locations where the U.S. military uses such alternatives, and the trade-offs of using alternatives.

To address the third objective, we analyzed data from the Defense Occupational and Environmental Health Readiness System on ambient air sampling in Afghanistan and Iraq conducted from 2002 through 2010. We assessed the reliability of these data by (1) performing electronic testing of required data elements, (2) reviewing existing information about the data and the system that produced them, and (3) interviewing agency officials knowledgeable about the data. We determined that the data were sufficiently reliable for the purposes of this report. In addition, we analyzed DOD air sampling, health risk characterization, and health surveillance documents; as well as documents from the Department of Veterans Affairs (VA), which provides healthcare and other benefits to veterans and their families, on health surveillance efforts. We also interviewed DOD officials regarding air sampling efforts and officials from VA and DOD regarding efforts to study the potential health impacts of burn pit emissions.

Lawsuits have been filed in federal court in at least 43 states in which current and former servicemembers have alleged, among other things, that a contractor's negligent management of burn pit operations, contrary to applicable contract provisions, exposed them to air pollutants that subsequently caused serious health problems. [1] The contractor has moved to dismiss the suits, arguing, among other things, that it cannot be held liable for any injuries that may have occurred to service personnel because all its burn pit activities occurred at the direction of the military. We express no view in this report on any issue in this pending litigation involving burn pits. Moreover, because of the pending litigation, we did not evaluate whether the contractor has complied with the terms of its contract with respect to burn pit operations.

We conducted this performance audit from September 2009 to October 2010, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[1]For preliminary purposes, the suits have been consolidated in the federal district court in Maryland. *In re KBR Burn Pit Litigation*, Civ. No. 09-2083 (D. Md.).

Appendix II: Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

OCT 0 5 2010

Mr. John Stephenson
Director, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Stephenson:

Thank you for the opportunity to provide DoD comments to the GAO Draft Report, GAO-10-942, "AFGHANISTAN AND IRAQ – DOD Should Improve Adherence to Its Guidance on Open Pit Burning and Solid Waste Management," dated September 2010 (GAO Code 361123).

We provide in the enclosure the DoD responses to the GAO recommendations. We partially concur with recommendation #3. If current guidance concerning monitoring burn pits needs revision, we would direct U.S. Central Command to seek additional guidance from the Office of the Secretary of Defense. We concur with all other recommendations.

We also provide in the enclosure the DoD recommended changes to the GAO report language to improve clarity and accuracy. We ask that GAO accept these changes.

Sincerely,

Dorothy Robyn
Deputy Under Secretary of Defense
(Installations and Environment)

Enclosures:
As stated

GAO DRAFT REPORT DATED SEPTEMBER 1, 2010
GAO-10-942 (GAO CODE 361123)

"AFGHANISTAN AND IRAQ: DOD SHOULD IMPROVE ADHERENCE TO ITS GUIDANCE ON OPEN PIT BURNING AND SOLID WASTE MANAGEMENT"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to comprehensively implement relevant guidance related to burn pit management and operations.
(See page 48/GAO Draft Report.)

DoD RESPONSE: Concur. Office of the Secretary of Defense staff visited U.S. Central Command (USCENTCOM) Headquarters in August 2010 and confirmed that USCENTCOM is comprehensively implementing relevant guidance for U.S. Forces in Iraq and Afghanistan.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to review and update contracts for burn pit operations to ensure that they reflect the most recent guidance
(See page 48/GAO Draft Report.)

DoD RESPONSE: Concur. Army Material Command (AMC) reviewed its Logistics Civil Augmentation Program (LOGCAP) contracts for Afghanistan and found that the statements of work for those contracts referred to outdated guidance. AMC subsequently issued a letter of Technical Direction directing contractors to comply with the latest guidance. U.S. Forces are transitioning away from burn pit usage in Iraq, making a review of relevant contract language unnecessary.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to monitor burn pits, in accordance with current guidance, or if current guidance needs revision, direct U.S. Central Command to collaborate with the Army Public Health Command and other relevant entities to propose alternative methods to monitor burn pit emissions, and amend the relevant guidance
(See page 48/GAO Draft Report.)

DoD RESPONSE: Partially Concur. Guidance for burn pit operations affects future operations for all Combatant Commands and is more appropriately issued by the Office

of the Secretary of Defense rather than CENTCOM. This recommendation should be restated as: "Monitor burn pits, in accordance with current guidance. If guidance is found to be insufficient, seek additional guidance from the Office of the Secretary of Defense."

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to analyze the waste stream generated by U.S. forces in each conflict and seek to identify opportunities for using materials that are less hazardous when burned and strategies for minimizing waste.
(See page 48/GAO Draft Report.)

DoD RESPONSE: Concur. This recommendation will potentially affect unit Tables of Organization and Equipment, Basic Supply Loads, and logistical lines of operations.

RECOMMENDATION 5: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to improve their adherence to guidance on solid waste management practices and further pursue waste prevention through the re-use and recycling of materials.
(See page 48/GAO Draft Report.)

DoD RESPONSE: Concur. The Defense Reutilization and Marketing Service and the Army Material Command are improving solid waste management practices and establishing their own re-use and recycling programs in Iraq and Afghanistan, where opportunities for recycling in the local economies are limited.

RECOMMENDATION 6: The GAO recommends that the Secretary of Defense direct U.S. forces in Afghanistan and Iraq to analyze the relative merits—including the benefits and costs—of alternatives to open pit burning, taking into account important considerations such as feasibility and the potential health effects of open pit burning.
(See page 48/GAO Draft Report.)

DoD RESPONSE: Concur. The Army is currently in the preliminary stages of considering the inclusion of deployable incineration equipment in future unit Tables of Organization and Equipment. If implemented, the availability of such equipment would represent a major change in the handling of solid waste at the unit level.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Michael Hix (Assistant Director), Johana Ayers, John Bumgarner, Seth Carlson, Carole Coffey, Timothy Di Napoli, Phillip Farah, Quindi Franco, Cindy Gilbert, Melissa Hermes, Justin Jaynes, Richard Johnson, Joy Myers, Alison O'Neill, Mark Pross, Minette Richardson, Kiki Theodoropoulos, and Eugene Wisnoski made key contributions to this report.

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