Chapter Four

Environmental Health and Safety Issues

Introduction

Following the attack on the Pentagon, the Army Medical Department faced environmental health and safety issues resulting from the explosion of Flight 77 in the 60-year-old building and the fire it caused. Damage was extensive in portions of renovated wedge 1 and in wedge 2, which had just begun to be renovated. The demolition and reduction of wedge 1 during its renovation had produced 332 million pounds of hazardous material, and it was feared that the fire would introduce more hazardous material into the environment. It was therefore necessary to determine if air quality in the rest of the Pentagon was safe, and if not, how to make it so. Potential dangers included toxic dust, ash, and chemicals found in burning wood, plastics, and other materials. Substances such as lead or asbestos contained in the construction materials of older buildings were also concerns. Immediate action was essential because on the evening of 9/11, Secretary of Defense Donald Rumsfeld had declared "that the Pentagon would be open for business the next day." He wanted to let the terrorists know they had not stopped the building from functioning.[1(ppA-65,A-68),2]

The Washington Headquarters Services (WHS), a Department of Defense (DoD) agency that supervised everyday operations at the Pentagon, was responsible for environmental and health surveillance at the building following the attack. The agency's Safety and Environmental Management Branch deployed a team of seven environmental health specialists to manage the industrial health and safety programs following the attack. It also hired contract personnel from Applied Environmental, Inc, of Reston, Virginia, who contributed expertise and routine support. Augmenting recovery efforts were the staff of the Pentagon Renovation Program Safety Office and environmental, health, and safety experts of the renovation contractors.[3(p10)]

Other DoD environmental health and safety experts came from the Army Center for Health Promotion and Preventive Medicine (CHPPM), located in

Aberdeen Proving Ground, Maryland, which provided a special medical augmentation response team (SMART team) for preventive medicine. Supplementing CHPPM's team were at least 30 Air Force bioenvironmental engineers from Keesler Air Force Base in Mississippi, Bolling Air Force Base in Washington, DC, and Andrews Air Force Base in Maryland. Also assisting were a nuclear, biological, and chemical team from Walter Reed Army Medical Center (WRAMC), an occupational health team from the DiLorenzo Clinic, National Guard units from Virginia and West Virginia, and personnel from the Uniformed Services University of the Health Sciences and the National Naval Medical Center (both in Bethesda, Maryland).[3(p10)]

Although WHS was in command, having operational control over all of the Pentagon, the agency let CHPPM's SMART team, which had the technical expertise, take the lead in monitoring ambient air and sampling for contaminants.[4] The team's charter was to

> Determine the levels of hazardous contamination present in and around the Pentagon; recommend mitigation of any hazards that pose a health threat to occupants and personnel conducting operations in response to their incident; and measure and assess the health impact of a wide range of contaminants that might be present because of the aircraft crash, the building fire, and subsequent damage that might adversely affect the health of building occupants.[3(p11)]

Commanded by Major General Lester Martinez-Lopez, CHPPM was the lead DoD agency dealing with health-related environmental issues. CHPPM's mission was to "provide health promotion and preventive medicine leadership and services to counter environmental, occupational, and disease threats to health, fitness, and readiness, in support of the National Military Strategy."[5(p1-1)] From his headquarters at Aberdeen, Martinez-Lopez oversaw a many-sided response involving skilled personnel and specialists in occupational and preventive medicine, environmental science, behavioral health, epidemiology, and medical surveillance. Those experts came from CHPPM's various directorates and subordinate units within the Army Medical Department, the Air Force, the Navy, and the DoD. Martinez-Lopez and his command coordinated their efforts with the WHS.[5(p1-6)]

Additional environmental health and safety experts came from the Federal Bureau of Investigation (FBI), Federal Emergency Management Agency, Occupational Safety and Health Administration, Environmental Protection Agency (EPA), Arlington County Fire Department, Virginia Department of Emergency Management, and the Virginia Department of Environmental Quality. The presence of federal and state environmental professionals at the site provided additional expertise to assist with technical problems.[3(p11)]

The DoD's emergency health and safety experts, led by the CHPPM team, conducted most of the sampling at the Pentagon, focusing on the inside of the building. After recording and analyzing the data, CHPPM forwarded it to the emergency operations centers at Aberdeen, the Pentagon's DiLorenzo Tricare Health Clinic, and WHS. WHS had a representative at the Joint Operations Center at Fort Myer, which served as a focal point for the coordination of DoD's efforts with other federal, state, and local agencies.[3(pp8,9),4]

US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE ORGANIZATIONAL LISTING

CHPPM COMMANDER

Deputy for Technical Services
Secretary to the General Staff
Safety Manager/Environmental Coordinator
Radiation Production Officer
Adjutant
Company Commander
Sergeant Major
Aide de Camp
Staff Judge Advocate
Auditor
Strategic Initiatives Office
Acting Inspector General
Inspector General
Protocol Officer
Chief, Public Affairs Office

CHIEF OF STAFF

Deputy Chief of Staff for Resource Management
Chief, Budget Division
Chief, Human Resource Management Division

Deputy Chief of Staff for Information Management
Automation Management Officer
Chief, Infrastructure Management Division
Chief, Document Management Division
Chief, Visual Information Division

Deputy Chief of Staff for Logistics
Chief, Property Division
Equipment Program Manager
Chief, Public Works Division

Deputy Chief of Staff for Operations
Chief, Current Operations Division
Chief, Support Operations Division
Health Information Operations Division

DIRECTOR, ENVIRONMENTAL HEALTH ENGINEERING

Program Manager, Water Supply 1 Management, Program 3
Program Manager, Surface Water and Wastewater, Program 32
Program Manager, Hazardous and Medical Waste, Program 37
Program Manager, Ground Water and Solid Waste, Program 38
Program Manager, Environmental Health Risk Assessment, Program 39
Program Manager, Air Quality Surveillance, Program 43
Program Manager, Deployment Environmental Surveillance, Program 47
Program Manager, Environmental Noise, Program 52

DIRECTOR, CLINICAL PREVENTIVE MEDICINE

Program Manager, Disease and Injury Control Policy, Program 34
Program Manager, Occupational and Environmental Medicine, Program 64
Program Manager, Tri-Service Vision Conservation and Readiness, Program 63
Program Manager, Hearing Conservation, Program 51

(*continued*)

CHPPM Organizational Listing continued

DIRECTOR, LABORATORY SCIENCES

- Chief, Laboratory Information & Sample Management Division, Program 72
- Chief, Analytical Spectrometry Division, Program 80
- Chief, Radiologic, Classic & Clinical Chemistry Division, Program 79
- Chief, Chromatographic Analysis Division, Program 82
- Chief, Laboratory Consultants Office
- Chief, DoD Cholinesterase Reference Laboratory, Program 84

DIRECTOR, TOXICOLOGY

- Program Manager, Toxicity Evaluation, Program 85
- Program Manager, Health Effects Research, Program 87
- Chief, Veterinary Medicine Division

DIRECTOR, EPIDEMIOLOGY AND DISEASE SURVEILLANCE

- Program Manager, Professional Medical Education, Program 11
- Program Manager, Injury Prevention, Program 12
- Program Manager, Occupational Health, Program 13
- Program Manager, Epidemiology, Program 29
- Program Manager, Medical Surveillance, Program 30

DIRECTOR, OCCUPATIONAL HEALTH SCIENCES

- Program Manager, Entomological Sciences, Program 18
- Program Manager, Radiofrequency/Ultrasound, Program 24
- Program Manager, Laser/Optical Radiation, Program 25
- Program Manager, Health Physics, Program 26
- Program Manager, OHMIS, Program 53
- Program Manager, DOEHRS, Program 53
- Program Manager, Industrial Hygiene Field Services (Technical), Program 55
- Program Manager, Industrial Hygiene Field Services (Administrative), Program 55
- Program Manager, Industrial Hygiene and Medical Safety Management, Program 59
- Program Manager, Health Hazard Assessment, Program 69
- Program Manager, Ergonomics, Program 88

DIRECTOR, HEALTH PROMOTION AND WELLNESS

- Program Manager, Readiness Resource, Program 21
- Program Manager, Population Resource, Program 46
- Program Manager, Wellness Resource, Program 22
- Chaplain

(*continued*)

CHPPM Organizational Listing continued

DIRECTOR, HEALTH RISK MANAGEMENT

Program Manager, Environmental Health Risk Assessment, Program 39
Program Manager, Deployment Environmental Surveillance, Program 47
Program Manager, Health Risk Communication Office, Program 33
Chief, Agency for Toxic Substance & Disease Registry (liaison office)

COMMANDER, USACHPPM-NORTH

Chief, Administrative Support Office
Chief, Industrial Hygiene Division
Chief, Environmental Health Engineering Division
Chief, Entomological Sciences Division
Chief, Preventive Medicine Field Division

COMMANDER, USACHPPM-SOUTH

Chief, Quality Management and Support Division
Chief, Army Reserve Command Liaison Office
Chief, Environmental Health Engineering Division
Chief, Entomological Services Division
Chief, Field Preventive Medicine Division
Chief, Industrial Hygiene Division

COMMANDER, USACHPPM-WEST

Chief, Industrial Hygiene Division
Chief, Environmental Health Engineering Division
Chief, Entomological Sciences Division
Chief, Field Preventive Medicine

COMMANDER, USACHPPM-EUROPE

Deputy Commander
Operations Officer
Chief, Department of Administrative Services
Headquarters Headquarters Detachment
Chief, Department of Environmental Health Sciences
Chief, Department of Laboratory Sciences
Chief, Occupational Health and Epidemiology

COMMANDER, USACHPPM-PACIFIC

Director, Environmental Laboratory Division
Chief, Environmental Health Sciences Division
Chief, Preventive Medicine Division
DoD: Department of Defense

DOEHRS: Defense Occupational and Environmental Health Reporting System
OHMIS: Occupational Health Management Information System
USACHPPM: US Army Center for Health Promotion and Preventive Medicine

Initial Response

On 9/11, Martinez-Lopez and his people went on standby when the twin towers at New York City's World Trade Center were first attacked at 8:46. In preparation to support an Army medical response to New York City, Kevin Delaney, CHPPM's chief of health information operations, assisted in establishing an emergency operations center at the agency's headquarters in Aberdeen. After the assault on the Pentagon at 9:37, the unit concentrated on assembling and deploying a preventive medicine SMART team to help address environmental health issues in and around the building. Although the team was already in existence, it was augmented to deal with the crisis.[6,7] The team ultimately consisted of

> one chaplain, one social worker, one preventive medicine physician, one health physicist, nine environmental science officers, three sanitary engineers, two preventive medicine noncommissioned officers, ten industrial hygienists, two industrial hygiene technicians, three environmental engineers, two environmental scientists, two engineering technicians, and one mechanical engineer.[6(p64)]

According to Colonel Paul Smith, a CHPPM occupational medicine staff officer working for the preventive medicine consultant in the Office of the Surgeon General, and Colonel Tim Mallon, CHPPM's director of clinical medicine, the original government guidance covering responses to nuclear, biological, and chemical threats made CHPPM responsible only for providing expert advice on the dangers to and treatment of those coming in contact with hazardous materials. On 9/11, however, CHPPM was asked to do more: to sample air quality, test hazardous materials, and ultimately conduct decontamination operations in areas that might pose threats to health. CHPPM also was asked to send a team as soon as possible, and complied. While the SMART team was assembling, Colonel Smith called Aberdeen to urge his colleagues to send the team as soon as possible to initiate limited sampling of materials for contaminants, particularly toxic fumes resulting from the airliner's impact and the fire it caused.[8]

Major Anthony Intrepido, CHPPM's manager of industrial hygiene field services in the Directorate of Occupational Health Sciences, took a half hour to put together an advance hazardous materials team and depart for the Pentagon (the main body of the team would follow the next day). The five military and civilian volunteers consisted of four industrial hygienists and one operations officer, who packed and loaded instruments that measured a variety of contaminants with instant results, and other equipment to measure the building's air quality by detecting the presence of gases, aldehydes, and volatile organic compounds. They also packed whatever protective gear they could find. At 1300, the team left Aberdeen in a pickup truck and drove to the Pentagon, spending the trip brain-storming about what to do when they got there. At about 1500, they arrived at the crash site.[9]

At the Pentagon Major Intrepido and his team encountered a chaotic situation with no clear indication about where they should report. Stopped frequently and asked to identify themselves and their destination, the group got through every checkpoint by showing their identification cards and saying they "were just DoD's

hazmat team." Finally they linked up with an Army Medical Department cell at the DiLorenzo Clinic in the basement of the Pentagon.[9]

Intrepido and his team then began sampling in the center court, where there was a lot of smoke, and outside the southwest entrance, the site of the fire and the great plume of smoke it generated. Using detector tubes and direct reading instruments, they monitored for chemicals and combustible products that might be harmful to recovery workers in the area and to personnel in offices close to the crash site: aldehydes, carbon monoxide, particulates, volatile organics, and other chemicals. They felt under pressure to ascertain immediate health threats because of rumors that Pentagon employees were to return to work in the building the next day.[5(p365),9]

Having rushed to the Pentagon with insufficient personal protective equipment of their own, the advance team had to use abandoned face masks that others had laid aside at the scene. The lack of defensive gear was worrisome: it was unknown on the evening of 9/11 if the plane had chemical, biological, or radiological agents on board. The plane had not burned up in one big fireball, and aircraft parts were strewn about along with unused jet fuel.[9]

While Intrepido's team focused on toxic materials, WRAMC's nuclear, biological, and chemical response team, which had arrived about 1400, ran tests of its own. The group's members initially served as litter bearers until 1730, when they received permission from Defense Protective Service (the Pentagons' police force) to begin surveying for nuclear, chemical, and biological contaminants. WRAMC's team consisted of doctors, nurses, enlisted soldiers, an environmental science officer, and a nuclear medicine specialist. In addition to conducting surveys, the team was capable as well of providing nuclear, chemical, or biological casualty care. They used a radiation meter in the courtyard but did no further biological or chemical testing on 9/11.[10–13]

Occupational health personnel from the DiLorenzo Clinic also began work on the afternoon of 9/11. A team of seven occupational health nurses and two ancillary support personnel, under the leadership of Joe Balinas, an occupational medicine physician's assistant at DiLorenzo and coordinator for indoor air quality programs in the Pentagon, supported the overall effort by using their ecological knowledge of the Pentagon to assist environmental experts in seeing that the building was clean and safe enough for people to reenter. Normally, the Occupational Medicine Department was concerned with the building's heating, air conditioning, and ventilating systems and their effect on the health of its occupants. The age of those systems was a major reason for the recent renovations. The Department's secondary mission was to work with hygienists and environmentalists in identifying health hazards and in recommending remedial action. Balinas coordinated his activities with CHPPM's environmental medicine team.[8,14]

These environmental and occupational health personnel worked against the clock to determine if the Pentagon was safe for workers to return the next day. Assistant Chief James Schwartz of the Arlington County Fire Department, in accordance with the wishes of President Bush and Secretary of Defense Rumsfeld, had decided to allow workers back into the undamaged parts of the Pentagon on

12 September, even though smoke was still billowing from the ruptured building and the recovery of bodies was underway. Because there was a clear and significant risk to the soldiers and civilian employees slated to return, the decision to have them do so had to have been a conscious one, thought Colonel Mallon. The political consequences of closing the building were so great that Secretary of Defense Rumsfeld and President Bush were willing to take the risk of reoccupying the building without confirmation that it was safe.[8]

"It's a monumental task to assess a building this size in such short order and to say that it was completely safe to reenter," said Colonel Mallon, and to provide a definitive answer in one day was impossible. However, Mallon, Smith, and the other environment experts believed that initial samples on 9/11 revealed little of risk in most areas, even if some areas were heavily contaminated with lead, asbestos, dioxin, and other materials, and the building would need extensive cleaning. On 12 September, employees returned to work in offices in areas that appeared safe, but sampling continued (a more thorough assessment would occur later once this initial data could be reviewed). The team anticipated that the complete sampling effort would take between 2 and 3 weeks of daytime, nighttime, and weekend work to provide the information needed to formulate a response if heavy contamination of a hazardous material appeared.[8]

Sampling Efforts

On 12 September, the main body of the preventive medicine SMART team and a smaller contingent from CHPPM's office at Fort George C Meade, Maryland, converged on the Pentagon, where they joined forces at 1100 with the advance team from Aberdeen. The Fort Meade unit's commander, Lieutenant Colonel Laurie Cummings, became leader of the effort, which by then also included other DoD environmental health and safety experts.[5(ppviii,4-2),15]

At a meeting called by WHS that day, DoD civilian, military, and contractor environmental safety and health personnel began selecting areas for sampling. Not every office in the Pentagon was included; those on the edge of the impact area had been closed off. Checking other work spaces would be done on a statistical basis; sampling and cleaning efforts would start in the most damaged sections and progress to the least, and offices closest to the damaged areas with the greatest number of employees would have priority. Specifically, unoccupied offices on the fifth floor closest to the crash site (corridors 2 and 6) would receive immediate attention. Occupied offices farthest from the crash site would be sampled and cleaned last. Samples would be taken from soldiers on guard duty in and around the crash site. Staff from CHPPM and WHS (including contractors) would work as a cadre to conduct sampling concurrently on all floors of the Pentagon. CHPPM's team would review their own sampling data along with WHS's results. It would be necessary to collaborate with the FBI's hazardous material response unit because the area immediately surrounding the aircraft's impact (corridors 4 and 5, and parts of corridors 2 and 6) was

under the FBI's direct control. WHS would brief environmental leaders daily on data and conclusions.[2,3(p11),5,15,16(p2),17]

In sampling the Pentagon's interior, environmental safety and health experts under the leadership of CHPPM's team had three basic objectives: (1) to identify possible exposures to people who had remained in the building, such as security guards and maintenance workers; (2) to identify possible exposures to the soldiers engaged in search and recovery efforts; and (3) to determine the degree of possible contamination in the undamaged areas of the building that were being reoccupied. The sampling teams focused on aircraft parts, building materials, jet fuel, and flammable commodities in these materials. Using a variety of devices that included direct-reading instruments, detector tubes, and a mobile contamination detector machine, with both high- and low-volume air sampling as well as surface wipes, to measure, sort, and identify likely impurities, they created a contamination profile of every floor in the building. The data enabled the team to assess probable health risks to persons working inside the building, such as FBI forensics specialists and soldiers at the crash site, where recovery operations, engineering operations, and mortuary affairs were ongoing. Sampling went on for 2 weeks. In the end, the preventive medicine team found low amounts of volatile organic compounds, hydrocarbons, metals, asbestos, lead, and other contaminants, but there was a noticeable drop in contamination levels after cleaning. There was also a smell of death as team members worked on the top floors near the crash site. The work was continual and debilitating. Later in the week, a biological detector system became available—a trailer mounted on a Humvee that collected air and monitored its quality.)[2,5(pp3-65,3-66),13]

During the 2-week sampling effort, special attention was paid to soldiers of the 3d Infantry Regiment (Old Guard). The sampling team closely observed 85 soldiers who had served as guards inside the Pentagon and at the crash site during recovery efforts, conducting blood tests for lead and taking air samples in the areas they occupied, in order to record and analyze possible health threats from burning aircraft fuel and other contaminants such as asbestos dust dislodged by the impact and explosion. "These samples ensured air quality levels were within acceptable limits and aided in decisions for work rest–cycles of recovery operation teams," said Master Sergeant Roberto Rolon, a CHPPM team member.[18(p15)]

The sampling group had to contend with a number of obstacles. The fire at the Pentagon, for example, burned until the afternoon of 12 September. The hallways of the building were filled with smoke, and as a result the air quality was poor. High levels of carbon monoxide were reported. Fires in the wooden attic were spreading from wedge to wedge, and portions of the building were cordoned off. Puddles of water from the fire hoses throughout the structure made moving around difficult. Also, many team members had never been in the Pentagon before, did not use available maps, and were unaware that the rings sometimes had dead ends. Worse, tight security caused team members to stand in long lines to obtain badges or enter various portions of the building.[6(p3),9]

As they worked, industrial health personnel, like others involved in the response, confronted such challenges as working 18-hour days for more than 2

weeks, covering each shift, forming teams from groups of people who had not previously worked together, and making sure each specialist found his or her "niche." Some members had little experience doing the sampling assessments, while others had been doing the work for 20 or 30 years. Working through the Pentagon bureaucracy and getting their data out to external colleagues also was difficult. The group also had to deal with workers worried about the effects of the environment on pregnancies, or concerned about returning to ash-strewn offices. A lot of informal mentoring occurred.[9]

By the second week, personnel from offices near the impact site that were still intact were allowed back into the rooms to get their belongings. Before they could enter, however, a CHPPM team member had to take samples to make sure the area was safe, which involved wiping surfaces and sending the samples out for analysis. Finally, before entering their work spaces, the employees received respirators.[15]

Sampling Analysis and Results

Navy laboratory technicians from the Uniformed Services University of the Health Sciences' Department of Preventive Medicine and Biometrics provided on-site field analysis to the Army and the EPA[1] to help analyze samples quickly. Also, a Navy Chemical Detection Command unit was at the Pentagon from 14 to 25 September assisting with assessments. Beginning on 15 September, the unit received augmentation from Navy industrial hygiene personnel from the National Naval Medical Center. The Navy personnel worked in shifts, 24 hours a day for several days, and produced more than 120 analyzed collections of volatile material, mainly jet fuel. The team also tested for asbestos. In less than an hour, results from the Navy laboratories were sent to the EPA and other organizations to help determine when it would be safe to resume search and recovery efforts in the offices tested.[3(pp10,11),18(pp10,11)]

CHPPM personnel in Aberdeen, however, performed the bulk of analysis. David Morrow and Kenneth Williams, laboratory consultants in CHPPM's Laboratory Consultants Office of the Laboratory Sciences Directorate, coordinated delivery of samples to Aberdeen, consulted with on-site personnel about the best analytic methods and procedures to use, and provided analysis results back to on-site personnel every day. To minimize the delay between sample collection, sample logging, and analysis, they at first ordered one shipment a day from the Pentagon, and later two shipments: one at 0800 in the morning and another late at night. Helicopters picked up the samples from the Pentagon and transported them to the laboratories at Aberdeen. Laboratory personnel collected the samples from a central location at Aberdeen once a day. This routine highlighted the importance of logistics and coordination.[19]

The Laboratory Consultants Office also decided which analyses should be done in-house and which should be contracted out. Commercial laboratories were able to do routine analyses on a day-to-day basis, but only CHPPM and Navy laboratories could analyze masses of data from the attack and return the results within a

32-hour period to the EPA and other organizations that would determine when it would be safe to resume search and recovery efforts in the impact area. The military had the personnel and the work hours necessary to do the job.[19]

Laboring 16 hours a day, CHPPM's chemists analyzed samples for contaminants from 12 September to early November. They found little asbestos and lead, and nonthreatening levels of semivolatile organic compounds, a toxic residue that remains after all other materials have evaporated from boiling petroleum. CHPPM technicians had monitored the organic vapors for the semivolatiles and other chemicals because the Pentagon's basement was filled with unburned fuel as well as water and other chemicals from fire suppressants. CHPPM sent samples to an EPA laboratory in Mississippi to test for dioxin because its own equipment was unable to detect it.[19]

Four of CHPPM's Laboratory Sciences Directorate divisions were responsible for sample analysis. They were the Analytic Spectrometry Division; the Chromatographic Analysis Division; the Radiologic, Classic, and Clinical Chemistry Division; and the Laboratory Information and Sample Management Division. The Analytic Spectrometry Division analyzed air, surface wipes, and drinking water from the Pentagon for contamination by heavy metal and volatile organic compounds. The Chromatographic Analysis Division used nine different analytical procedures to sample air and drinking water for contaminants. The Radiologic, Classic, and Clinical Chemistry Division gave top priority to the analysis of asbestos contamination. Later, much of the process involved in asbestos identification was contracted out.[5(pp3-42,3-45,3-48)] The divisions conducted analysis and data reporting within 24 hours of the samples' arrival. This quick turnaround allowed on-site environmental teams to quickly identify those areas of the Pentagon that posed a health hazard to workers.The Laboratory Information and Sample Management Division provided administrative and technical services to the laboratories. It received, processed, distributed, and tracked samples and maintained a database of analytical reports. It also developed and managed analytical contracts for analyses that exceeded CHPPM's ability to undertake. In all, the Laboratory Sciences Directorate's "laboratories analyzed 1,498 air, water, and surface samples for greater than 1,900 contaminants in fifteen days and reported ninety-four percent of the results [with]in thirty-two hours."[5(p3-39)]

Only 14 of 319 wipe samples for asbestos and 31 of 497 wipe samples for lead showed evidence of baseline contamination. All of the 163 air samples for asbestos and 133 air samples for lead were within acceptable EPA health standards. Although air samples from air returns and exhaust vents with visible soot, especially on the fifth floor, revealed traces of asbestos and lead, those samples were likewise far below EPA occupational exposure limits. Other contaminants sampled were well within acceptable health standards. The overall results indicated no significant risk to Pentagon employees.[3(p13),5(pp3-65,3-66),8]

WHS contractor Applied Environmental, Inc, screened for dioxins, furans, and polychlorinated biphenyls (PCBs). PCBs become hazardous when they burn. Surface wipe samples done before and after cleaning detected traces of the substances,

TABLE 4-1

NUMBERS, TYPES, AND RESULTS OF SAMPLES COLLECTED DURING PENTAGON SAMPLING AFTER 9/11 BY THE US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE USING DIRECT READING INSTRUMENTS*

Sample Type	Samples Collected	Samples Above Standard	Samples Below Standard
Direct reading			
Carbon monoxide	318	0	318
Formaldehyde	272	0	272
Hydrogen sulfide	316	0	316
Lower explosive limit	131	0	131
Photo ionization detection	279	0	279
Oxygen	318	0	318
Respirable dust	130	0	130
Volatile organic compounds	46	0	46
Air			
Aldehyde	21	0	21
Aromatic hydrocarbons	18	0	18
Asbestos	163	0	163
Metals	109	0	109
Lead	133	0	133
Industrial hygiene polynuclear aromatic hydrocarbons	6	0	6
Polynuclear aromatic hydrocarbons	3	0	3
Silica	14	0	14

*Not including all of the data from the initial sampling done on the evening of the 11th.
Adapted from: US Army Center for Health Promotion and Preventive Medicine. *Environmental and Occupational Health Surveillance and Assessment of the Pentagon Following the 11 September 2001 Terrorist Attack 11–28 September 2001*. Aberdeen Proving Ground, MD: USACHPPM; nd. Pentagon report 57-LH-7426-02: 6, Table 1A.

but CHPPM's analysts concluded that they posed no risk to Pentagon employees.[3(p13)]

Mold, which can cause asthma, allergic reactions, and other respiratory ailments, became a problem several days after the attack because of the amount of water used to put out the fire. At least 15 strains of mold were isolated at the Pentagon. Using Department of Housing and Urban Development standards, cleanup staff worked to keep "indoor mold levels to no more than fifteen percent of outdoor levels."[3(pp13,14)]

Additional Environmental Concerns

While industrial hygienists performed floor-by-floor analyses of the Pentagon, radiation detection experts from CHPPM's preventive medicine SMART team conducted an extensive radiological survey of the impact area, the courtyard, and the building's interior adjacent to the crash site. Captain Ricardo Reyes, a nuclear medical science officer, arrived at the Pentagon on the morning of the 12th to survey for possible radiological contaminants from the airplane or depleted uranium from the aircraft's counterweights. Upon arrival, he received a briefing by CHPPM's preventive medicine team. After obtaining a clearance from the FBI to enter the site, he and a soldier assistant used direct reading instruments to assess radiation levels. With two meters going at all times, they began taking samples on the Pentagon's west side at the edge of the crash site, where wooden supports had been placed to keep the building from collapsing. They surveyed evidence such as airplane parts being carried out of the building in bags by FBI personnel. When the FBI stopped bringing out parts, Captain Reyes and the soldier moved into the building and surveyed corridors 3, 2, 1, 10, 9, 8, and 7, in that order, on all floors, and rings A to E. They also surveyed the courtyard. Sampling all these areas took 24 hours. As Captain Reyes went up and down floors, he observed lots of water damage, soldiers on guard duty wearing masks, ropes across corridors 2 and 7 to prevent people from going into the crash area, heavy smoke damage on the top floors, skin and hair embedded into metal, and children's sandals. He would never forget the smell of death. The smell got into his clothes and hair, which he washed twice when he got home. The results of his surveys showed no radioactive material beyond normal readings and no depleted uranium.[2,5(p3-33),20]

Drinking water was another environmental concern. Members of CHPPM's water supply management program tested the Pentagon's drinking water supplies for contamination from airplane fuel or from back-flow as a result of lowered water pressure levels due to heavy water use by the fire department. Results met EPA drinking water standards.[3(p17),5(p3-23),16(p31),19]

CHPPM also inspected for chemical and biological warfare agents. None were detected by a hand-held monitor on 16–17 September. On 21 September, the Biological Defense Research Directorate Operations of the Naval Medical Research Center collected 25 samples from the Pentagon and its parking lots. All of the screenings for plague, anthrax, smallpox, botulism, and tularemia proved negative.[3(p17)]

Environmental Efforts of Other Agencies

The EPA took the lead among the other federal and state occupational health and safety agencies that performed sampling activities. Emergency responders from the agency's region 111(3) worked with the FBI, DoD, and local environmental authorities from 11 through 29 September taking air, water, and debris samples from the work zone of recovery workers, around the perimeter of the Pentagon, and in and around Washington DC to ensure the safety of rescue and recovery personnel, Pentagon employees, and nearby residents. With the exception of the recovery zone, EPA left sampling the inside of the Pentagon to CHPPM

personnel. The EPA documented and examined its results.[1(pA-68),3(pp15,16),21]

EPA staff sampled these areas for asbestos, volatile organic chemicals, and other chemicals. They took a total of 244 air samples, 146 asbestos samples (133 air, 8 bulk [ash/debris], and 5 wipe samples), 78 silica samples, 22 lead samples, and 7 volatile organic chemical samples. Although one bulk sample contained over 1% of asbestos, all other samples contained none or were below regulatory limits. Samples for silica, lead, and volatile organic chemicals also presented no problems.[21(pp1-2)]

After canvassing off-site air quality for smoke, particulate matter, volatile organic chemicals, and other chemicals, the EPA reported that "all data collected from these stations were at levels typical of urban air pollution, and no influence from the fire was detected." The results of sampling runoff water from fire hoses and from the debris-collecting area in the north parking lot indicated that the levels of contamination were "below levels of concern for short term exposure for human health." Debris and ash specimens from inside the building revealed high concentrations of metals. The EPA asserted, however, that "short term exposure and limited routes of contact have minimized any potential for harm." Most of this debris became landfill and did not contaminate the environment. In addition, workers on the debris piles wore respirators and protective clothing.[21(p2)] For its part, the Virginia Department of Environmental Quality reported that "hourly average air pollution monitoring data from all air monitoring stations [in] the Washington area showed only typical low levels of pollution during September 11 and 12."[3(p16)]

To protect the health of FBI evidence response team members as they gathered materials inside the Pentagon, a member of the FBI's hazardous materials response unit accompanied them into the building. This specialist used a photoionization detector to search for volatile organic compounds and a four-gas detector to measure concentrations of oxygen, hydrogen sulfide, and carbon monoxide. Because he sampled only the area where evidence collectors were working, sampling "was not indicative of the overall environmental conditions at the site or inside the Pentagon." For example, because the FBI searched for the plane's black box recorder in an area where fires were still burning, carbon monoxide levels were high. To reduce levels of carbon monoxide and allow recovery efforts to continue in areas that were still burning, the FBI team used air blowers provided by the fire department. The hazardous materials team did not keep a thorough record of its data or analyze its results.[3(p16)]

As a major urban fire department, Arlington County carried instruments for measuring oxygen, lower explosive limits, and volatile organic compounds to safeguard its own personnel. Like the FBI's monitoring activities, Arlington's efforts were not intended to document ambient air levels but to protect rescue workers.[3(p16)]

Coordination/Command and Control/Communications

Because of the number of military, federal, and state environmental health and safety agencies engaged in sampling and air monitoring, coordination of these

efforts was a challenge. The Army's sampling and remediation plans for inside the Pentagon, the EPA's plan for the support zone and areas outside the Pentagon, and efforts to safeguard the health of FBI and Arlington Country rescue workers helped to delineate spheres of activity. CHPPM's emergency operations center at the DiLorenzo Clinic and the Joint Operations Center at Fort Myer served as focal points for coordinating hazardous materials activities with other organizations. In addition, the WHS daily briefings on the environmental situation helped with the exchange of information and data results.[4]

Nevertheless, coordination of the military effort became difficult because of uncertainty about the lead agent and lines of authority. Although nominally the WHS, the agency responsible for the operation of the Pentagon, was the lead, WHS gave CHPPM the lead inside the building because of its technical expertise. Also, CHPPM's team fell under the DiLorenzo Clinic's deputy commander as the senior Army medical officer on site. Dr Lisa Block, a WRAMC occupational health expert, was responsible for overseeing occupational health at DiLorenzo. Yet WHS had operational control over all of the Pentagon, including the DiLorenzo Clinic. In addition, because of the Pentagon's location and the sensitivity of the response, CHPPM's team received direct missions from the Army surgeon general, the North Atlantic Regional Medical Command, the Army Operations Center, and the deputy assistant secretary of the Army for environment, safety, and occupational health. This situation sometimes led to confusion about who was in charge and resulted in delays in communicating information.[4,22]

CHPPM had to work through the bureaucracy to get messages out. Delaney, the agency's chief of health information operations, kept Pentagon employees informed about CHPPM's activities by forwarding updates and messages to the DiLorenzo Clinic for distribution throughout the building. Meanwhile, CHPPM's emergency operations center in DiLorenzo's Industrial Health Section developed health risk assessment guidelines for Pentagon employees on protective measures to follow when they returned to work.[2,7,22] The DiLorenzo Clinic helped CHPPM to distribute health guidelines to Pentagon employees. On 16 September, DiLorenzo issued CHPPM's recommendations regarding air quality in the building:

> Odors from the fire are to be expected, and pose no health hazards. Symptoms, such as mild irritation of the eyes, nose, and throat, are very common in this type of environment. However, if you do experience more significant or worrisome symptoms, you should leave the area immediately and seek medical care. Some persons, such as those with asthma or other lung disease, and pregnant women, may be more sensitive and should seek additional advice from the health clinic. If you have any concerns about working in the Pentagon and how it relates to your health, please contact the DiLorenzo Tricare and Civilian Occupational Health Clinic.[2]

CHPPM was also concerned about the medical and technical accuracy of information in building circulars whose distribution was a WHS responsibility. Through a combination of diplomacy and persistence, Delaney succeeded most of the time in giving medical personnel the last word on any message with medical implications.[7]

Decontamination Efforts

CHPPM also provided field support to the decontamination efforts of the national medical response team task force, a unit under the US Department of Health and Human Services that is activated when a national disaster is declared. The response team set up three decontamination corridors and three medical tents at the Pentagon. CHPPM oversaw the contractor doing facility decontamination and provided technical expertise on assessment of potential hazards from chemical exposure related to the 9/11 attack. Recovery workers, including soldiers who aided the FBI in retrieving debris and body parts, underwent decontamination at the Pentagon. Some of the fire and rescue teams underwent decontamination and medical assessments at their own fire stations.[1(ppA-61,A-68),5(p3-19)]

Site Safety and Security Issues

Safety and security efforts at the Pentagon affected the environmental program. From day one, environmental safety officers were concerned about the numbers and movement of people at the Pentagon site. Thousands of workers evacuated the building on 9/11, but hundreds of others remained to help in the rescue effort. Numerous fire, rescue, and medical personnel also entered the Pentagon grounds. To keep unauthorized persons out of the area, Arlington County Fire Chief Edward Plaugher, who had appointed Assistant Chief Schwartz as the incident commander for the 10 days of the Pentagon fire and rescue operation, had ordered a 2,000-foot chain-link fence constructed around the outer perimeter early on 11 September. This barrier did not go up, however, until the following day. By mid-afternoon of 9/11 the number of professionals and volunteers on site had grown to more than 3,000. There were numerous incidents of people, including firefighters, moving throughout the area without proper personal protective equipment and safety gear. Having no authority over the activities of the countless responders, industrial hygienists and occupational health workers worried about hazardous materials and contaminating substances in the air and on surfaces.[1(pp6,A-65–A-69)]

There were other security problems as well. On 9/11 and the days that followed, official visitors sometimes presented a risk. Although some visitors, such as Major General James T Jackson, Military District of Washington commander, tried to set an example by complying with rules for minimum protective clothing and equipment, others were unprepared and created problems. Also, people seeking to rescue personal items and confidential papers from their Pentagon offices were in danger of becoming contaminated. Some requests for retrieval of material were based on issues of national security. Each was reviewed by the Joint Operations Center in conjunction with incident commander Schwartz's representative, who determined the structural soundness and safety of the area. If the request was approved, retrieval took place during the next work day.[1(ppA-67,A-68)]

On 13 September, the Arlington County Fire Department began holding daily meetings at the Pentagon on such safety issues as decontamination procedures, the minimum acceptable protective clothing and equipment, and the use of res-

pirators. The meetings emphasized the need for individuals to take personal responsibility and the necessity to prohibit dangerous activities such as refueling vehicles and generators while motors were running. Representatives from about 20 organizations, including the DoD, attended those meetings.[1(pA-67)]

Some environmental and health agencies pressed for all responders, regardless of assignment, to follow strict standards, including wearing Tyvek (DuPont, Wilmington, DE) suits, which provide the best protection under the most severe conditions. Not all organizations involved in air monitoring, however, wanted to follow these precautions. The incident commander, for example, tried to keep his people safe without everyone having to wear Tyvek suits, which could produce heat stress. He ordered responders to observe thorough personal decontamination measures, and search and recovery teams to clean their equipment every night.[1(pA-68)]

Summary

The Army's success in responding to environmental issues following the attack on the Pentagon resulted from hard work and training—typical attributes of the military, and a work ethic encouraged in its civilian employees. Training such as CHPPM's risk communication courses and the Federal Emergency Management Agency's classes on humanitarian assistance, exercises, and previous missions enabled military–civilian volunteer teams to practice the organizational structure of a response. CHPPM and WHS staff labored around the clock to ensure that the Pentagon was safe for employees. Industrial hygienists formed teams to sample air quality, test hazardous materials, and conduct decontamination operations in areas that posed threats to health. CHPPM chemists at Aberdeen performed thousands of tests on samples of material from the building and its environs, and returned their analyses quickly during the first few days when concern was at the greatest. CHPPM headquarters issued guidelines on minimum exposure to contaminants and safety in the workplace.

The operation became triservice, with Navy and Air Force environmental experts working with CHPPM personnel in conducting an all-inclusive environmental analysis of the Pentagon site. The North Atlantic Regional Medical Command also sent a WRAMC team of nuclear, biological, and chemical health specialists to the building on 9/11. The WRAMC team coordinated activities with CHPPM's radiation team in surveying the impact area and the building's interior for possible radiological contaminants. The DiLorenzo Tricare Health Clinic provided occupational and preventive medicine professionals. Its industrial health specialists helped identify health hazards and recommended actions to protect building staff. Other participants who monitored air quality, and in some cases conducted decontamination operations, were the EPA, the FBI, the Department of Health and Human Services' national medical response team, and federal and state occupational health and safety teams. Environmental activities were synchronized with WHS, the manager of the Pentagon building, which had its own industrial hygiene staff of mostly contractors.[1(pA-68),5(pp1-2,3-7,3-19),17,23(ppii,3)] Under CHPPM's

leadership, DoD industrial hygienists supported a multidisciplinary force that evaluated health risks associated with the terrorist attack on the Pentagon. Their efforts in ensuring that the building was a safe place in which to work were highly successful.

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