

Civilian Research Project USAWC Fellow

Identifying and Reducing Health Risks Associated with Open-Air Burn Pits

by

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United States Army War College
Class of 2013

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE (DD-MM-YYYY) xx-04-2013		2. REPORT TYPE CIVILIAN RESEARCH PROJECT		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Identifying and Reducing Health Risks Associated with Open-Air Burn Pits				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Lieutenant Colonel James B. Kyle, III United States Army				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) The Honorable Katherine Hammack ASA (Installations, Energy, and Environment)				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Mr. Brent Bankus U.S. Army War College, 122 Forbes Avenue, Carlisle, PA 17013				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Distribution A: Approved for Public Release. Distribution is Unlimited.					
13. SUPPLEMENTARY NOTES Word Count: 4973					
14. ABSTRACT DOD maintains the evidence is inconclusive regarding whether exposure to burn pit emissions creates a long-term health risk for deployed personnel. Contrary to this position, several military professionals maintain the evidence is clear. An Air Force physician at Balad Air Base concurred with a 2006 memorandum and stated: "In my professional opinion, the known carcinogens and respiratory sensitizers released into the atmosphere by the burn pit present both an acute and a chronic health hazard to our troops and the local population." A 2011 memorandum from an Army Officer cited evidence that air quality on Bagram Air Field was "unhealthy" and concluded that the primary contributor was the burn pit. He also listed potential long-term health risks associated with long-term exposure to air conditions such as those found on Bagram. The 2011 memorandum led to a Congressional inquiry and passage of Public Law 112-260 directing the VA to establish an "Open Air Burn Pit Registry." This paper will examine studies on exposure to open-air burn pits, look at the recent legislation and potential ramifications for the VA system, and will conclude with a review of technology that might be implemented to abolish open-air burn pits.					
15. SUBJECT TERMS Burn Pit Registry, incinerator, gasification, recycling, composting, particulate matter.					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 30	19a. NAME OF RESPONSIBLE PERSON
a. REPORT UU	b. ABSTRACT UU	c. THIS PAGE UU			19b. TELEPHONE NUMBER (Include area code)

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Abstract

Title: Identifying and Reducing Health Risks Associated with Open-Air Burn Pits

Report Date: April 2013

Page Count: 30

Word Count: 4973

Key Terms: Burn Pit Registry, incinerator, gasification, recycling, composting, particulate matter.

Classification: Unclassified

DOD maintains the evidence is inconclusive regarding whether exposure to burn pit emissions creates a long-term health risk for deployed personnel. Contrary to this position, several military professionals maintain the evidence is clear. An Air Force physician at Balad Air Base concurred with a 2006 memorandum and stated: "In my professional opinion, the known carcinogens and respiratory sensitizers released into the atmosphere by the burn pit present both an acute and a chronic health hazard to our troops and the local population." A 2011 memorandum from an Army Officer cited evidence that air quality on Bagram Air Field was "unhealthy" and concluded that the primary contributor was the burn pit. He also listed potential long-term health risks associated with long-term exposure to air conditions such as those found on Bagram. The 2011 memorandum led to a Congressional inquiry and passage of Public Law 112-260 directing the VA to establish an "Open Air Burn Pit Registry." This paper will examine studies on exposure to open-air burn pits, look at the recent legislation and potential ramifications for the VA system, and will conclude with a review of technology that might be implemented to abolish open-air burn pits.

Identifying and Reducing Health Risks Associated with Open-Air Burn Pits

The military's use of open-air burn pits in Iraq and Afghanistan has recently received much attention in the popular press and on Capitol Hill. Many servicemembers and civilians claim that exposure to open-air burn pits has caused serious illness. This article discusses the ongoing controversy over the military's use of open-air burn pits, studies of health effects of exposure to smoke and particulate matter from open-air burn pits during operational deployments, and makes recommendations on how to reduce our solid waste and curtail our dependency on open-air burn pits as a method of disposal of our solid waste.

Current and former military members filed lawsuits in federal court in at least 43 states alleging that a contractor's negligent management of open-air burn pits exposed them to air pollutants that subsequently caused serious health problems.¹ The 112th Congress of the United States passed Bills titled the "Open Burn Pit Registry Act of 2011" directing the U.S. Department of Veterans Affairs (VA) to establish an open air burn pit registry, update members on developments, and contract with an independent scientific organization to study the Defense Department's efforts to collect and track air quality in forward-deployed areas.² President Obama signed this legislation into law on January 10, 2013 as Public Law 112-260. Numerous professional committees have been formed and activities tasked to study the health consequences of exposure to open-air burn pits.³ Peer reviewed articles have been published in numerous professional journals including The New England Journal of Medicine, and an entire special issue of the Journal of Occupational and Environmental Medicine was devoted to the "Health Effects of Deployment to Afghanistan and Iraq."⁴ This article examines several of those studies and publications regarding the health effects of exposure to

open-air burn pits as well as the health effects of deployment to Afghanistan and Iraq with no documented open-air burn pit exposure. This article also briefly discusses the recent legislation and potential ramifications for the VA medical system and concludes with a review of technology or practices that might be implemented to abolish open-air burn pits along with the potential problems for those technologies or practices.

What has Changed with the Burn Pits in Iraq and Afghanistan?

United States Forces – Afghanistan (USFOR-A) ordered open burning to cease by 1 July 2013 for bases that exceed a population of 100 personnel.⁵ These restrictions are in direct contrast to the open burning of trash that has been practiced for centuries. In fact, CENTCOM Regulation 200-2 acknowledges “[o]pen-air burn pits are likely to be used, under certain circumstances, as a necessary method to destroy and reduce the volume of solid waste during contingency operations.”⁶ So, what is the problem? What has changed?

When I enlisted in the Tennessee Army National Guard in 1987, I was issued two canteens, whereas, upon arriving in Iraq in 2004, I was shown the location of containers full of pallets filled with 1.5 liter plastic bottles of water. Each pallet was shrink wrapped in plastic. I was also shown the location of our dining facility, where we ate off plastic plates with plastic utensils and drank from Styrofoam cups. The way America goes to war has changed. These changes have brought many of the comforts of home to the servicemember in the field. However, it has also exacerbated the problem of what to do with the mounds of solid waste generated by servicemembers in the field.

CENTCOM Regulations

The United States Central Command (CENTCOM) is responsible for military operations in Afghanistan and Iraq. CENTCOM previously estimated that “[b]ase camps in contingency operations generate between 9 to 12 lbs per person per day of solid waste.”⁷ CENTCOM Regulation 200-2 defines a base camp as a location that has a population of greater than 100 United States personnel including contract personnel working for the United States.⁸ This regulation directs base camp environmental officers to: “Plan for the disposal of [solid waste] SW (landfills, burn pits, incinerators and recycling yards) and take into account future camp expansion. The SW plan will facilitate environmental compliance and consider relevant force health protection issues.”⁹ The regulation further directs environmental officers to “[d]evelop an operation (i.e. burn pit, landfill, and/or incinerators) to properly dispose of non-reusable SW. If a burn pit is used, develop a plan to transition from this method as the camp matures and population increases. Burning waste in burn pits gives off toxic fumes that can affect the life, health and safety of USCENTCOM and coalition forces.”¹⁰ This regulation goes on to state: “Burn pits are typically utilized as contingency operations bases are first stood up. The burn pits must be replaced by alternative disposal methods (e.g. incineration, landfill, recycling, composting, Host Nation disposal, or a combination of methods) when contractor support has been provided to the base. Bases that exceed a population of 100 personnel for more than 90 days will begin planning for LOGCAP [Logistics Civil Augmentation Program] or other contracted waste management as long as the LEC [Lead Environmental Component] has determined the contractors have the capability to manage the waste properly.”¹¹ Later, the regulation further directs: “Once LOGCAP has started supporting a base, waste management will be one of the mandatory services. If

incinerators are the technology of choice for the base, LOGCAP contractors will ensure they are in place and operational 365 days after the LOGCAP support begins.”¹² These directions and timeline offer much improved guidance over the previous version of the regulation which declared open burning as “the most convenient method of waste disposal initially as base camps are established,” and went on to state simply that “[t]he disposal method must shift to incineration as camps mature.”¹³

The regulation also prohibits many items from being burned in a burn pit. These prohibited items are known as “covered waste” as defined by Department of Defense Instruction number 4715.19.¹⁴ Covered waste includes prohibited items such as: petroleum, oils, lubricants, tires, treated wood, batteries, plastic, and foam tent material.¹⁵ Hazardous waste and medical waste are also considered covered waste and are prohibited from being burned in a burn pit.¹⁶ However, the U.S. Government Accountability Office (GAO) found that prior to 2009 “regulated medical waste, hazardous waste, and substantial quantities of plastic, were routinely disposed on in burn pits.”¹⁷

The revised CENTCOM 200-2 now mentions composting in addition to recycling as ways to reduce the amount of solid waste. The regulation states that “[r]ecycling is encouraged in order to reduce the amount of SW generated and to decrease the environmental footprint of the base.”¹⁸ Additionally, “[c]omposting is another method of reducing waste volume and providing a useable product to the base or local nationals to add nutrients to improve the soil.”¹⁹ While recycling and composting does require additional manpower, the benefits may be substantial through the reduction in volume of solid waste and earning good will with the local nationals.

Burn Pit Litigation

Operation of the open air burn pits in Iraq and Afghanistan led to the filing of fifty-seven separate complaints against Defendants KBR, Inc., Kellogg Brown & Root Services Inc., Kellogg Brown & Root LLC, and Halliburton Company (collectively “Defendants”).²⁰ The Plaintiffs, the majority of which are military personnel, sued Defendants to recover “for injuries they claim to have suffered as a result of alleged exposure to emissions from burn pits and to contaminated water at military bases at literally hundreds of locations throughout Iraq and Afghanistan.”²¹ All of the separate lawsuits were consolidated and transferred to the United States District Court for the District of Maryland. On February 27, 2013, this Court filed a Memorandum Opinion dismissing all of the Plaintiffs’ claims against the Defendants.²² In its Opinion, the Court stated: “In the final analysis, it is the national interest that dictates dismissal of all of the cases now pending before this Court. The critical interests of the United States could be compromised if military contractors were left ‘holding the bag’ for claims made by military and other personnel that could not be made against the military itself. The ability of the military to recruit contractors and their willingness to assist the military in time of war could be called into serious question if they did not enjoy the same protections as does the United States for combat activities.”²³ The Court went on to state: “This does not mean that the Court is unsympathetic to the claims of the Plaintiffs. The use of open burn pits in Iraq and Afghanistan allegedly has caused harm to these Plaintiffs. The inevitable by-product of open burning of waste in war zones is an escalation of risk factors for those in close proximity to smoke emanating from such burn pits. As to military personnel, there are a number of statutory remedies available to them, and with

respect to civilian Plaintiffs employed by government contractors other remedies are also available.”²⁴ The Court concluded its Opinion stating: “Finally, to the extent that any special or additional remedy should be made available for those claiming to have been affected by open burn pits or impure water in these two wars, the remedy is through the military and the legislative processes, not through the judiciary.”²⁵ Attorneys for the Plaintiffs indicated they will appeal this decision. If the Plaintiffs’ appeal is unsuccessful, the only potential monetary recovery for servicemembers, barring Congressional action, will be through the VA disability system, and as further discussed below, that will likely be an extremely long and difficult process for servicemembers.

Burn Pit Memorandums

Two memorandums in particular caused quite a stir and spurred a recent congressional inquiry. Darrin L. Curtis, an Air Force Bioenvironmental Engineering Flight Commander authored a memorandum in December of 2006 opining that exposure to the open-air burn pit at Balad Air Base, Iraq was an environmental health hazard.²⁶ Lt. Col. Curtis wrote: “In my professional opinion, there is an acute health hazard for individuals. There is also the possibility for chronic health hazards associated with the smoke; thus the information is being made a permanent part of each Airman’s medical record.”²⁷ This memorandum received a concurrence from Lt. Col. James R. Elliott, Chief, Aeromedical Services, who stated: “In my professional opinion, the known carcinogens and respiratory sensitizers released into the atmosphere by the burn pit present both an acute and a chronic health hazard to our troops and the local population.”²⁸ Lt. Col. Curtis has earned a Doctor of Philosophy in Engineering (Environmental) and is licensed as a Professional Engineer in Arkansas and Utah. Lt.

Col. Elliott is a licensed physician. This memorandum should be given credence given each of these individuals' academic credentials. However, the difficulty of this entire situation is noted by Lt. Col. Curtis when he states: "We have not yet been able to quantify contaminants that exceed the Military Exposure Guides (MEG) for most of the chemicals of concern. The data gap is a result of our inability to collect 'worst case' data due to the dynamic nature of the burn pit's plume."²⁹

On November 6, 2009, Lt. Col. Curtis testified before the Senate Democratic Policy Committee. Lt. Col. Curtis testified: "I wrote the memo because, despite the acute health hazards associated with the use of burn pits, it was evident that the construction of the incinerators at Balad was not moving forward. I was told that there were contracting and/or money problems associated with the construction of the incinerators."³⁰ This issue was not unique to Balad. Incinerators sat in crates in Iraq and Afghanistan awaiting the resolution of contracting issues to make the incinerators operational. We must do better in future contingency operations expediting the use of available incinerators.

Another memorandum, this one from Captain G. Michael Pratt, an Army Environmental Science Engineering Officer, dated 15 April 2011, cited evidence that the air quality on Bagram Air Field (BAF) would be considered "unhealthy" under EPA standards.³¹ CPT Pratt noted that preventive medicine teams take weekly air samples of Particulate Matter 10 and 2.5 micrometers in size (PM₁₀ and PM_{2.5}). The air samples are then analyzed by the U.S. Army Public Health Command which then summarizes the results in the Periodic Occupational Exposure Monitoring Summary (POEMS). Based on his review of the POEMS data, CPT Pratt opined: "The long term health risk

associated with air conditions on BAF from PM_{2.5} and PM₁₀ indicates there is a potential that long-term exposure at these levels may increase the risk for developing chronic health conditions such as reduced lung function or exacerbated chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, atherosclerosis, or other cardiopulmonary diseases. This does not mean that service members that served on BAF will acquire adverse long term pulmonary or heart conditions but that the risk for such is increased.”³² Having noted the evidence that the air quality on BAF is unhealthy, CPT Pratt then makes the leap to declare: “The primary contributor to the elevated PM₁₀ and PM_{2.5} was a burn pit which services the trash generated on BAF with a population of up to 40,000 Service Members and contractors.”³³ CPT Pratt notes his visual observation: “Throughout the deployment the burn pit smoke plume drifted over the LSA exposing Service Members to increased air contaminants.”³⁴ However, CPT Pratt does not mention any testing of the air quality in Bagram outside BAF. He also fails to consider the fact that local nationals burn tires to cook and heat their homes. While the evidence is clear that the air quality on BAF is unhealthy, and while certainly not arguing that burn pits do not contribute particulate matter to the air, it is not nearly as clear what the “primary contributor” is. Additionally, this memorandum makes no mention of the particular chemicals that service members may have been exposed to. Without detailed exposure data, it will continue to be difficult to properly define the health risks involved and to make appropriate care available. Nevertheless, CPT Pratt’s 2011 memorandum led to a Congressional inquiry on burn pits and brought this issue to the forefront in the press.³⁵

Studies Conducted

In October 2009, the Acting Deputy Assistant Secretary of Defense (Force Health Protection and Readiness) tasked the Armed Forces Health Surveillance Center and the Naval Health Research Center “to conduct expedient epidemiologic studies using readily available data to determine any associations between exposure to burn pit smoke and illness or other health events.”³⁶ This study concluded: “Exposure within a 5-mile radius of a burn pit was not associated with an increased risk for newly reported or recurring respiratory outcomes, chronic multisymptom illness (CMI), or newly reported rheumatoid arthritis.”³⁷ However, the study did find increased odds of birth defects among a subset of infants whose fathers were exposed more than 280 days prior to the estimated date of conception. The study stated that “this unexpected finding may be attributed to chance alone and should be considered for further investigation.”³⁸ The study also found: “While newly reported lupus was not found to be elevated at Camp Taji or COB Speicher, Joint Base Balad was associated with a statistically significant risk of newly reported lupus and this should also be considered a subject for additional study.”³⁹

Another interesting study was published by the Institute of Medicine, Committee on the Long-Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan.⁴⁰ From its study, the Committee concluded: “The air-monitoring data suggest that the pollutants of greatest concern at JBB [Joint Base Balad] may be the mixture of chemicals from regional background and local sources—other than the burn pit—that contribute to high PM [Particulate Matter]. The PM consists of substantial amounts of windblown dust combined with elemental carbon and metals that arise from transportation and industrial activities. ... [T]he committee is unable to say whether

long-term health effects are likely to result from exposure to emissions from the burn pit at JBB. However, the committee's review of the literature and the data from JBB suggests that service in Iraq or Afghanistan—that is, a broader consideration of air pollution than exposure only to burn pit emissions—might be associated with long-term health effects, particularly in highly exposed populations (such as those who worked at the burn pit) or susceptible populations (for example, those who have asthma), mainly because of the high ambient concentrations of PM from both natural and anthropogenic, including military, sources."⁴¹

Perhaps one of the more controversial studies involved eighty soldiers from Fort Campbell, Kentucky who were "referred to Vanderbilt University Medical Center for evaluation of exercise intolerance because of exertional dyspnea after returning from duty in Iraq or Afghanistan."⁴² Of these soldiers, forty-nine "underwent thoracoscopic lung biopsy after noninvasive evaluation did not provide an explanation for their symptoms."⁴³ An analysis of the biopsy samples from the forty-nine soldiers "showed diffuse constrictive bronchiolitis, which was possibly associated with inhalational exposure, in thirty-eight soldiers."⁴⁴ In this study, the authors initially "expected that the finding of constrictive bronchiolitis would be limited" to the group of soldiers who "had prolonged exposure to toxic levels of sulfur dioxide associated with the Mosul sulfur-mine fire."⁴⁵ However, the finding of constrictive bronchiolitis was not limited to soldiers exposed to the sulfur mine fire. This causes the authors "particular concern" since the other soldiers diagnosed with constrictive bronchiolitis share the same "potential toxic exposures" with "most personnel who were deployed to Iraq and Afghanistan. These

common exposures include open-air burn pits, ... and desert dust storms of such severity that they obscured visibility.”⁴⁶

In June of 2012, the Journal of Occupational and Environmental Medicine (JOEM) published a special issue entitled “Health Effects of Deployment to Afghanistan and Iraq.”⁴⁷ This issue contains several informative studies that interestingly do not find long term health consequences from serving in near proximity to an open-air burn pit, but one study does find “an increase in postdeployment respiratory symptoms and medical encounters for obstructive pulmonary diseases, relative to predeployment rates.”⁴⁸ In a study supported by the U.S. Department of Defense, the authors noted: “Particulate matter (PM) in the region is a primary exposure concern of the US military due to blowing sand and dust, emissions from petrochemical and other industrial sites, vehicle traffic, burn pits used for waste disposal, and oil fields and fires. Deployed military service members are often exposed to PM levels exceeding typical levels in the United States.”⁴⁹ However, it is noteworthy that the increase in postdeployment respiratory symptoms and medical encounters for obstructive pulmonary diseases, relative to predeployment rates, had no association with the number of deployments or the duration of deployment.⁵⁰ This led the authors to conclude “that specific environmental exposures, rather than deployment in general, are determinants of postdeployment respiratory illness.”⁵¹

Another study in the June 2012 issue of JOEM studied whether chronic multisymptom illness (CMI) reporting was associated with open-air burn pit smoke exposure in Iraq.⁵² The study involved: “More than 21,000 Cohort participants were deployed in support of the current operations, including more than 3000 participants

with at least one deployment with a 3-mile radius of a documented burn pit.”⁵³ This study concluded that “[t]here was no increase in CMI symptom reporting in those deployed to three selected bases with documented burn pits compared with other deployers.”⁵⁴

The June 2012 issue of JOEM also published a study the objective of which “was to examine the association between respiratory illness and exposure within 2-, 3-, and 5-mile radii of documented open-air burn pits among a large group of Army and Air Force personnel who deployed to operations in Iraq or Afghanistan.”⁵⁵ This study published its results as: “Burn pit exposure within 3 or 5 miles was not associated with respiratory outcomes after statistical adjustment. Increased symptom reporting was observed among Air Force deployers located within 2 miles of Joint Base Balad; however, this finding was marginally significant with no evidence of trend.”⁵⁶

One study supported by the Veterans Affairs Medical Center, Northport, New York, concluded: “New-onset Iraq/Afghanistan war lung injury is common and rates of symptoms leading to a diagnosis requiring spirometry are high.”⁵⁷ The authors noted: “This study provides the first indication that the scope of respiratory symptoms among US military personnel deployed to Iraq and Afghanistan from 2004 to 2010 is widespread. Soldiers deployed to Iraq and Afghanistan were more often symptomatic and received spirometry more than soldiers stationed elsewhere. At issue is whether this is a form of lung injury rather than classic extrinsic IgE versus intrinsic non-IgE asthma. Lung injury and bronchiolitis are plausible because infections, irritants, and toxin exposure may be occurring on the battlefield.”⁵⁸ This study opined that “Air pollution (PM10) may explain these findings,” but also went on to state that

“[u]ncontrolled burning of trash in Balad burn pits without use of incinerators prior to November 2009 is concerning because plastic water bottles doused in jet fuel were lit on fire.”⁵⁹ One of the authors of this article, Dr. Anthony Szema, had earlier testified before the Senate Democratic Policy Committee in November of 2009.

In his Congressional testimony, Dr. Szema noted a variety of health risks that might be associated with the burning of waste. “The type of plastic (PVC) used to make plastic bottles produces dioxin and hydrochloric acid when burned. These chemicals are associated with immune dysfunction, IQ deficit, and reproductive abnormalities. Polystyrene foam cups can be a source of carcinogens including dioxin, benzene, styrene and furans when burned. Chromated copper arsenate (CCA)-treated wood contains pro-carcinogenic arsenic. Bleached or colored paper contains harmful chemicals. Bleached paper contains halogenated hydrocarbons and furans associated with leukemia and liver disease. Colored paper contains heavy metals like lead and cadmium associated with blood, liver and kidney disease. Particle board and plywood release formaldehyde when burned; this is associated with nose and throat cancer, as well as liver and kidney disease and airway inflammation. Cardboard used for packaging of foodstuffs may contain fungicides which are associated with neurological disorders.”⁶⁰

Dr. Szema further testified: “In my practice as an allergist and pulmonologist at the Veterans Affairs Medical Center in Northport, NY, the demographics of the patients I typically see have changed since 1997. Until 2004, I mostly saw 80-year-old veterans. However, from 2004 to the present, I have begun seeing young women and men who were previously healthy athletes capable of passing basic training and performing

combat duty. Now these individuals suffer from a variety of respiratory illnesses, including asthma and difficulty breathing during exertion, and are not fit for continued military duty. This is an alarming trend.”⁶¹

As evidenced by the results of studies mentioned above, there is no clear answer as to the long term health effects of exposure to smoke from open air burn pits. No one will argue that breathing smoke is healthy. Science has proven when particular items are burned, certain chemicals are produced. However, we do not have the data to measure particular service member’s exposures during their specific rotations. A few of the studies seem to point to the general poor air quality in Iraq and Afghanistan as being the major cause for health problems. However, if this were the case, respiratory and other health problems should be linked to the number of deployments or length of deployments; this was not the case. One thing is clear, additional studies are needed, and the burn pit registry is a start.

Burn Pit Health Registry Planning

Public Law 112-260 requires the Veterans Administration to establish an open burn pit registry within one year after the enactment was signed into law on January 10, 2013. Any individual who served, on or after September 11, 2001, in the Armed Forces and was deployed in support of a contingency operation to a base where an open burn pit was used is eligible for the registry. The VA is required to coordinate with the Secretary of Defense on establishing the registry. One potential problem will be determining all the bases where an open burn pit was used. If the Secretary of Defense is unable to provide this information to the VA, the VA is likely to make a presumption that any service member deployed to Iraq or Afghanistan on or after September 11,

2001 is presumed to have been exposed to an open burn pit. According to VA estimates, following this presumption could make over two million service members eligible for the registry.⁶²

Current plans call for a web based system where veterans can self-register and provide an email address.⁶³ Veterans will then receive online health risk communications, a welcome packet, and information describing available programs based on the self-identified level of concern and symptoms. Veterans will be given the option to request an in-person exam. Based on the VA's historic data, over fifty percent of those eligible for inclusion in the registry will not seek enrollment.⁶⁴ Additionally, according to the VA, historic participation in in-person registry examinations is roughly 10% of those eligible.⁶⁵ Researchers admit that low participation rates limit the ability to estimate true health risks from exposure. However, if the historic participation rate continues, that is still approximately 200,000 service members who will seek an in-person registry examination.

As discussed earlier in this paper, a problem with this entire process is the lack of knowledge of what chemicals service members were exposed to. Will the Open Burn Pit Registry continue to evolve such as the Agent Orange Registry evolved over the years through the use of presumptions? It appears likely that everyone who served in Iraq or Afghanistan will be presumed to have been exposed to a burn pit. The problem lies in making the next presumption. If a service member was exposed to an open burn pit, to what chemicals is the service member presumed to have been exposed? Finally, what health problems will the VA presume are the result of exposure to a particular chemical? As Dr. Szema testified, exposure to the burning of any of a number of different items

can lead to problems ranging from airway inflammation to leukemia, blood, liver and kidney disease, nose and throat cancer, and neurological disorders.⁶⁶ Given this wide range of potential illnesses, and lack of exposure data, it seems unlikely that the VA will make such broad presumptions, as to do so would open the VA's doors to almost any service member who served in Iraq or Afghanistan and is now suffering from some type of health problem.

Recommendations

We must reduce our solid waste. While more efficient incinerators are needed, we must decrease the need for those incinerators. We can significantly reduce our current dependency on plastic water bottles. The military should make use of the water purification and packaging systems already in its inventory and servicemembers should utilize "camel backs" or canteens. Plastic plates, bowls, and Styrofoam cups should be eliminated. Bio-degradable paper products should be utilized, or the "mess kit" brought back into use. Research into re-usable, compostable, or multi-purpose shipping and packing materials should continue. By implementing these changes, we can eliminate most plastic and foam waste.

We must move faster at contingency bases to install incinerators or to execute solid waste disposal contracts with Host Nation contractors where available. Development should continue on smaller and lighter incinerators that can be integrated into the Force Provider module. As evidenced in both Iraq and Afghanistan, construction/installation of incinerators takes time. Having an incinerator incorporated into the Force Provider package would allow units to begin incineration upon receipt of the modules.

Recycling and composting should be implemented whenever possible to reduce solid waste. Recycling has been encouraged since CENTCOM 200-2 was first published in 2009. Continued emphasis should be placed on recycling. CENTCOM's updated 200-2 also mentions composting as another method of reducing waste. The regulation mentions open composting as well as closed composting systems. Research should continue on closed composting systems such as the system currently being evaluated at Joint Base Myer-Henderson Hall. These closed type composting systems increase the speed in which compost is generated while also reducing the odor and keeping vermin out of the compost. This type closed composting system could also be incorporated into the Force Provider module.

Research and testing should continue on waste-to-energy type systems that convert solid waste to energy to either power the unit itself or that provide enough energy to power other equipment. Products such as the micro auto gasification system currently being tested by the U.S. Marine Corps should be evaluated.⁶⁷ "The Micro Auto Gasification System disposes of solid waste through a process of pyrolysis, where trash is reduced to a synthetic gas which is then used to power the MAG system."⁶⁸ These type systems are self sustaining, needing diesel fuel only for the initial start up, and thus providing an advantage over the traditional incinerator. Another similar type system being evaluated by a Strategic Environmental Research and Development Program (SERDP) project team is the Rotary Kiln Gasification System. Testing has shown this system has an 80% reduction in fuel usage versus a similar capacity incinerator. This reduction in fuel usage is critical as every gallon of fuel transported over the road

increases our operational challenges and places personnel at risk. Research should also continue into the larger scale biowaste to bioenergy technology.

In order to adequately study exposures and better protect our servicemembers, we must have better air monitoring data.⁶⁹ According to the GAO, “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.”⁷⁰ Without the required data, it will be difficult to determine whether servicemembers are being exposed to harmful chemicals from burn pits or if ambient air pollution in general is causing health problems. Regardless, command emphasis must be placed on any open-air burn operations to ensure that prohibited items are not being burned and that the required emissions sampling is being conducted.

Endnotes

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¹⁶ *Ibid.*, 11.

¹⁷ U.S. Government Accountability Office, GAO-11-63, *Afghanistan and Iraq, DOD Should Improve Adherence to Its Guidance on Open Pit Burning and Solid Waste Management: Report to Congressional Requesters* (Washington, DC: U.S. Government Accountability Office, October 2010), 16.

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²⁸ Ibid.

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⁴⁸ See American College of Occupational and Environmental Medicine, *Journal of Occupational and Environmental Medicine*, June 2012, vol. 54, no. 6; Joseph H. Abraham, ScD, et. al., "Does Deployment to Iraq and Afghanistan Affect Respiratory Health of US Military Personnel?," *Journal of Occupational and Environmental Medicine*, June 2012, vol. 54, no. 6: 740.

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