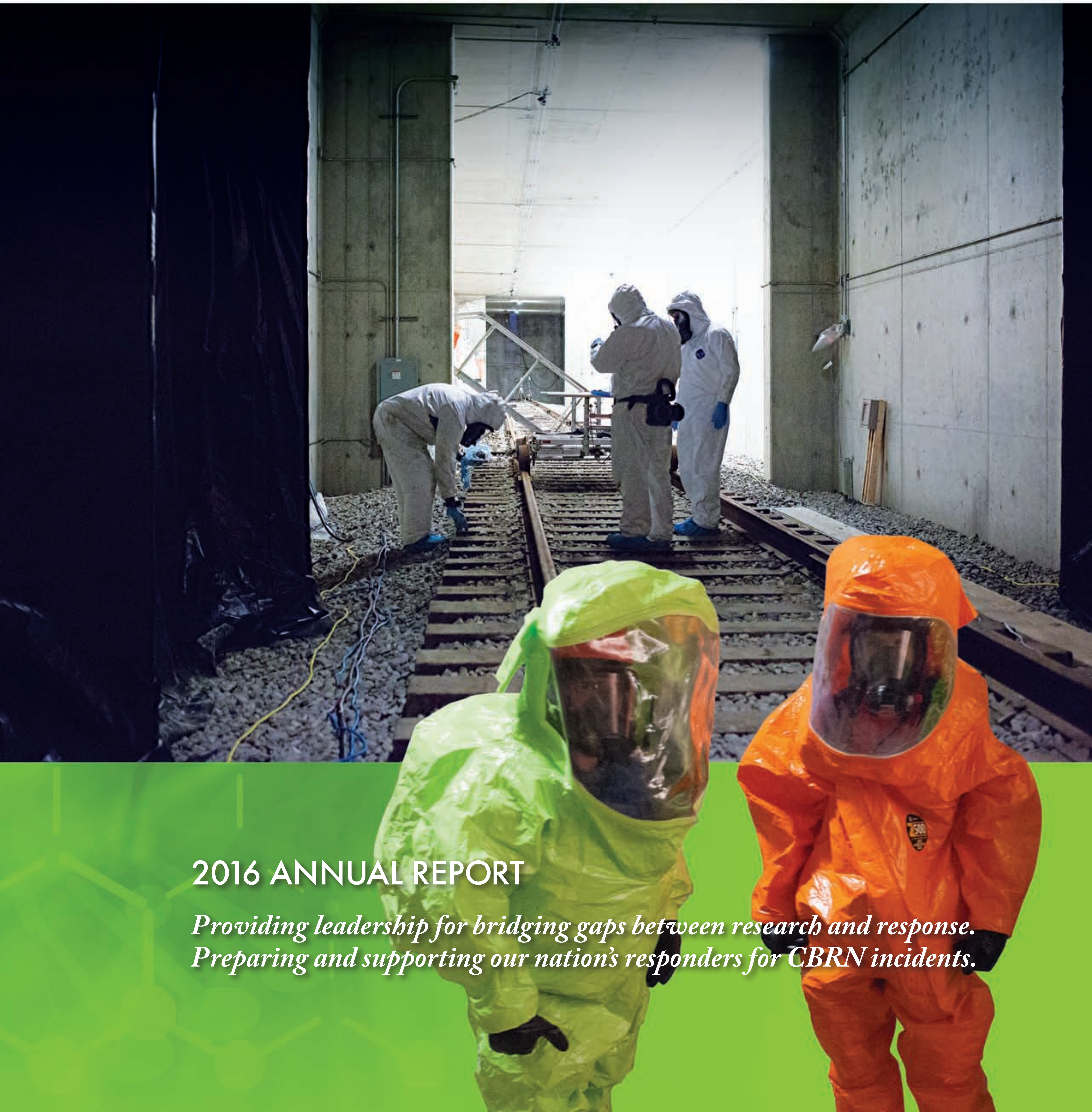
Chemical, Biological, Radiological & Nuclear Consequence Management Advisory Division



2016 ANNUAL REPORT

Providing leadership for bridging gaps between research and response.
Preparing and supporting our nation's responders for CBRN incidents.

2016

As the year comes to a close, it is my pleasure to highlight the collaborative efforts and partnerships of the Consequence Management Advisory Division (CMAD). This has been a year of transition and great accomplishments, beginning with the selection of Director Erica Canzler for the Senior Executive Service (SES) position as the Director, National Enforcement Investigations Center (NEIC), Office of Criminal Enforcement, Forensics, and Training in Denver, Colorado. Additionally, Erica was selected as the Manager of the Year of the Office of Land and Emergency Management (OLEM). These accomplishments are a testament to her able leadership of the division.

During the transition to a new director, several internal and external individuals have acted in the Director's position. Through these changes, CMAD has remained focused on seamlessly working with our partners to continue chemical, biological, radiological, and nuclear (CBRN) preparedness activities, response support, and work on other major projects. This report provides details on major CMAD projects, including: the Underground Transport Restoration (UTR) Outdoor Technical Demonstration (OTD) conducted in partnership with the Department of Homeland Security (DHS) and EPA's National Homeland Security Research Center (NHSRC); support provided to Region 5 by the Portable High Throughput Integrated Laboratory Identification System (PHILIS) program to respond to the water crisis in Flint, MI; support provided for other regional projects; various Airborne Spectral Photometric Environmental Collection Technology (ASPECT) deployments; and events utilizing CMAD's new Radiation Source Program.

Along with Regional colleagues, several CMAD personnel were honored to be recognized with the "Exceptional Support to ORD - Partners' Extraordinary Efforts to Support Homeland Security Research" award. Another notable achievement of various CMAD and Regional collaborators was the award of the EPA Gold Medal for Exceptional Service for Ebola outbreak response planning. Other significant CMAD distinctions include Terry Smith's Silver Medal "in recognition of protecting public health and the environment through exceptional scientific support" and Captain John Cardarelli's United States Public Health Meritorious Service Medal for notable career accomplishments in radiological remote-sensing technologies and in preparing the Nation for large-scale radiological responses.

In an effort to continually enhance CMAD capabilities with experienced, knowledgeable, and capable personnel, CMAD has gained two new staff members. Terry Smith has officially joined CMAD and brings more than 40 years of experience in chemical analysis, quality management, operations management, and research. Terry has a Bachelor's Degree in chemistry and a Master's Degree in geochemistry. He joined EPA in 1999 as Program Manager of EPA's Contract Laboratory Program (CLP) and transitioned to the Office of Emergency Management (OEM) in 2005 to establish the EPA Emergency Response Laboratory network, including PHILIS mobile operations as an EPA Chemical Warfare Agent (CWA) Laboratory. Terry is the OEM Science Liaison to the OLEM Office of the Science Advisor.

Another new face at CMAD and EPA is David Bright, co-recipient of the 2013 Nobel Peace Prize for his work as a weapons inspector and analytical chemist for the Organization for the Prohibition of Chemical Weapons (OPCW). Earlier in his career, David was a lead analyst at a chemical weapons destruction facility on Johnston Island and a chemist and test engineer with the Department of the Navy in Florida. He also has been a quality manager for the Nebraska Department of Agriculture Laboratory, where he developed and implemented a quality management system accredited under ISO/IEC 17025. Most recently, David worked at the U.S. Department of Agriculture (USDA) National Grain Center as a chemist in the Analytical Chemistry Branch.

We look forward to working with all of our partners during 2017.

Very Respectfully,

Mike Nalipinski
CMAD Associate Director

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REGION 3

Region 3 utilizes CMAD support in developing disposal strategies for "tritium getter" beds

During the Fall of 2015, On-Scene Coordinator (OSC) Ann DiDonato from Region 3 contacted the Consequence Management Advisory Division (CMAD) because she knew they had the personnel, expertise and resources to identify an economic disposal option for more than 30 "tritium getter" (also known as "pyro") beds abandoned at the Safety Light Corporation (SLC) site in Bloomsburg, PA. The Region 3 Emergency and Rapid Response Services (ERRS) contractor had identified a potential disposal option, but the costs were extraordinarily high. CMAD worked with Region 3 and its contractors to research alternative disposal methods. CMAD also used its support contractor to find tritium getter experts to develop characterization and disposal strategies.

A tritium getter bed is composed of a few hundred grams of finely divided, chemically reactive (pyrophoric), depleted uranium-238 (U-238) metal enclosed in a stainless-steel vessel with associated valves and tubing. When a getter bed is exposed to hydrogen or tritium at room temperature, a chemically stable uranium hydride compound forms, and the getter bed acts as a hydrogen storage device. The devices were used to ship and store large quantities of tritium and to collect unused tritium during past manufacturing activities at the Safety Light plant. Each tritium getter bed contains approximately 150 to 500 grams of U-238 and has 5,000 to 25,000 Curies (Ci) (185 to 925 terabecquerels [TBq]) of tritium bound to the uranium. Getter beds were attached to work stations and then heated above 300 degrees Celsius to release the tritium from the bed to make products such as exit signs. The tritium in these signs is what makes them glow.

There are several disposal options for the abandoned tritium getter beds. One option is to recycle the tritium by shipping the getter beds from the SLC site to users who can recycle and then reuse the tritium. However, potential users were not interested in the SLC getter beds because of their poor condition and the unknown amount of tritium they contained. Another option is disposal, but this option requires that EPA, as the generator, must quantify the amount of tritium contained so that the getter beds can be properly shipped to the ultimate disposal site. A third option that is currently being evaluated is to process the getter beds in batches in a manner that oxidizes the reactive uranium in a controlled environment while capturing any released tritium.

Calorimetry, the process of measuring the heat of chemical reactions, is a potential method being considered to quantify the amount of tritium in the getter beds. The challenge is to find a calorimeter with a chamber large enough to fit an entire getter bed. One such calorimeter was located in the United Kingdom, and it is portable so that it can be moved to the site if needed to measure tritium concentrations in each of the getter beds. To conduct these sensitive measurements, a temporary structure would need to be built. Each measurement takes approximately 8 hours, with a detection limit of about 100 Ci (3.7 TBq). Special efforts can be made to reduce the detection limit to about 50 Ci, if needed.

The uranium in the getter beds is pyrophoric and therefore must be addressed before the getter beds can be safely disposed of. One method is to oxidize the uranium, but by doing so, the remaining tritium would be released to the environment. Another method involves macroencapsulating the entire getter bed to prevent releases. However, this option later was determined to be unacceptable because of the associated high costs. The batch processing described earlier is under evaluation and may simultaneously address the uranium and tritium issues.

CMAD developed a detailed work plan to dispose of the getter beds that considers the following:

1. Equipment and facility requirements to conduct characterization measurements
2. Disposal plans
3. Number of personnel and schedule to complete the job
4. Health and Safety Plan
5. Operating procedures
6. Quality assurance and quality control measures
7. Cost estimates

The work plan provided Region 3 with the information needed to potentially carry out the work.

Previously, Region 3 had only one cost estimate from an internal source that the OSC had felt was excessive. The CMAD cost estimates are lower than the original estimate but do not cover further investigation that must be conducted to complete the work. A key factor affecting the cost estimates are transportation and disposal costs that require the tritium getter beds to be fully characterized, which account for about 25 percent of the total costs.

Region 3 used the CMAD work plan to solicit independent bids from other vendors to reduce disposal costs. These efforts did not yield any viable economic options for Region 3. As a result, the getter beds remain on site in a temporary storage area until funds become available for disposal or until the option of batch processing is determined to be economic and satisfactory. For more information about CMAD involvement, contact Captain John Cardarelli (U.S. Public Health Service) at cardarelli.john@epa.gov.

This story illustrates how EPA Regions can use CMAD to assist with removal and remedial challenges. CMAD worked with Region 3, providing additional technical and contractual reach-back support to develop detailed work plans and allow a better understanding of the costs and complexities associated with characterizing and disposing of tritium getter beds. CMAD's efforts helped Region 3 identify alternative disposal methods that cost less.

Tritium getter bed from the Safety Light Corporation site, Bloomsburg, PA

RTFL

Radiation Task Force Leaders annual training

Radiation Task Force Leaders (RTFL) participated in annual refresher training in Montgomery, AL at the Radiological Emergency Response Team (RERT) facility on Gunter Annex of Maxwell Air Force Base (AFB) on January 11 through 15, 2016. The training focused on sample collection and procedures for operating in support of RERT's Mobile Environmental Response Laboratory (MERL). RERT hosted the event in its warehouse, which was a conducive environment as a training facility.

Along with several firefighters and military security staff from Maxwell AFB, 12 RTFLs participated in the training event. Topics covered included sample collection procedures, personal protective equipment (PPE), best practices, contamination control, detection equipment use, and MERL-specific procedures to process samples in preparation for counting and further analysis. Three teams rotated the tasks of collecting samples (air, water, swipe, and soil), in-processing the samples and paperwork for MERL procedures, and counting the actual samples in the MERL.

During this training event, the RTFL participants discussed EPA's radiation asset management, and agreed that merging capabilities, equipment, and personnel would greatly improve EPA's response program. In the future, radiation response should be coordinated through:

- Office of Emergency Management for permission to use RTFL
- Office of Radiation and Indoor Air and RERT for MERL
- Consequence Management Advisory Division and Environmental Response Team for instructors and support
- Regions for the RTFL personnel

Future training events will offer enhanced training in several areas, depending on the desires of the students and instructors. Topics considered include air sampling calculations, PPE, detailed training on health physics units and terms, counting statistics, and various instrument "clinics."

Through attrition (retirement, new jobs, etc.) the size of the RTFL program has fluctuated. In upcoming sessions the program will offer new particpants training to join the team.

Practicing soil sampling procedures

We thank the following individuals for their RTFL participation: Chris Guzzetti, David Pratt, Antony Tseng, Daniel Garvey, Lawrence Libelo, Michael Mikulka, and Michael Carillo. For more information about CMAD involvement, contact Scott Hudson at hudson.scott@ epa.gov.

REGION 4

Region 4 advanced radiation training support in Atlanta, GA

At the request of On-Scene Coordinators (OSCs) Kevin Eichinger and Chuck Berry, the Consequence Management Advisory Division (CMAD) supported EPA Region 4's annual advanced radiation training event on March 22 and 23, 2016 in Atlanta, GA. This training exercise followed the Region 4 Safety, Health and Environmental Management (SHEM) guidelines to emphasize actual work practices, and involved response activities in areas with elevated (above naturally-occurring background) radiation readings. Approximately 30 EPA and local firefighters participated in the first day of training, while the second day's exercise was limited to 20 EPA participants.

The first day of training covered a case history of an actual EPA response at a contaminated apartment in Boise, ID. The EPA Radiological Emergency Response Team (RERT) directed this response with the assistance of the Department of Energy (DOE), Civil Support Teams (CST), and GA state resources. The case history discussion included possible alternative tactics and remedial strategies was well received by Region 4 students. This case history will be considered for future training efforts. In addition, in preparation for the next day's exercise, discussions and didactic training covered turn-back levels, types of radiation detection equipment, equipment operating parameters and use, and best practices for a contaminated environment. Students reiterated the oft-heard complaint, "If you don't use it, you lose it" regarding radiation response guidelines, underscoring the need for annual (or more frequent) training on rare or unusual response situations, with a focus on turn-back levels, isotope-specific information, and the waiver process for exceeding the annual 500-millirem EPA limit. All participants passed the exam with a score of 80% or better, qualifying them as having passed the advanced radiation safety training event.

The second day consisted of an all-day response to an "unknown" material. By using multiple entries, the responding teams discovered a radiation reading from a container mixed in with several other containers, collected swipes to determine if contamination was present, and measured ambient gamma-ray dose rates in proximity to actual milliCurie-level sources, provided by the CMAD Radiation Source Program for use during the training. All responding team members were dressed in appropriate PPE and dosimetry, in addition to wearing real-time dose reading instruments. One important parameter of concern was what kind of dose each responder might receive under these "live-agent" conditions. After the training, all dose readings were compared – the highest dose received was less than 1.5 millirem. EPA responders are limited to 500 mrem annually; most radiation workers are allowed a limit 10x higher, or 5,000 millirem per year from occupational exposures. Acute health effects are not observed until 25,000 to 50,000 millirem. This exercise demonstrated the effectiveness of the as low as reasonably achievable (ALARA) principles in limiting dose.

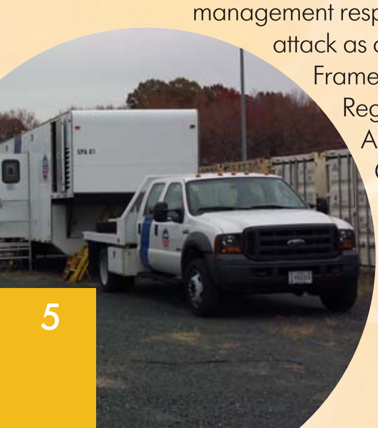
Overall, the training and exercise succeeded in providing Region 4 participants with valuable experience. Region 4 has already reached out to CMAD for assistance in planning the 2017 annual training, which is intended to involve the CSTs in the Region 4 area. For more information about CMAD involvement, contact Scott Hudson at hudson.scott@epa.gov.

ECBC

Regions receive support for CBRN exercises from ECBC and Special Teams

In October 2015, Region 3 On-Scene Coordinators (OSCs) invited subject matter experts from the Consequence Management Advisory Division (CMAD) and Environmental Response Team (ERT) to participate in their chemical warfare agent (CWA) Level A training and exercise at the Edgewood Chemical and Biological Center (ECBC). The Level A exercise also included Region 5 OSCs, members of the National Guard Civil Support Teams (CSTs), Chemical Biological Application and Risk Reduction (CBARR) team, and Aberdeen Proving Ground (APG).

ECBC at the Department of Defense (DoD) facility at APG in Maryland is home to the CBARR team. CBARR has extensive experience in the decommission of U.S. CWA facilities as well as with the recent destruction of chemical agent precursors from the Syrian conflict. EPA has reached out to CBARR to determine if CBARR's experience and assets can be leveraged to augment EPA's capacity and capability to provide consequence management response in the event of a CWA terrorist attack as defined under the National Response Framework (NRF). As part of this effort, EPA Regions 2 and 3 have held two CWA Level A training and exercise sessions with CBARR participation in October 2015 and May 2016.



Exercise participants spent 2 full days responding to a realistic CWA incident scenario that ECBC carefully planned with EPA Region 3 to address specific training needs. A mock single-family home was constructed inside an APG warehouse and staged to resemble a home laboratory where terrorists had loaded mustard agent into fire extinguishers for a planned attack. The OSCs performed a series of Level A entries into the test venue while being observed and evaluated by the CBARR, ERT and CMAD subject matter experts (SMEs) who then provided entrants with productive feedback.

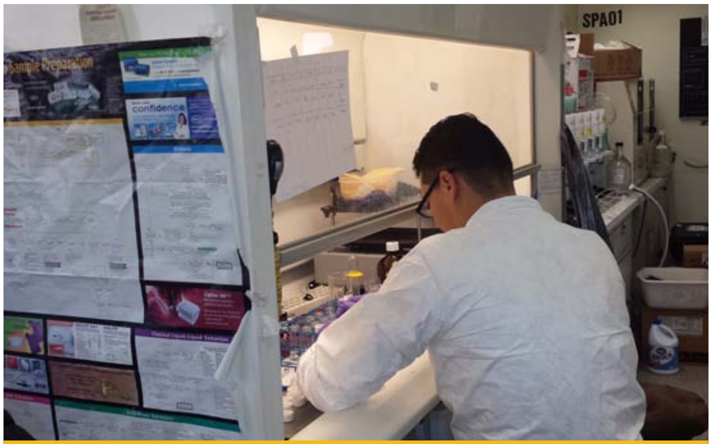
Region 3 OSC Charlie Fitzsimmons stated, "This training offered us something we don't usually get -- very specific instruction in chemical and biological agent response and recovery techniques taught by people who have done it all. . . . Theory can't replace the ECBC instructors' on-the ground experience; they have tried and true methods we can adopt." Another observer at the training, Nancy Abrams, a program analyst from EPA Office of Emergency Management (OEM) headquarters, stated, "ECBC's knowledge of the history and toxicity of chemical warfare agents is unique, and they created a very good scenario for real-world training with some very realistic details. Duplicating the transfer of command from the CST team to the EPA was a unique aspect to this exercise and made it even more realistic. It's also very helpful for the EPA and ECBC to get to know one another's capabilities."

In May 2016, Region 2 OSCs also held their own CWA Level A training at the ECBC training facility. Emergency Response Special

Teams members from CMAD and ERT repeated their roles as observers and evaluators.

The Region 2 exercise utilized the same APG venue with a mock home and sulfur mustard agent scenario. The SMEs and ECBC evaluators provided feedback on the implementation of CWA characterization sampling methods, personnel decontamination line protocols, and emergency response operating procedures.

Through an expanded Interagency Agreement (IA), EPA will continue to develop and deepen its cooperative relationship with CBARR to leverage their expertise, experience, and response assets to augment EPA's CWA response capabilities and responsibilities under the NRF. CMAD has played a pivotal role in cultivating this cooperation with CBARR, beginning



Laboratory analyst preparing samples to be tested for sulfur mustard contamination

EPA emergency responders in Level-A PPE entering building potentially contaminated with sulfur mustard simulant during training exercise

as early as 2010 with projects jointly sponsored by the EPA and Department of Homeland Security (DHS) under the "Remediation Guidance for Major Airports After a Chemical Attack" and the "Integrated Detection Decontamination Demonstration Project." The two organizations will continue to foster strong ties in efforts to strengthen their capabilities for consequence management response in the event of a CWA terrorist attack. For more information about CMAD involvement, contact Terry Smith at smith.terry@epa.gov.

NCERT

National Criminal Enforcement Response Team annual training in Brunswick, GA

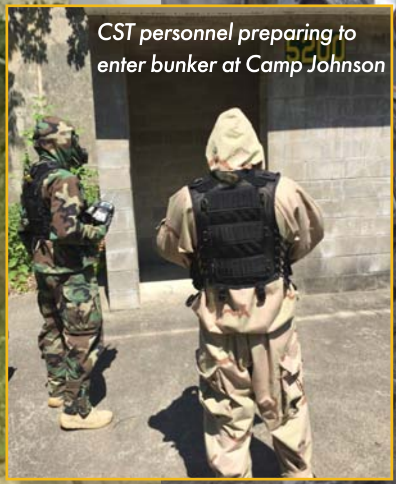
On April 18 through 20, 2016, the National Criminal Enforcement Response Team (NCERT) conducted its annual training at the Federal Law Enforcement Training Center in Brunswick, Georgia. Personnel from the Consequence Management Advisory Division (CMAD) and the Environmental Response Team (ERT) participated in the classroom discussions, which covered donning and doffing Level A personal protective equipment (PPE), developing Health and Safety Plans, and developing quality assurance/quality control measures.

CMAD discussed its mobile assets, including the Portable High-Throughput Integrated Laboratory Identification System (PHILIS) and the Airborne Spectral Photometric Environmental Collection Technology (ASPECT). PHILIS is a rapid-turnaround mobile laboratory for the on-site analysis of chemical warfare agents and toxic industrial compounds in environmental samples. ASPECT is a fixed-wing, response-ready aircraft that can collect chemical, radiological, and photographic data to provide actionable intelligence to decision-makers within minutes of data collection using a satellite communication system while the aircraft is still flying.

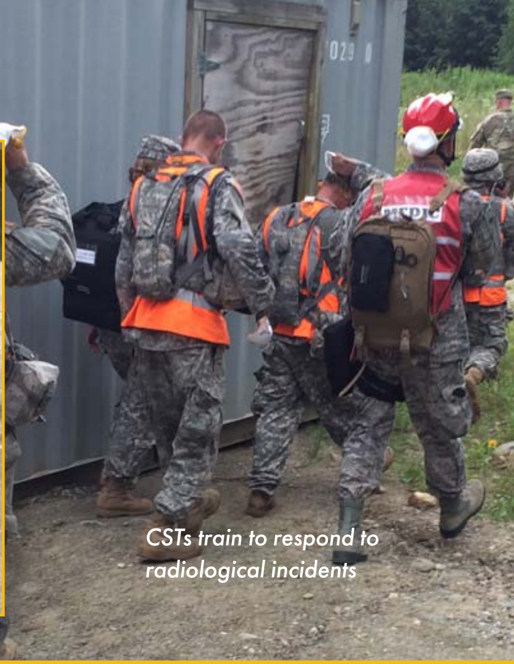
ERT provided a briefing on the VIPER Data Management System, a wireless network-based communications system designed to enable real-time transmission of data from field sensors to a local computer, remote computer, or enterprise server and provide data management, analysis, and visualization.

CMAD and ERT participated in NCERT's practical exercises, including performing a confined space entry. NCERT, CMAD, and ERT also discussed further response and collaboration opportunities. For more information about CMAD involvement, contact Mike Nalipinski at nalipinski.mike@epa.gov.

Actors participating in the exercise took direction from the Search and Rescue Team



CST personnel preparing to enter bunker at Camp Johnson



CSTs train to respond to radiological incidents

RAD FSE

CSTs train to respond to radiological incidents

Vigilant Guard is sponsored and funded by the U.S. Northern Command (NORTHCOM). According to U.S. Army Captain Konrad Stawicki (Deputy Directorate of Military Support, Joint Force Headquarters, Vermont National Guard), Vigilant Guard is a Full-Scale Exercise (FSE) designed to test the maximum level that a state's National Guard can handle in its defense support of civil authorities. Approximately 5,000 troops from around the country participated in this exercise. The Consequence Management Advisory Division (CMAD) provided its radioactive sources to support mock radiological response scenarios during the week of July 25, 2016. CMAD is licensed by the Nuclear Regulatory Commission (NRC) to maintain a series of radioactive sources (gamma and neutron emitters) for calibrating and checking instruments, conducting field exercises and demonstrations, and teaching and training individuals in civil defense activities. CMAD provides access to these sources to state, federal, and local partners for training purposes and manages all the field logistics related to health and safety, transportation, and storage of these sources.

CMAD sources generate an elevated but safe radioactive environment and allow exercise participants to gain experience using field instruments in a real-world setting. CMAD personnel only provided the radioactive sources and did not provide tactical directions or guidance on National Guard or Civil Support Team (CST) field protocols or operations. The sources consisted of an Americium-241/Beryllium (Am/Be) neutron source and two Cobalt-60 and two Cesium-137 beta/gamma sources.

EPA personnel distributed these five radioactive sources throughout three locations: two at Camp Ethan Allen and one at Camp Johnson. Camp Ethan Allen placed five conex boxes in the shape of a "U", and then EPA personnel positioned the Cesium-137 beta/gamma and Americium-241/ Beryllium (Am/Be) neutron sources inside two of the conex boxes. Firing Point 74 also contained two conex boxes, a shed, a truck, and two scrap metal piles. EPA personnel also placed a Cesium-137 source in one conex box and a Cobalt-60 source in a scrap metal pile within the training area. The Camp Johnson location had a bunker that housed a Cobalt-60 source for location and identification training scenarios.

Various CSTs performed surveys at each location. Some surveys consisted only of locating and identifying the source, whereas other surveys became increasingly complex with the addition of actors playing the role of exposed civilians that required safe evacuation for further medical attention. In one instance, radiological surveyors used a cone system to identify regions of higher radioactivity, where a yellow cone classified an area with two times the background level, an orange cone indicated a measurement of 2 milliRoentgens per hour (mR/h), and a red cone indicated a measurement of 10 mR/h.

Overall, the exercise taught the participants many valuable lessons with respect to instrument response and field protocols. This type of training prepares personnel for interpreting equipment readings and rapidly detecting, identifying, and isolating radiation sources. The training provided a good example of how practical field experience cannot be obtained by using smaller check or "button" sources. The training provided NORTHCOM and the Vermont National Guard with points to consider for future training exercises and demonstrates that a live-agent radiation exercise should be included in the training of emergency responders in CBRN areas of operation.

For more information about the CMAD source inventory and how to request use of the sources for civil defense training, contact the CMAD Radiation Safety Officer, Captain John Cardarelli (U.S. Public Health Service) at cardarelli.john@epa.gov.

REGION 7

Region 7 supported by PHILIS team during sulfur mustard response in St. Louis, MO

Safe containing vial of potentially hazardous material

On March 24, 2015, the St. Louis Metro Police Department (SLMPD) executed a search warrant at a convenience store and found a suspected hazardous material in a vial after opening a locked safe on the property. The St. Louis Fire Division was notified, and they verified that the air in the store was unaffected by the material. The SLMPD Bomb and Arson Unit determined that the vial possibly contained sulfur mustard, a blistering substance commonly used as a chemical warfare agent.

To ensure public safety, the St. Louis Building Inspector ordered that the building be condemned and boarded up immediately. The property was to remain closed until samples could be collected and analyzed, and the property cleared of contamination. The City of St. Louis (City) and its contractors were unable to find a laboratory that could analyze for sulfur mustard. Ultimately, the Building Inspector called the EPA Region 7 Phone Duty Officer to request assistance in finding a willing and accredited laboratory. On March 25, 2016, the EPA Region 7 Phone Duty Officer contacted the Consequence Management Advisory Division (CMAD) about the availability of laboratory support.

Based on discussions with the EPA Region 7 Phone Duty Officer and the St. Louis Building Inspector, CMAD staff proposed sending screening and surface wipe sampling kits with instructions directly to the City. The plan proposed by CMAD was that the City would collect the samples and ship them to the Portable High Throughput Integrated Laboratory Identification System (PHILIS) laboratory unit in Castle Rock, Colorado, for rapid turnaround analysis. The plan, once agreed upon, resulted in a request for Federal Assistance from the Missouri Department of Natural Resources to EPA Region 7.

CMAD staff, with their PHILIS contractor, prepared and shipped the screening and sampling kits directly to the St. Louis City contractor. EPA Region 7 deployed On-Scene Coordinator (OSC) Joe Davis to the site during sample collection to ensure adherence to a written sampling plan and conformance with chain-of-custody procedures. Under supervision by OSC Davis, the City contractor deployed a number of "M8" and "M9" screening papers sensitive to sulfur mustard throughout the site to detect "hot spots," to help delineate sampling locations, and to ensure contractor safety. No "hot spots" were identified. The contractor then collected 12 surface wipe samples from throughout the convenience store and from the safe that contained the vial. The samples were double-wrapped, placed in a cooler with ice, and shipped to the PHILIS laboratory.

CMAD analyzed the samples for sulfur mustard (and mustard degradation products) following an EPA method developed by the EPA National Homeland Security Research Center. Sampling results were validated through a multi-laboratory validation process that included the PHILIS laboratory in Castle Rock, Colorado. No sulfur mustard (or degradation products) was detected in any of the 12 samples, using an established reporting level for sulfur mustard at 5 nanograms per wipe sample.

Fewer than 72 hours were required from the time of the initial request for analytical assistance to shipping the sampling kits, collecting the samples, and providing the analytical results to the City. This effort resulted in a successful coordination and response demonstrating the results of a prepared team and well managed program. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

Vial

December 2016 OSC Academy speakers: Megan Palmer (Stanford University), Ben Franco (OSC R4), Francisco Cruz (CMAD), and Worth Calfee (NHSRC)

OSC

CBRN response training at the 2016 OSC Academy

Although On-Scene Coordinators (OSCs) are very familiar with industrial chemical releases and oil spills, incidents involving biological agents, chemical warfare agents (CWA), and dirty bombs may present unique challenges to even the most seasoned OSC. To further the awareness of the OSC community about chemical, biological, radiological, and nuclear (CBRN) threats and responses, the Consequence Management Advisory Division (CMAD) facilitated the CBRN training track for the January 2016 offering of the OSC Academy, and then a more advanced Biological training track during the December 2016 event.

The OSC Academy provides 1 week of training opportunities for OSCs. The biggest change from the former OSC Readiness structure is the implementation of OSC training tracks.

Training was divided into specific disciplines, including Advanced Oil Response – Emergency Response, Advanced Oil Response – Oil Removals, CBRN Response, and the Comprehensive Environmental Response and Recovery Act (CERCLA) Response. During the January 2016 offering, OSCs participated in track-specific training for the entire week of the OSC Academy, with networking opportunities scheduled during break periods. The 4 days of the CBRN training track were divided into general CBRN response and support, CWA response, biological agent response, and radiological and nuclear response. CMAD's goal for the training was to provide OSCs with training to make them familiar with key resources and information to respond to an incident, with more specialized resources, such as CMAD supporting the response. Lectures focused on sampling, laboratory analysis, regulatory authorities, health and safety, decontamination, and EPA and other federal agency resources. Additionally, several case studies were presented to train OSCs about the challenges they may face during a CBRN incident.

A second offering of the OSC Academy was held December 5-9, 2016, with some small adjustments to the format. Track-specific training was held over 2 days, and the remaining days allowed OSCs to enroll in other courses of interest. The CBRN training track in December focused on biological responses, as more OSCs are familiar with general CWAs and radiological incidents during non-homeland security scenarios. OSCs Ben Franco (Region 4), Steve Wolfe (Region 5), and Jason Musante (Region 9) finished the two-day session by conducting a biological table top exercise to reinforce the materials presented.

Instructors for the courses were from the following organizations:

- Regional OSCs and Subject Matter Experts
- CMAD
- National Homeland Security Research Center (NHSRC)
- Environmental Response Team (ERT)
- Radiological Emergency Response Team (RERT)
- Office of Resource Conservation and Recovery (ORCR)
- ECBC CBARR
- Gerard Proehl, International Atomic Energy Agency (IAEA)
- Wisconsin National Guard
- Heather Underwood, Denver Bio Lab
- Megan Palmer, Stanford University

For more information, contact Paul Kudarauskas at kudarauskas.paul@epa.gov.

ERRP

Developing an Environmental Response and Remediation Plan for biological agent incidents involving *Bacillus anthracis*

To prepare for potential future biological responses, the EPA Consequence Management Advisory Division (CMAD) has been working to develop Environmental Response and Remediation Plans (ERRP) for biological incidents involving *Bacillus anthracis* (*B. anthracis*) for use by U.S. cities with mass transit systems. The ERRP is based upon the New York City Bio-Response efforts led by Region 2 On-Scene Coordinator (OSC) Chris Jimenez, Region 3 OSC Rich Rupert, and Region 5 Homeland Security Advisor Mark Durno. The objective of the ERRP is to provide tactical and operational guidance to help restore a mass transit system to operational status after the release of *B. anthracis*. The ERRP assumes *B. anthracis* as the biological agent since *B. anthracis* is persistent in the environment and difficult to inactivate , and thus almost any other biological agent incident would respond to the same methods and techniques. The ERRP provides guidance on sampling, decontamination, clearance, waste management, safety, and other processes needed for successful remediation.

Location-specific features of a major city such as a dense population, a large subway system, the presence of key economic institutions, and a unique urban environment require consideration. The ERRP serves as a "template" for biological remediation and response that can be modified based on the actual location and events of an incident. The ERRP template is structured so that text can be modified and updated as necessary, with some sections tailored to reflect the user's city- or state-specific remediation and response plans. It should be noted that due to many factors being unknown, until an actual incident occurs, the ERRP does not provide step-by-step instructions for responding to an incident and does not focus on an incident of any particular size. Instead, the ERRP provides guidance that is scalable and applicable to small-scale incidents (defined as affecting a single building) as well as to incidents that affect multiple city blocks, hundreds of facilities, and multiple response agencies.

Many phases of a response are linked, and the goal of response and recovery to allow reoccupancy generally drives the overall response strategy. Proper planning and prioritization of resources, preferably before an incident occurs, are critical to achieve reoccupancy. One goal of the ERRP is to provide cities with a useful tool for considering planning and resource prioritization issues before an incident occurs in order to achieve reoccupancy as quickly and easily as possible.

Response and recovery after the release of *B. anthracis* (or any biological agent) is a complex and resource-intensive undertaking that will present local, state, and federal agencies with many challenges related to resource limitations and knowledge gaps. Throughout the ERRP, the text identifies current gaps in knowledge, science, data, and experience for incidents involving *B. anthracis*. Identification of these gaps will help ensure that associated issues are planned for ahead of time, potentially saving lives, time, and resources. The limited response experience for a large-scale *B. anthracis* incident likely will result in a strong need to improvise and adapt commonly available resources and techniques for effective remediation. During a response, ERRP users may need to field-prove and modify the techniques presented to help establish the process knowledge required for environmental- and site-specific conditions.

The ERRP also facilitates discussion of many policy issues that warrant consideration by state and city agencies before an incident occurs. In its entirety, the ERRP provides a single point of reference for state-of-the art information and procedures on both pre-planning and disaster management to help cities manage the magnitude and complexity of recovery operations required after a biological incident. For more information, contact Natalie Koch at koch.natalie@epa.gov.

REGION 5

Region 5 synthetic drug decontamination and PPE technical support to Lac Du Flambeau Band of Lake Superior Chippewa

EPA Region 5 On-Scene Coordinator (OSC) Kathy Halbur requested technical consultation assistance from the Consequence Management Advisory Division (CMAD) for the Lac Du Flambeau Band of Lake Superior Chippewa, a federally recognized tribe in northern Wisconsin. Specifically, CMAD provided support regarding decontamination options for structures contaminated by synthetic drugs. OSC Halbur facilitated discussions between the EPA, the Agency for Toxic Substances and Disease Registry, and the Regional Tribal Office.

During discussions on decontamination options and procedures, the Tribal Police Department also requested that CMAD provide personal protective equipment (PPE) recommendations for upcoming law enforcement actions at additional properties suspected of containing synthetic drugs. CMAD coordinated with National Criminal Enforcement Response Team (NCERT) staff in Lakewood, Colorado, and Edison, New Jersey, for tactical information on how federal law enforcement agencies have been addressing incidents involving synthetic drugs. All information then was shared with the tribe.

The Lac Du Flambeau Band of Lake Superior Chippewa was satisfied with the recommendations for structure decontamination and the tactical PPE recommendations provided by the NCERT and CMAD. For more information about CMAD involvement, contact Mike Nalipinski at nalipinski.mike@epa.gov.

BIO SOP

Biological Decontamination Line Standard Operating Procedure Video

In preparation for potential Ebola contamination responses, the EPA National Homeland Security Research Center (NHSRC) released a draft study titled "The Decontamination Line Protocol Evaluation for Biological Contamination Incidents Assessments and Evaluations Report" that identifies vulnerabilities in the "Long-Term Biological Decontamination Line SOP." The NHSRC study found that decontamination line liquid can be a contaminant carrier and that existing personal protective equipment (PPE) doffing procedures could put personnel at risk to exposure. Partnering with EPA federal On-Scene Coordinators (OSCs) who have experience in responding to biological incidents and/or are regional representatives that served on the National Biological Preparedness Working Group, along with subject matter experts (SME) from the National Homeland Security Research Center (NHSRC), the Consequence Management Advisory Division (CMAD) assisted with the development of a decontamination standard operating procedure (SOP) titled "Long-Term Biological Decontamination Line SOP" to help protect EPA OSCs and their contractors during removal activities.

"EPA's Ebola 2014 Outbreak Decontamination Line SOP" (later renamed the "Bio Response Decontamination Line SOP") was developed and then tested during several trainings in Fiscal Year 2015. A functional training exercise was developed and led by EPA Region 2 OSC Chris Jimenez, CMAD, the Environmental Response Team (ERT), the National Counterterrorism Evidence Response Team (NCERT), NHSRC, and the Centers for Disease Control and Prevention (CDC). During the training, OSCs and contractors practiced and evaluated the SOP to help develop decontamination and engineering best practices to facilitate the cleanup and decontamination of Ebola. After the training, the SOP was edited and finalized to incorporate changes and issues identified during the training.

Biological decon line prepared in accordance with SOP

CMAD personnel donning PPE prior to video production

These efforts culminated in July 2016, when CMAD personnel, with the assistance of EPA's Office of Multi Media (OMM), created a video detailing the processes outlined in the "Bio Response Decontamination Line SOP." Over the course of a week, CMAD and OMM filmed PPE donning, decontamination, and PPE doffing procedures to create a visual just-in-time training tool for use by the EPA Regions during responses to biological incidents. For more information about CMAD involvement, contact Francisco Cruz at cruz.franciscoj@epa.gov.

Filming the decon process

DHS conducts release for UTR study in NYC

UTR

Collaboration with MIT's Lincoln Laboratory in support of the DHS Underground Transport Restoration Project during a NYC full-scale dispersion subway test

As part of the Underground Transport Restoration (UTR) Project, in May 2016, the U.S. Department of Homeland Security (DHS) funded a comprehensive test to demonstrate and determine what would happen if a biological agent was released into a fully operational subway system. Specifically, the test focused on how aerosolized particles and gases travel in and through a subway environment. Subways, by nature, are dynamic environments with rapid and predictable movement. Subways are used by hundreds of thousands of people and have miles and miles of track and tunnels. Subway cars quickly accelerate and decelerate in and out of stations and have active and passive heating and ventilation systems. The test studied New York City's (NYC) subway system because it is the most complex, busiest, and largest transit system in the United States. NYC's Metropolitan Transit Authority (MTA) operates over 600 miles of subway tracks. At rush hour, over 4,000 subway cars are in service, and more than 5.5 million people use the MTA subway on a typical weekday.

EPA personnel from several Regions 1, 2, 3, 5, and 9, the Consequence Management Advisory Division (CMAD), the National Homeland Security Research Center (NHSRC), and the Environmental Response Team (ERT) supported MIT Lincoln Laboratories, the lead for this phase of the UTR Project, at NYC's Grand Central Terminal to perform the test, which covered 55 train stations (including two in Queens, one in Brooklyn, and one in New Jersey) and the interiors of 10 different trains. A total of 115 people participated in this event.

During a routine week for the MTA transit system (no major closures, holidays, or special events), the test controllers released 1 gram of a harmless aerosolized analogue of simulated anthrax particles into the air every minute for 20 minutes each day from one of the platforms at Grand Central Terminal. Lawrence Livermore National Laboratory developed the anthrax surrogate, which has been used in the past to help the U.S. Centers for Disease Control and Prevention track food-poisoning outbreaks. Two particle sizes were developed for this test, 2 microns and 5 microns. A series of DNA chains was attached to the particles that acted as microscopic "barcodes." During the week, the controllers released particles with different barcodes into the system. These barcodes helped researchers understand how the air moves throughout the entire subway system as well as how particles resuspend and reaerosolize.

In addition to the anthrax surrogate particles, the controllers also released a harmless perfluorocarbon gas into the system. Argonne National Laboratory has developed dispersion models for use by subway operators and owners and local, state, and federal emergency responders to predict air flow during a biological incident. These models were developed based on the results from several past air-flow tests using gases. The perfluorocarbon gas was tracked as a control to demonstrate that the air flow during this test did not radically deviate from the original tests used to calibrate the dispersion models.

During the week of testing, the sampling teams collected approximately 7,000 surface wipe and air samples as well as 5,000 gas samples. Surface wipe samples were collected from aluminum coupons placed throughout the subway platforms, and air samples were collected from filters on personal monitors worn by samplers riding the trains, stationary filter units throughout the MTA stations and platforms, and HVAC filters from a limited number of trains and buildings. Additional sampling locations included building rooftops and aboveground sidewalks.

Region 2 OSC, Neil Norrell, served in the lead role for EPA as the Regional Manager Coordinator overseeing the multi-organization sampling teams. Other EPA personnel served as Sample Team Managers and Quality Assurance/Quality Control Leaders, assisted in concurrent sampling efforts, and performed the enormous tasks of data management and sample processing and shipping. Approximately 100 people each day performed tasks needed to accomplish test objectives.

The data from this test will be used to validate and improve the dispersion models previously developed by Argonne National Laboratory to predict air flow during a biological incident.

Removing a sample from a portable sampling unit (PSU)

An effective model could allow a response team to rapidly isolate sections of the subway to minimize the spread of particles and thus impact fewer people. The test results also will be used to improve plans for placing detection equipment within the transit system to ensure the fastest response possible. Ultimately, the findings of the UTR Project will allow EPA to develop better plans for responding to, decontaminating, and recovering from a biological attack. For more information about CMAD involvement, contact Elise Jakabhazy at jakabhazy.elise@epa.gov.

Test participants included the Metropolitan Transit Authority, Metro North Railroad, NYC Police Department, MIT Lincoln Laboratories, EPA Regions 1, 2, 3, 5, and 9, National Guard Civil Support Teams, Argonne National Laboratory, Sandia National Laboratories, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Brookhaven National Laboratory, Pacific Northwest National Laboratory, Edgewood Chemical Biological Center, and the Singapore National Environment Agency.

Verifying the flow rate of the dry filter unit sampler

UTR OTD

CMAD, NHSRC, and Region 3 partner to conduct an operational exercise focusing on the rapid return to service of a subway system impacted by a biological agent release

In mid-2016, EPA's Consequence Management Advisory Division (CMAD) and the National Homeland Security Research Center (NHSRC), with Region 3, led the Underground Transport Restoration (UTR) Operational Technology Demonstration (OTD), an exercise focusing on the rapid return to service of a subway system impacted by a biological agent release. Jointly funded by EPA and the Department of Homeland Security (DHS), the UTR OTD involved numerous federal agencies, including EPA, DHS, Lawrence Livermore National Laboratory, the Massachusetts Institute of Technology (MIT) Lincoln Laboratory (LL), Sandia National Laboratory (SNL), and the Pacific Northwest National Laboratory (PNNL).

This major exercise required approximately 18 months to plan, 174 personnel to complete, and was conducted between September through mid-October 2016. In addition to the participating federal agencies mentioned above, multiple organizations assisted with the field work, including EPA Regions 3, 6, 7, and 9; EPA's Office of Resource Conservation and Recovery (ORCR); EPA's Environmental Response Team (ERT); the 32nd National Guard Weapons of Mass Destruction (WMD) Civil Support Team (CST); the U.S. Coast Guard Atlantic Strike team; the U.S. Army; the Virginia Department of Environmental Quality; and the Fort A.P. Hill (FAPH) Fire Department.

The UTR OTD focused on conducting and evaluating a field-scale remediation test of a mock mass transportation system for responders to learn scalable techniques that may be used for decontaminating an actual subway/transit system in the event of an intentional release of a biological agent, such as *Bacillus (B.)*

Sampling team in the Hot Zone

anthracis. EPA designated the following objectives for the UTR OTD:

- Conduct and evaluate field-scale remediation of a subway system, from initial discovery to final environmental remediation.
- Demonstrate fogging and spraying of sporicidal compounds to inactivate a biological agent in a subway system.
- Collect and analyze results from the decontamination study, and perform a cost analysis of the two decontamination approaches, fogging and spraying.
- Determine any adverse impacts on the subway system and its components from decontamination.

After evaluating several potential venues, the mock subway system at FAPH, VA was selected. Prior to conducting the field-test, EPA personnel, their contractors, and external partners all prepared the system for the releases, testing, and decontamination activities: MIT LL constructed barriers for contamination and toxic gas control; EPA installed negative air machines at the main barrier and each subway stairwell to aid in spore containment and to minimize drying time after

Sprayer decontamination system prior to entry in the Hot Zone

decontamination; EPA covered electrical systems to reduce damage from the decontamination solutions; and EPA Region 3 constructed an elevated personnel decontamination line outside of the main barrier along the tracks.

EPA released a non-pathogenic surrogate organism for *B. anthracis*, *B. atrophaeus*, into the mock system before each round of assessment.

EPA selected two off-the-shelf portable fogging and portable sprayer technologies for testing because these technologies are readily available and easily adaptable. EPA CMAD and NHSRC evaluated each technology during two separate field-level decontamination assessments.

During Round 1, EPA used a portable fogging system to deploy a germicidal bleach decontamination solution under field-relevant conditions. During Round 2, a portable low-pressure sprayer was used to spray a pH-adjusted bleach decontamination solution onto test

Region 3, CMAD and NHSRC complete spray decontamination of the tunnel

areas. These decontaminants were selected because they achieved a 6 log reduction of spores on a variety of surfaces in bench-scale experiments.

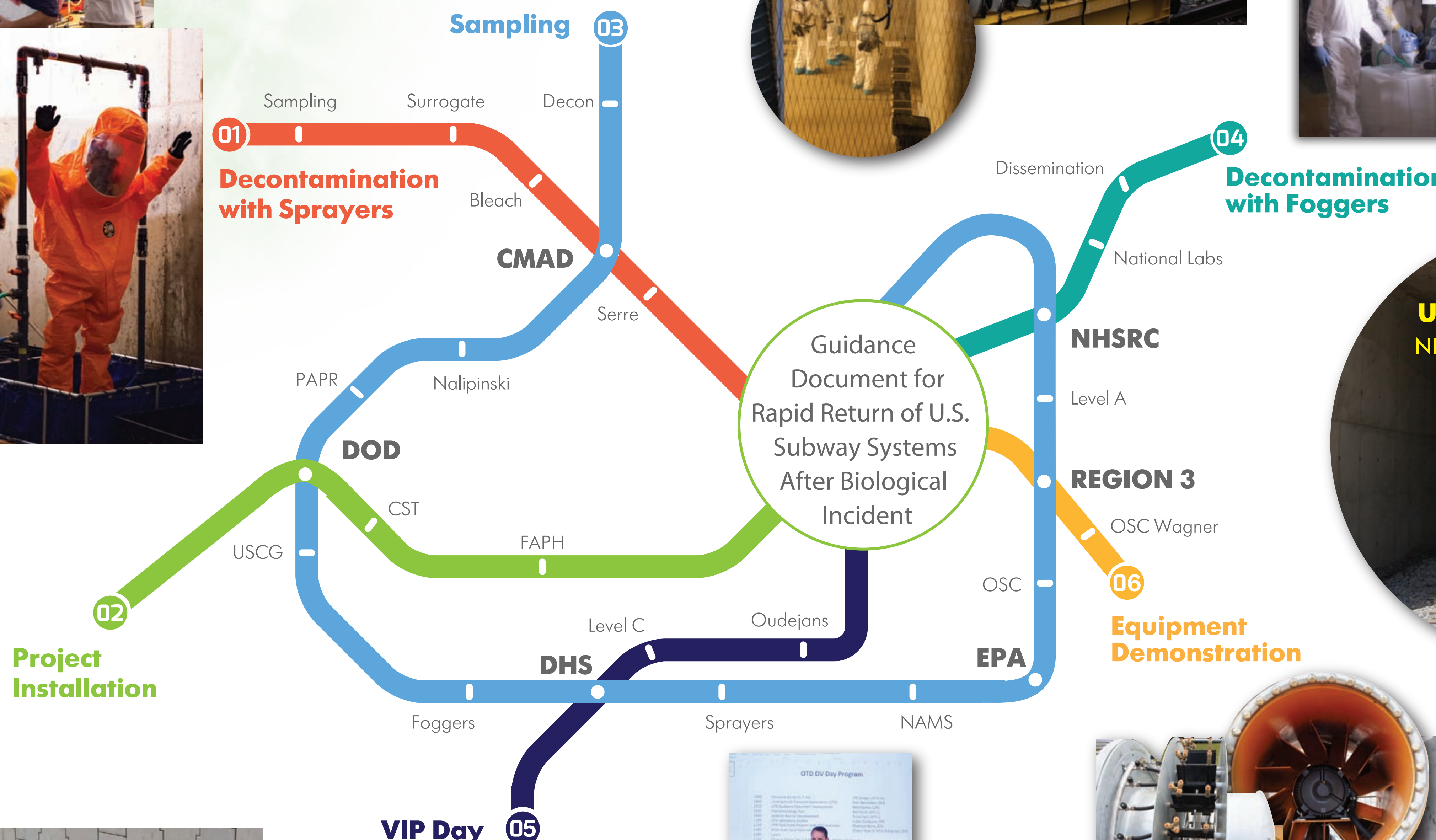
After completing both the fogging and spraying decontamination options, EPA then conducted additional remediation demonstrations of two additional off-the-shelf technologies to determine their feasibility for rapidly decontaminating a mass transit subway system. EPA and FAPH personnel loaded an orchard sprayer and a "dust boss" sprayer (commonly used for dust suppression) onto a flatbed railcar to move the equipment into the mock system. Researchers sprayed water onto test areas to test the technologies.

At this time, the final results of the UTR OTD study are pending. EPA will use information obtained from the study to develop a biological incident decontamination guidance document for subway system organizations throughout the United States to help them prepare for and respond to a biological agent release. For more information, contact Shannon Serre at serre.shannon@epa.gov.

Fogging and spray equipment for the decontamination tests

UTR

Underground Transport Restoration(**UTR**) Operational Technology Demonstration(**OTD**): conduct and evaluate field-level remediation of a subway system from initial discovery to final environmental remediation.



HPAI

Region 7, Region 3, CMAD, and NHSRC partner in a study to evaluate chlorine dioxide gas and heat treatment on highly pathogenic avian influenza

Commercial livestock production facilities contaminated with highly pathogenic avian influenza (HPAI) or other biological contaminants could pose risks to human and animal health. Operational procedures for decontaminating viruses and bacteria in complex facilities and under challenging conditions are limited, and knowledge gaps exist. Viable options for returning livestock facilities to pre-incident risk levels are needed immediately. To put that in perspective, in 2015, over 50 million chickens and turkeys were euthanized due to an HPAI outbreak. Furthermore, rapid-clearance methods are needed for all pathogens to facilitate the return of producers to normal business practices as soon as possible.

EPA Region 3 On-Scene Coordinator (OSC) Rich Rupert, Consequence Management Advisory Division (CMAD) and National Homeland Security Research Center (NHSRC) were joined by Region 7 OSCs Megan Schuette and Eric Nold for a large-scale study at a commercial poultry farm in Eagle Grove, IA, in March 2016. The farm had been infected with HPAI in 2015. The study evaluated the efficacy and material effects of chlorine dioxide (ClO_2) gas and heat treatment to reduce or inactivate viable test organisms. Testing was conducted in March 2016, when ambient temperatures ranged from 25 to 55 °F. This testing time was chosen to make operational conditions challenging for both treatment processes.

Test organisms ranged from bacteriophage to spore-forming bacteria on different surface materials, including several high-challenge surfaces. The test organisms were relevant microorganisms for *Bacillus anthracis* spores, HPAI, and other pathogens, and included MS2 bacteriophage, *Bacillus subtilis, Bacillus atrophaeus*, and *Geobacillus stearothermophilus*. Project testing was conducted under a cooperative research and development agreement (CRADA) between EPA and Sabre BioResponse, LLC (Sabre). The U.S. Department of Agriculture (USDA) also participated in the planning and execution of the study tests.

Commercial poultry farm, Eagle Grove, IA

The main objectives of the study are summarized below.

- Conduct a large-scale barn field test to compare ClO_2 fumigation and heat treatment technology efficacy during winter conditions in the Midwest by evaluating the two technologies for inactivating a bacteriophage surrogate. Based on the overall project objectives, microorganisms spanning the hierarchy of disinfectant susceptibility were used as biological indicators (BI) and included MS2 bacteriophage (a more resistant, non-enveloped viral microorganism) and *Bacillus subtilis* (a gram-positive, spore-forming bacterial microorganism).
- Evaluate the material effects of the two test technologies under specific treatment conditions.
- Evaluate the use of non-pathogenic surrogates that simulate HPAI as well as high-challenge surrogates on various building surfaces under a range of field conditions.

Dr. Worth Calfee (NHSRC) and Region 3 OSC Rich Rupert review a sample

Testing was conducted on material substrates with comparable compositions to surfaces and machinery found in poultry barns, including concrete, galvanized metal, black iron, plywood, canvas belt material, and high-density polyethylene (HDPE). Coupons of these materials were prepared with both clean and soiled (chicken feces and mineral oil) surfaces. The coupons were inoculated with between 3- and 9-log colony forming units/plaque forming units (CFU/PFU) of each test organism, packaged in a Tyvek envelope, and then placed throughout the commercial poultry farm.

Two barns at the poultry farm were used for testing, each with dimensions of roughly 55 by 600 feet. Both barns were depopulated and had been dry cleaned (and wet cleaned, if desired) to a similar condition following the USDA cleaning procedure. Sabre fumigated one barn with ClO_2 at a minimum temperature of 70 °F and a relative humidity of greater than 70%. The ClO_2 target concentration-time was 25,000 parts per million-hours throughout the barn.

The second barn was treated with heat following the USDA guidance for treating poultry facilities. The barn was heated to 100 to 120 °F for 7 days, with 3 consecutive days at a minimum average facility temperature of 100 °F. Temperatures were verified at each monitoring point within the barn. There were 10 real-time monitoring points, with an additional 40 loggers for temperature and relative humidity placed throughout the barn. To heat the barn for 7 days, 24 heaters with a capacity of 800,000 British thermal units per hour were used. For more information, contact Shannon Serre at serre.shannon@epa.gov.

IsoArk decontamination isolation chamber

RDD

Region 4 OSC and CMAD provide assistance to DoD and the Israeli Ministry of Defense to evaluate decontamination technologies

To prepare for a possible radiological attack, the capability to decontaminate critical infrastructure must be evaluated. Critical infrastructure may include transportation, power, communications, medical, and essential government service facilities and equipment. Currently available decontamination technologies must be evaluated for performance on a range of surfaces that could be contaminated after a wide-area radiological incident. This evaluation must go beyond the bench scale to ascertain if the tested technologies will be effective.

The U.S. Department of Defense (DoD) and the Ministry of Defense of the State of Israel (MOD) are jointly engaged in a project called "White City" to study procedures for cleaning up contaminated areas after an event involving a radiological dispersal device (RDD). The results obtained from this project are applicable to any wide-area radiological contamination incident. The DoD Technical Support Work Group (TSWG) and the MOD led the project, with the participation of EPA's Consequence Management Advisory Division (CMAD) and EPA Region 4 On-Scene Coordinator (OSC) Terry Stilman and experts from the Israeli Nuclear Research Center Negev (NRCN). The project work was conducted under TSWG task plan No. CB.3803-5. MOD, the Israel Atomic Energy Commission (IAEC)-NRCN, and TSWG provided financial support for this project.

The "White City" project was developed to evaluate intermediate-level (between bench-scale and large-scale or wide-area implementation) decontamination procedures, materials, technologies, and techniques used to remove radioactive material from different surfaces. In the event of a radiological incident, the application of intermediate-level technology would primarily be intended to decontaminate high-value buildings, important infrastructure, and landmarks.

Project Background

Two radioisotopes were tested: the aqueous salts of cesium-137 (^{137}Cs) and the short lived simulant to ^{137}Cs, rubidium-86 (^{86}Rb). The radioisotope technetium-99m (^{99m}Tc) also was used for a preliminary test of the experimental procedures. Two types of decontamination technology products were evaluated: DeconGel™ (DG), a product of Cellular Bioengineering Inc. (CBI), and Argonne Super Gel (ASG), a product developed by researchers at Argonne National Laboratory (ANL) and now manufactured and supplied by Environmental Alternatives, Inc. (EAI).

The project work was conducted at the assigned Chemical, Biological, Radiological, and Nuclear (CBRN) Israel Defense Force (IDF) home front command facility near the town of Ramla and at the NRCN Israel. Experimental setups at the two sites were identical, except that at the Ramla site, ^{99m}Tc and ^{86}Rb were used, while at the NRCN site, only ^{137}Cs was used. The project results yielded similar removal factors (percent removal [%R]) and operational factors for both ^{86}Rb and ^{137}Cs. This outcome was predicted based on the similar chemical properties of both elements. The project results further showed that the short half-life radioisotope ^{86}Rb can be used in future experiments to simulate ^{137}Cs.

The information from this project addresses loose surface contamination. In the past few years, the EPA has evaluated the performance of several peelable/strippable coatings for radiation decontamination. The major differences between this project and previously conducted studies are the larger size of the test surfaces and the use of ^{86}Rb as a simulant for ^{137}Cs. The use of larger surfaces (1.5 by 2 square meters) allowed more accurate evaluation of the time and effort needed for a large-scale decontamination effort. The use of the short half-life radioisotope ^{86}Rb (half life = 18.642 days) instead of the medium half-life radioisotope ^{137}Cs (half life = 30.17 years) allowed the experiment to be conducted outside of a controlled nuclear facility and allowed the evaluation of the use of ^{86}Rb as a simulant for ^{137}Cs during future large-scale decontamination experiments.

Test Methods and Materials

The testing conducted included the application of radioactive contamination to the test surfaces, measurement of the radiation contamination on the surfaces (through gamma counting), application and removal of two types of decontamination technologies, and subsequent measurement of the residual contamination to determine the efficacy of each decontamination technology. The tests used two isolation chambers to prevent the spread of radioactive contamination outside the test facility. The IsoArk decontamination isolation chambers used for this project were specifically designed and manufactured for the project by Beth-El Industries Ltd. In the isolation chambers, temperature, relative humidity (RH), and airflow conditions were controlled.

DG, manufactured by CBI Polymers, Inc. (Honolulu, HI), is a one-component, water-based, broad-application, peelable decontamination hydrogel. DG attracts the contaminant, binds to it physically or chemically, and upon curing, mechanically locks or encapsulates the contaminant in a polymer matrix. DG is available in three viscosities each developed for a specific decontamination use on various surfaces and areas. The compound used for this project was the DG 1120 formulation. This product was purchased directly from the supplier as a ready-to-use mixture not requiring dilution.

ASG, manufactured by EAI (Clarksburg, MD), is a gel system that can clean ^{137}Cs radioactive contamination from porous structures such as brick and concrete on vertical surfaces. The system uses engineered nanoparticles and a superabsorbent gel to clean buildings and monuments exposed to radioactive materials. The ASG for this project was purchased as a dry powder. The powder was mixed with purified water at the site to prepare 4 liters of gel. The gel mixture was applied 1 to 2 hours after mixing to the test surface using the procedure discussed below.

Both DG and ASG were applied using a hand-held power sprayer with a wide-shot tip. The main electric motor and gel bucket were left out of the isolation chamber, and a long flexible hose was used to transfer the gel from the sprayer into the chamber.

Gel application process for Argonne Super Gel (left) and DeconGel ™ (right)

Results

Two separate rounds of testing were conducted on substrates that included concrete, ceramic, marble, and limestone panels each measuring 1.5 by 2 meters. Round 1 included ceramic and concrete substrates in the horizontal orientation, and Round 2 included limestone, marble, and concrete in the vertical orientation. During Round 2, application of the radioactive contaminant to test surfaces as well as pre-

Table 1 | Round 1 Average Calculated %R Value

Decontamination Gel	Decontamination Proce	Concrete (Standard Deviation)	Ceramics (Standard Deviation)
DeconGel™	First	25 (3)	70 (4)
	Second	31 (3)	85 (4)
Argonne Super Gel	First	33 (4)	80 (3)
	Second	50 (3)	89 (2)

Note: Results are an average of both ^{86}Rb and ^{137}Cs isotopes.

Table 2 | Round 2 Average Calculated %R Values

Decontamination Gel	Decontamination Process	Concrete (Standard Deviation)	Marble (Standard Deviation)	Limestone (Standard Deviation)
DeconGel™	First	8.8 (4)	17.1 (5.1)	39 (6.4)
	Second	13.6 (3.7)	28.1 (3.4)	45.2 (4.4)
Argonne Super Gel	First	32.5 (8.1)	31.4 (5)	26.4 (3.7)
	Second	42.7 (7.7)	38.4 (4.5)	35.2 (4.9)

Note: Results are an average of both ^{86}Rb and ^{137}Cs isotopes.



Gel removal process for Argonne Super Gel (left) and DeconGel ™ (middle and right)

and post-contamination and decontamination measurements were performed while the test surfaces were in a horizontal position. Two decontamination processes were conducted during each round. Results for each round are discussed below.

Round 1 Results

During Round 1, the following measurements were made: contamination level, contamination level after the first decontamination process, and contamination level after the second decontamination process. The calculated %R values after the first and second decontamination processes were calculated using Equation 1:

(1) $\%R = (1 - A_f/A_0) \times 100\%$

Where:

A_0 = Average radiological activity of the surface before decontamination

A_f = Average radiological activity of the surface after decontamination.

The radiological activity was measured using a 2-inch NaI (Tl) gamma detector.

Table 1 summarizes the final %R values for the different surfaces and decontamination gels.

An overall qualitative evaluation indicates that the DG is suitable for decontaminating smooth and small surfaces, such as those inside radioactive laboratories and facilities, whereas the ASG can be easily used on many surfaces, including textured surfaces such as concrete, asphalt, and limestone. A vacuum cleaner is needed to remove the ASG, whereas the DG can be removed by hand. Therefore, the overall decontamination process for the DG on medium-sized surfaces like the ones tested is shorter than for the ASG. However, this situation may change if large contaminated outdoor areas are cleaned using industrial instead of hand-held vacuum equipment.

Round 2 Results

For Round 2, the %R values after the first and second decontamination processes also were calculated using Equation 1. Table 2 summarizes the final %R values for the different surfaces and decontamination gels.

Conclusions

The general conclusions summarized below are based on the results from both rounds of testing.

- The overall average %R of the ASG is higher than that of the DG.
- The second decontamination process improved the overall cleaning efficiency.
- The DG is not suitable for decontamination of textured surfaces but works well on smooth, non-porous surfaces. Use of the DG on porous surfaces could damage the surfaces.
- The ASG should be vacuumed up no more than 30 minutes after application.
- The preparation process for ASG is not complicated. The DG does not require preparation because it is a ready-to-use commercial product.
- Unskilled workers can perform decontamination during a real incident after a short training process.
- Both the DG and ASG are not toxic.
- Both the DG and ASG produced very low amounts of dry waste materials.

A complete report on this project will be available in the future. For more information about CMAD involvement, contact Shannon Serre at serre.shannon@epa.gov.

Biological indicators (BI) placed in clothing

LCHP

CMAD and NHSRC partner to conduct field evaluations of low-concentration hydrogen peroxide in inactivating *Bacillus anthracis* spores using commercially available products

In Fiscal Year (FY) 2016, EPA's Consequence Management Advisory Division (CMAD) conducted field evaluations to demonstrate the efficacy of low-concentration hydrogen peroxide (LCHP) in inactivating *Bacillus anthracis* spores. The evaluations were conducted in a 1,200-square-foot, three-bedroom, fully furnished test house. The field studies were designed to follow up on bench-scale research conducted by EPA's National Homeland Security Research Center (NHSRC) laboratory results and with guidance from Region 4 On-Scene Coordinators (OSCs) Ken Rhame and Ben Franco and Region 3 OSC Rich Rupert. Off-the-shelf household humidifiers were placed though-out the test house, and used to disseminate commercially- and readily-available 3% hydrogen peroxide (HP) liquid. During the field study, the central air in the house remained turned on, and several additional oscillating fans were added to help evenly distribute the HP. Coupons for the biological indicators (BI) were placed throughout the house to evaluate efficacy of LCHP. To challenge the method, some BI coupons were placed in hard-to-reach locations.

The study found that 1.2 gallons of 3% liquid HP per 100 square feet of living space completely inactivated surrogate spores placed on coupons throughout the house. If a higher HP liquid concentration is used, a proportionally lower volume of liquid is needed in the humidifiers. For the BI coupons, LCHP was effective in the following hard-to-reach locations: an open drawer, under five sheets of paper, in pants pockets, under sheets, inside pillowcases, under comforters, in light fixtures, in a closed hall closet, and in the crack of a window seal. LCHP was ineffective in the following hard-to-reach locations: between couch cushions, beneath rugs, in a doorjamb crack, in a closed drawer, under 10 sheets of paper, in a closed book, in a heavy coat pocket, and behind light switch plates.

Significant conclusions based on the study results are summarized below.

1. The use of LCHP in household humidifiers greatly increases the response community's capacity to respond to a biological incident.
2. The use of LCHP is a green technology, resulting in oxygen and water as final reaction products.
3. The use of LCHP instead of more traditional fumigation techniques greatly reduces health and safety concerns.

Concentrations of HP used during the field evaluations were lower than the immediately dangerous to life and health (IDLH) level of 75 parts per million. Typical fumigation procedures use fumigant concentrations above the IDLH. The use of less than IDLH levels of HP provides a margin of safety for users.

EPA's NHSRC backed up its study findings with the U.S. Army's Edgewood Chemical Biological Center collaborative study showing that the surrogates used in this LCHP study were equivalent to or more difficult to inactivate than the highly pathogenic *Bacillus anthracis* Ames strain.

Procedures used during the field evaluations can be discussed in self-help guidance for home and small business owners, thereby exponentially increasing EPA's response capacity.

Both the CMAD and NHSRC reports about the field evaluations will become available at the following website addresses:

http://www2.epa.gov/emergency-response/consequence-management-advisory-division-cmad

https://www.epa.gov/homeland-security-research/remediation-following-man-made-or-natural-disasters-homeland-security#tab-3
For more information, contact Leroy Mickelsen at mickelsen.leroy@epa.gov.

REGION 9

City of Pasadena/Region 9 supported by ASPECT for 2016 Tournament of Roses Parade and Rose Bowl Game

ASPECT Aircraft Deployment

The City of Pasadena and California Emergency Management requested the Airborne Spectral Photometric Environmental Collection Technology (ASPECT) Program to provide airborne chemical, radiological, and situational awareness support to the City of Pasadena, CA, for activities associated with the 2016 Tournament of Roses Parade and Rose Bowl Game. The ASPECT aircraft is fielded by the EPA Chemical, Biological, Radiological, and Nuclear (CBRN) Consequence Management Advisory Division (CMAD) Field Operations Branch (FOB). The ASPECT aircraft was deployed in support of the City of Pasadena, California Emergency Management, and EPA Region 9.

ASPECT is the nation's only airborne asset capable of collecting real-time chemical and radiological detection data and infrared and photographic images. CMAD's ASPECT personnel and aircraft are available to assist local, national, and international agencies supporting hazardous substance response, radiological incident, and situational awareness efforts in the United States. The speed with which the ASPECT aircraft can transmit information permits efficient assessment of threats to critical infrastructure to minimize impacts to the American people, the environment, and the economy.

The overall objectives of the ASPECT aircraft deployment during the 2016 Rose Bowl were to:

- Fully integrate the ASPECT scientific reach-back team with the City of Pasadena and California State emergency response command structure,
- Conduct all ASPECT flight activities within the time bounds established by the City of Pasadena and California Emergency Management, including, but not limited to, the Rose Bowl Parade and subsequent Rose Bowl college football game, and
- Provide regular updates on current detections and the status of site-specific n-links to event security personnel through e-mail and text messages.

The deployment consisted of four flights: pre-event background data collection flight on December 31, 2015, an early-morning, low-level gamma radiation survey of the parade route and stadium areas, an active chemical/situational monitoring flight of the route during the parade, and an active chemical/situational monitoring flight of the Rose Bowl stadium during the game on January 1, 2016.

No significant detections were observed during the deployment.

Four Deployment Flights

During the four ASPECT aircraft deployment flights, the temperature ranged from 50 to 55 °F, humidity was low, and skies were mostly clear to partly cloudy. Winds along the parade route and at the stadium were generally light to calm. No appreciable standing precipitation was present on or around the route or fields around the stadium.

The pre-event background data collection flight was conducted to obtain background data for radiological and chemical characteristics on and around the Rose Bowl parade route and stadium. The aircraft completed the survey at 1600. Technical difficulties occurred during the flight with the Fourier transform infrared (FTIR) spectrometer. The flight team was able to troubleshoot the issue after the flight.

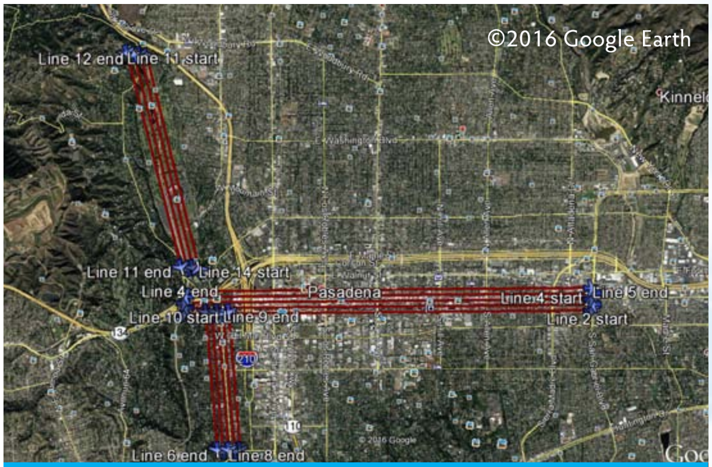
The ASPECT aircraft conducted an early morning low-level gamma radiation survey of the parade route and stadium areas on January 1, 2016. All radiological survey lines except for the cosmic lines were flown at the planned aboveground altitude (AGA) of 500 feet using the flight lines shown in the figure presented in the lower left corner of this page.

The data were processed in flight and downloaded by the reach-back team at the EOC within 5 minutes of acquisition. The reach-back team completed a quality review of the data before presenting the data to City of Pasadena officials.

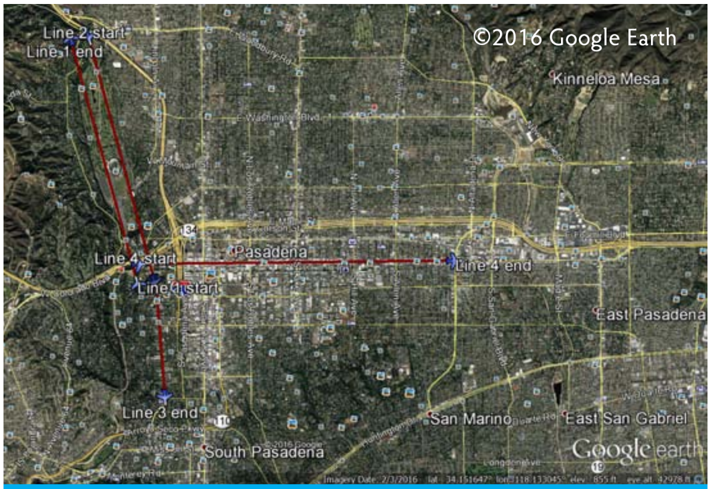
After the gamma radiation survey, the ASPECT aircraft began an active chemical/situational monitoring flight over the parade route to gather chemical and photographic data during the parade at 2,800 feet AGA. The figure in the upper right hand corner of this page shows the flight lines. These lines were flown at regular intervals over the parade route until the parade ended.

Data collected over the parade route were processed in flight and downloaded by the reach-back team at the Emergency Operations Center (EOC) within 5 minutes of acquisition. The reach-back team completed a quality review of the data before presenting the data to City of Pasadena officials.

The active chemical/situational monitoring flight over the Rose Bowl stadium during the game began at 1300 local time. This flight was conducted to gather chemical and photographic data during the game at 2,800 feet AGA. The figure above shows the flight lines.



Gamma radiation survey flight lines for 2016 Rose Bowl deployment



Chemical/situational monitoring of parade route and Rose Bowl stadium

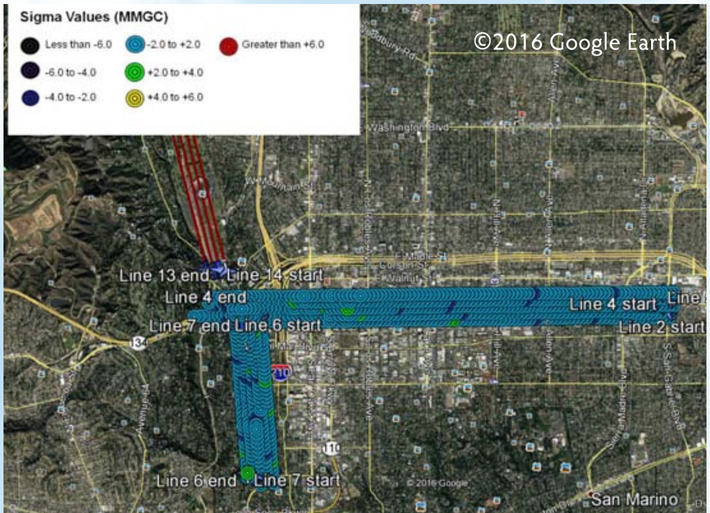
Data were collected at regular intervals over the stadium before kickoff and during the game until the game ended. After each flight pass, the data were processed on board, and the reach-back team at the EOC conducted a detailed content and quality review of the data for threat indications. All threat assessment results were communicated to the City of Pasadena Point of Contact, James Weckerle, and subsequently released to the entire EOC for reference throughout the day. At the completion of this flight, the aircraft remained in a holding pattern until no additional informational needs were identified, then returned to the airport. None of the data collected during the parade indicated a threat.

The available chemical and photographic data sets were downloaded onto hard drives after this flight to allow processing for the final deliverable posting in the Google Earth format (kmz, kml) for display and in the ESRI format for clients using that GIS system.

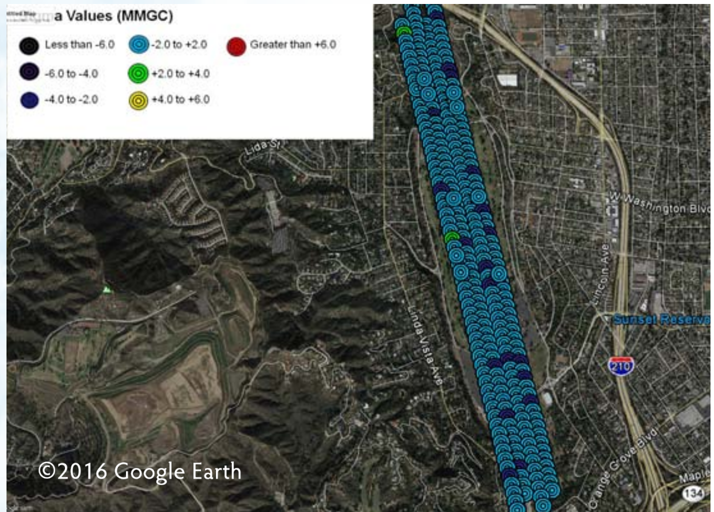
Radiological Survey Results

A number of standard ASPECT radiological products were generated as part of the radiological data collection efforts, including total gamma counts, man-made gamma count (MMGC) sigma plots, and dose rate plots. All of these products were geo-rectified, generated in a Google Earth format (kml, kmz), and uploaded to the Google Earth server accessible through the site-specific n-link.

The two figures at the top of the following page show examples of results presented to the local officials for the parade route and stadium area obtained by processing the radiological survey data using the MMGC method. The sigma plots provide a statistical comparison of every data point relative to a background location known to not contain any radiological contamination from man-made isotopes. Light blue dots are within 2 standard deviations (sigma) compared to the background location, green dots are greater than 2 and less than 4 sigma, yellow dots are greater than 4 and less than 6 sigma, and red dots exceed 6 sigma. Any deviation from background greater than 4 sigma usually is an initial indicator that the area may warrant a more detailed ground assessment. Any areas greater than 6 sigma almost certainly warrant further ground investigation and initiate a more intense assessment of the spectral data to identify the isotope(s).



Rose Bowl Parade route gamma radiation survey results



Rose Bowl stadium gamma radiation survey results

The sigma plot is an adequate and appropriate tool to quickly screen data values for further hazard investigation. To relate the hazard within a health-based metric, the airborne total gamma count data are scaled using an altitude- and aircraft-specific calibration algorithm to develop a 1-meter effective gamma dose rate contour.

Chemical Survey Results

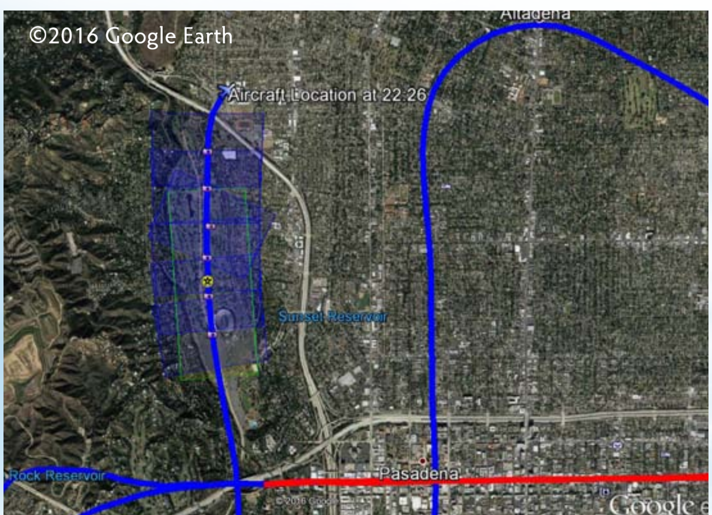
The chemical survey data included infrared imagery, aerial imagery, and flight status information. All of these products were geo-rectified, generated in a Google Earth format (kml, kmz), and uploaded to the Google Earth server accessible through the site-specific n-link.

The ASPECT RS800 infrared line scanner (IRLS) collected the infrared imagery. At the same time, a series of still photographic images were collected. Both of these products were geo-registered during flight operations.

The figure on the bottom left corner of this page shows an example of the ASPECT aircraft flight path in blue, with the gamma and chemical data collection locations indicated by different colors along the data acquisition sections. The gamma data collection flight path is shown in red. The yellow stars show the centroid locations of the IRLS images, with the coverage area outlined in green. The camera icons show the centroid locations of individual still photographic images, with the coverage area outlined in violet.

The figure on the bottom left corner of this page presents a typical IRLS image collected during a chemical survey flight. The image tends to show normal infrared content typical of a suburban setting, but there is some image distortion due to aircraft roll compensation resulting from wind turbulence at the collection altitude that affected the aircraft and IRLS gyroscope.

The figure in the upper right corner of the following page shows an aerial digital still image of the Rose Bowl stadium and surrounding area before kickoff. The resolution of this raw image is approximately 15 centimeters. The aerial photographs were tiled together to provide wide-area imagery taken during the game. Google Earth and ESRI provide the ability to zoom into the image and maintain the higher resolution of the individual frames during zooming.



Flight path (blue), gamma data coverage (red), digital photograph coverage area (outlined in violet), and RS-800 IRLS coverage area (outlined in green)

IRLS image over Rose Bowl stadium

Summary

The City of Pasadena and California Emergency Management requested the ASPECT Program to provide airborne chemical, radiological, and situational awareness support to the City of Pasadena, CA, for activities associated with the 2016 Tournament of Roses Parade and Rose Bowl Game. Specifically, the ASPECT aircraft was used to monitor the atmosphere for chemical and radiological threats and to provide situational updates associated with the 2016 Rose Bowl. Data analyses and assessment showed no significant detections during the deployment. This information was relayed to local officials within minutes of each flight pass. The successful deployment of the ASPECT aircraft during the 2016 Rose Bowl Parade and College Football Game allowed real-time assessment of potential threats. No threats were identified during the deployment, and the parade and game proceeded safely and without incident. For more information about CMAD involvement, contact Mark Thomas at thomas.markj@epa.gov.

Digital image of Rose Bowl stadium before kickoff

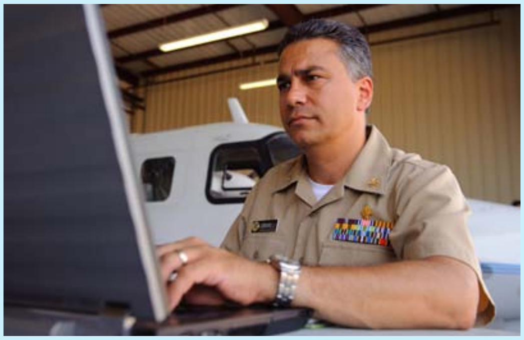
ASPECT

Aircraft system overview

CMAD fields the fixed-wing ASPECT aircraft, a response-ready asset that is available 24 hours a day, 7 days a week, 365 days a year. The ASPECT aircraft can be airborne within 1 hour to collect chemical, radiological, and photographic data anywhere in the continental United States within 9 hours of notification from its home base near Dallas, TX.

A primary goal of the ASPECT Program is to provide actionable intelligence to decision makers within minutes of data collection while the aircraft is still in flight using the aircraft satellite communication system.   All data are geo-referenced with embedded geographical coordinates and can be used in a variety of geographic information systems (GIS) systems. Onboard algorithms process collected data while the aircraft is in flight, and a satellite system sends preliminary data results to the ASPECT scientific reach-back team for quality assurance/quality control (QA/QC) review.

The ASPECT reach-back team encompasses scientists, engineers, and public health experts, all with advanced degrees. This team conducts all data validation and review in near real time, usually from an Emergency Operations Center. Validated data can be immediately relayed to local, state, tribal and other federal emergency management authorities.



The ASPECT team's certified health physicist reviews radiological survey data prior to release to decision makers

The ASPECT aircraft is a Cessna 208B Caravan (See photo below) containing two chemical sensors and three radiological sensors

ASPECT Aircraft; Cessna 208B Caravan

to detect and map chemical plumes and radiological deposition patterns and point sources. The chemical sensors include (1) a high-resolution (0.5-meter pixels), multi-spectral infrared line scanner (IRLS) that produces a two-dimensional image and (2) a point-detection MR-254AB Fourier transform infrared (FTIR) spectrometer that can obtain detailed chemical information for any point in a plume. Radiological sensors include sodium iodide (NaI; 25 L) and lanthanum bromide (LaBr; 1 L) gamma detectors and a boron tri-fluoride straw detector system. A high-resolution digital camera system captures survey images.

For more information about the ASPECT program, please go to: https://www.epa.gov/emergency-response/aspect


Photo courtesy of Alyssa S. Agranat

REGION 6

ASPECT provides assistance to the City of Albuquerque, NM and the New Mexico State Police at the Albuquerque International Balloon Fiesta

The City of Albuquerque, New Mexico (the City), and the New Mexico State Police (NMSP) requested the Consequence Management Advisory Division (CMAD) Airborne Spectral Photometric Environmental Collection Technology (ASPECT) Program to provide airborne chemical, radiological, and situational awareness support during the 2015 Albuquerque International Balloon Fiesta (AIBF) event. Specifically, the ASPECT Program was requested to support state homeland security operations at the AIBF event through deployment flights to detect significant radiological and chemical sources.

The deployment was conducted from October 2 through 12, 2015, and consisted of 10 ASPECT aircraft flights, including a pre-event background data collection flight, an early-morning radiological reconnaissance of the balloon field before any launches, and active chemical and situational monitoring of the field during the balloon flights each day on a schedule specified in the operations plan.

The overall objectives of this deployment are summarized below.

1. Conduct a full integration of the ASPECT reach-back team with the City and NMSP emergency response command structure. All data validation and review was to be conducted in near real-time at the Emergency Operations command post by the ASPECT reach-back team, including the EPA On-Scene Coordinator (OSC) Jon Rinehart. Validated data were to be immediately relayed to state and local emergency management authorities.
2. Conduct all ASPECT aircraft flight activities within the time bounds established by the City and the NMSP, including, but not limited to, pre-balloon launch events and ongoing balloon flights.
3. Provide regular updates to event personnel, including e-mail and text message updates about current detections and the status of n-links.

No significant radiological or chemical detections were observed during the deployment.

Background Survey

The ASPECT aircraft conducted a background flight on October 2, 2015, to obtain background data for both radiological and chemical characteristics on and around the balloon field and San Mateo Boulevard. This data collection effort was conducted during the incoming mobilization flight for the event deployment.

Data Collection Surveys

The ASPECT aircraft performed five gamma-radiation surveys each morning from October 3 through 12, 2015. All radiological survey lines except for the cosmic lines were flown at the planned above ground altitude (AGL) of 300 feet. The radiological survey data collection flights were completed before 0500. The data were processed in-flight and available for download within 5 minutes of acquisition. The ASPECT reach-back team at the command post downloaded the data and completed quality assurance/quality control (QA/QC) review before presenting the data to EPA OSC. OSC Rinehart cleared the data for release to state and local emergency management authorities.

ASPECT aircraft

Weather during these radiological surveys ranged in temperature from 10 to 15 °C, humidity was low, and skies were mostly clear to partly cloudy. Winds at the balloon field generally were light to calm during each flight. No appreciable standing precipitation was present on or around the field. The ASPECT aircraft returned to the airport each day immediately after completing radiological data collection.

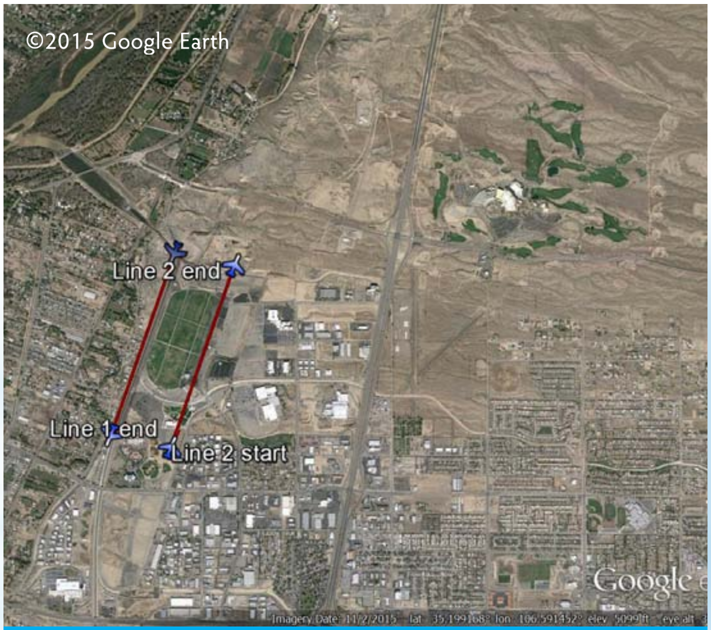
The ASPECT aircraft performed chemical and photographic data collection surveys following the same two flight lines, as indicated in red in the picture in the lower right hand corner of this page, over the balloon launch field. These survey flights were conducted in the afternoons on the same days as the gamma-radiation surveys at an altitude of 2,800 feet AGL. Flight conditions during the chemical and photographic surveys typically consisted of good light, low humidity, and generally light winds. The ASPECT reach-back team was relocated to an aircraft hangar in Santa Fe during these flights. Data were processed in-flight. The ASPECT reach-back team in Santa Fe downloaded the data and completed QA/QC review. Findings were communicated to the OSC for release to the local command post.

Radiological background lines mid-day chemical and aerial photo data collection surveys

The full chemical and photographic data sets were delivered by external drive upon the flight crew's return to the hangar. The full data sets were processed after the flights to generate file formats (kmz, kml) for Google Earth display to allow access by the state and local emergency operations command post through the site-specific n-link display web tool.

Standard Radiological Survey Products

A number of standard ASPECT radiological survey products were generated through the radiological background data collection effort, including total gamma counts, man-made gamma count (MMGC) sigma plots, and dose-rate plots. All of



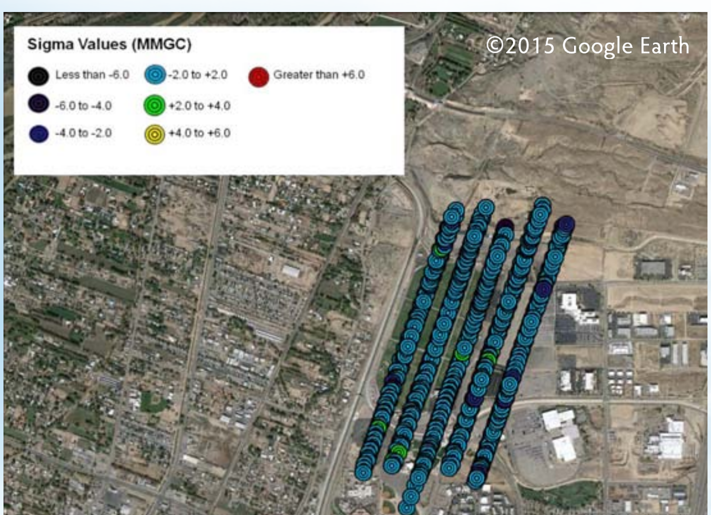
Chemical/photographic background flight lines these products were geo-rectified, generated in a Google Earth format (kmz, kml), and uploaded to the Google Earth server accessible through the site-specific n-link.

The figure at the bottom left of this page shows an example of results obtained by processing the radiological survey data using the MMGC method. The sigma plot provides a statistical comparison of every data point relative to a background location known to not contain any radiological contamination from man-made isotopes. Light blue dots are within 2 standard deviations (sigma) compared to the background location, green dots are greater than 2 and less than 4 sigma, yellow dots are greater than 4 and less than 6 sigma, and red dots exceed 6 sigma. Any deviation from background greater than 4 sigma usually is an initial indicator that the area may warrant more detailed ground assessment. Any areas greater than 6 sigma almost certainly warrant further ground investigation and initiate a more intense assessment of the spectral data to identify the isotope(s).

The sigma plot is an adequate and appropriate tool to quickly screen data values for further hazard investigation. To relate the hazard within a health-based metric, the airborne total gamma count data are scaled using an altitude- and aircraft-specific calibration algorithm to develop a 1-meter effective gamma dose rate contour. The figure to the right shows an example of this contour generated using closely spaced isopleths to show subtle detail within the field of view.

Standard Chemical Survey Products

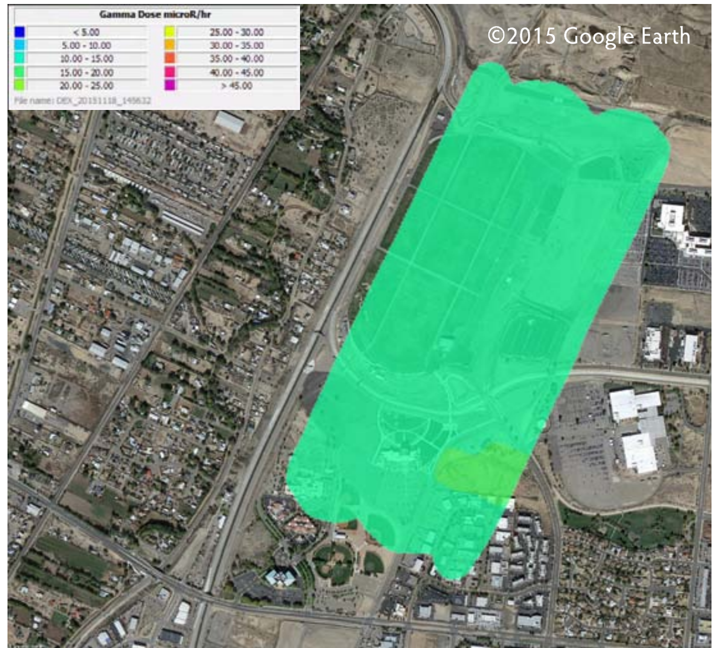
A number of standard ASPECT chemical results were generated through the chemical background data collection effort, including chemical detection plots, infrared imagery, aerial visible imagery, and flight status information. Fourier transform infrared (FTIR) data points were geo-rectified using a global information system (GIS). An associated concentration estimate then was generated for each FTIR point for each of the 78 chemical compound in the screening library. All products were generated in Google Earth format (kmz, km1) and uploaded to the Google Earth server to make them accessible through the site-specific n-link.



Background survey MMGC sigma plot

Infrared imagery data were collected concurrently with the FTIR data using the ASPECT RS800 infrared line scanner (IRLS) imaging system. At the same time, a series of still photographic images were collected. Both of these products were geo-registered during flight operations.

The top left image on the following page shows an example of the aircraft flight path, with the chemical data collection locations indicated by the green sections of the path. The FTIR



Radiation background survey MMGC dose contour

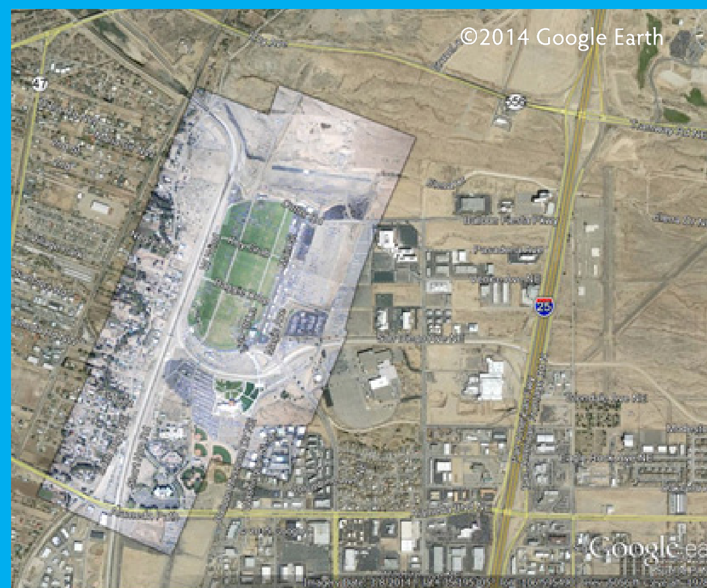
acquired data during flights over the green path, and the stars show the centroid locations of the IRLS images while the camera icons show locations where individual still photographic images were collected. Spectral analysis of all collected FTIR data showed no significant detections during the data collection flights.

The top right photo on the following page presents a typical IRLS image collected during a chemical survey flight. The image tends to show normal infrared content typical of a suburban setting, but there is some image distortion due to aircraft roll compensation resulting from wind turbulence at the collection altitude that affected the aircraft and IRLS gyroscope. The bottom left photo on the following page shows an aerial digital still image of the north end of the balloon field and surrounding area. The resolution of this image is approximately 15 centimeters. The aerial photographs were tiled together to provide wide-area imagery during the event. The bottom right photo on the following page shows the tiled image in Google Earth, which provides the ability to zoom into the image and maintain the higher resolution of the individual frames.

Chemical flight path and data collection locations

Infrared line scanner image over balloon field

Digital image overlay on Google Earth

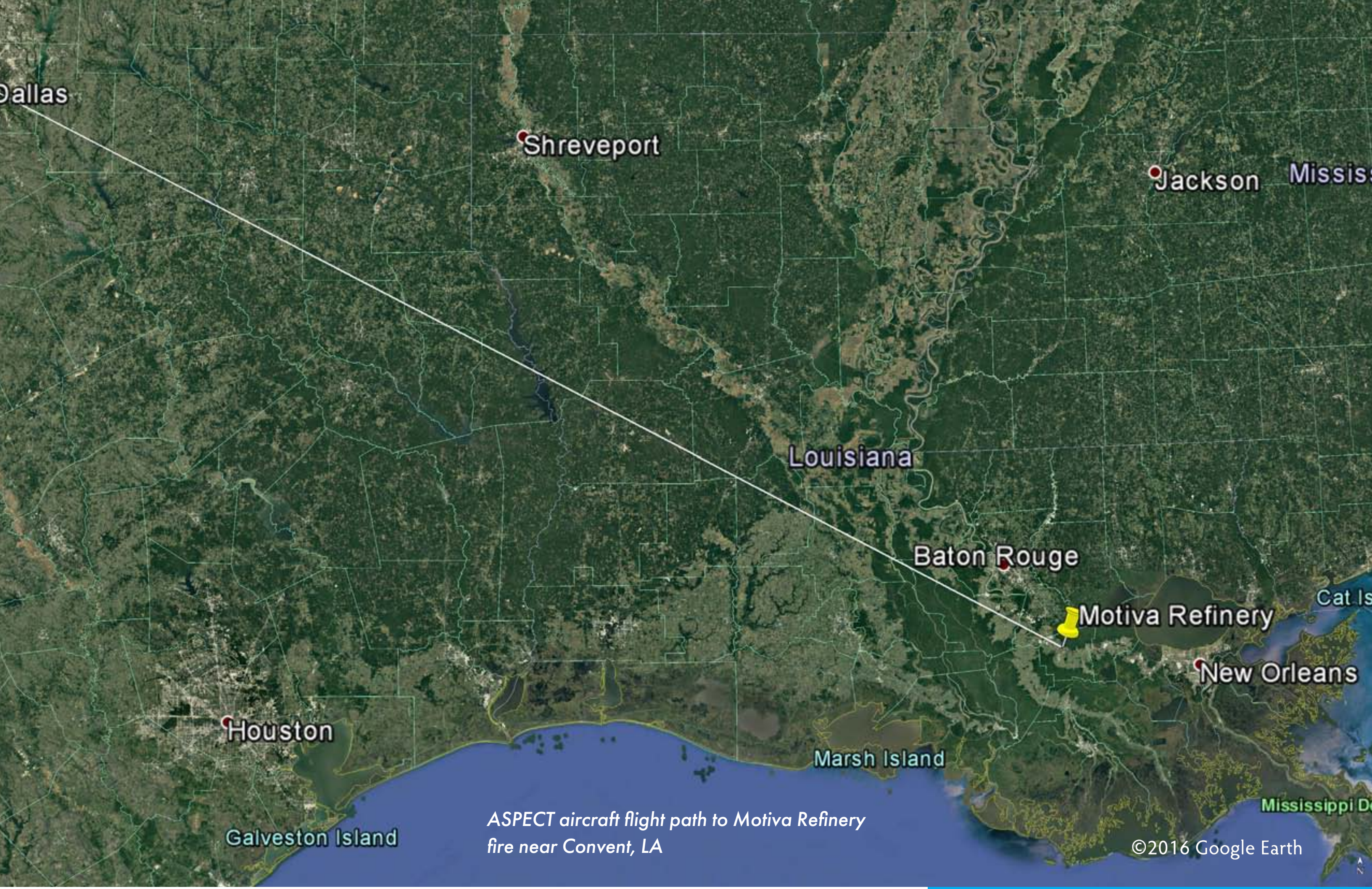


Aerial images of balloon field during event tiled for viewing by GIS system

Summary

The City and the NMSP requested the ASPECT Program to provide airborne chemical, radiological, and situational awareness support during the 2015 AIBF event. Specifically, the ASPECT Program was requested to support state homeland security operations at the AIBF event through deployment flights to detect significant radiological and chemical sources. The deployment was conducted from October 2 through 12, 2015, and consisted of 10 ASPECT aircraft flights consisting of standard gamma-radiation surveys at 300 feet AGL and chemical and photographic data collection surveys at 2,800 feet AGL.

Analyses and assessment of all data showed nothing unusual, and this information was relayed to the EPA OSC for approval before release of the information to state and local emergency management authorities. The U.S. Department of Energy Radiological Assistance Program (RAP) teams used the background data collection information and tiled imagery as a base layer for their GIS ground team tracking systems. For more information about CMAD involvement, contact Mark Thomas at thomas.markj@epa.gov.



ASPECT aircraft flight path to Motiva Refinery fire near Convent, LA

REGION 6

Region 6 activates ASPECT in response to the Motiva Refinery fire in Convent, LA

On August 11, 2016, the National Response Center received a call at 12:37 p.m. Eastern Daylight Time (EDT) about a fire at the Motiva Refinery near Convent, LA. The incident occurred at 10:50 a.m. local time (11:50 a.m. EDT). EPA Region 6 was notified at 12:47 p.m. EDT.

At approximately 2:00 p.m. EDT, the EPA Region 6 On-Scene Coordinator (OSC), Nicolas Brescia, requested the Airborne Spectral Photometric Environmental Collection Technology (ASPECT) aircraft to deploy to the incident site. By 2:23 p.m. EDT, Consequence Management Advisory Division (CMAD) ASPECT personnel contacted the EPA OSC to confirm authorization for ASPECT aircraft deployment. The ASPECT aircraft lifted off from its base of operations near Dallas, TX, at 3:05 p.m. EDT, with an estimated time-over-target at 5:30 p.m. EDT. The above figure shows the ASPECT aircraft flight path to the site. It took about 45 minutes for the aircraft to be airborne from the time the ASPECT Lead was notified and received authorization to deploy the aircraft.

ASPECT is the nation's only airborne asset capable of collecting real-time chemical and radiological detection data and infrared and photographic images. The ASPECT aircraft was requested for deployment during the fire to collect data to permit efficient assessment of potential threats from the fire.

During the 2.5-hour flight to the site, a mission assignment and flight lines were developed and uploaded to the aircraft computer through a secure satellite communication. The initial request was for aerial photography, chemical screening, and infrared imaging over the refinery fire. While the aircraft was *en route*, the EPA Region 6 OSC also requested a radiological survey over the site.

Twelve aerial photographs were taken over the incident site. The first figure in the next column presents the initial mosaic of four aerial photographs taken at approximately 5:30 p.m. EDT. This product was generated during the flight, reviewed by ASPECT scientific reach-back staff for quality assurance (QA) purposes, geo-rectified, and then sent in Google Earth format by e-mail to the OSC at 5:50 p.m. EDT.

Then ASPECT aircraft flew nine passes over the Motiva Refinery between 5:30 and 6:00 p.m. EDT, producing 13,739 unique scans for chemical anomalies. The figure in the top right corner shows a single pass of the ASPECT aircraft during the chemical screening survey. Each dot in the figure represents a single scan. Results from each of the 13,739 interferometry scans were processed through automated algorithms to look for more than 70 unique chemical compounds in the ASPECT chemical library. ASPECT scientific reach-back scientists reviewed all preliminary detections for QA purposes. No significant chemical detections were reported after the review. Ozone was detected, but this detection was not considered significant.

Single pass of ASPECT aircraft using FTIR spectrometer

Aerial image of Motiva Refinery about 5 hours after the fire started and about 3 hours after ASPECT deployment

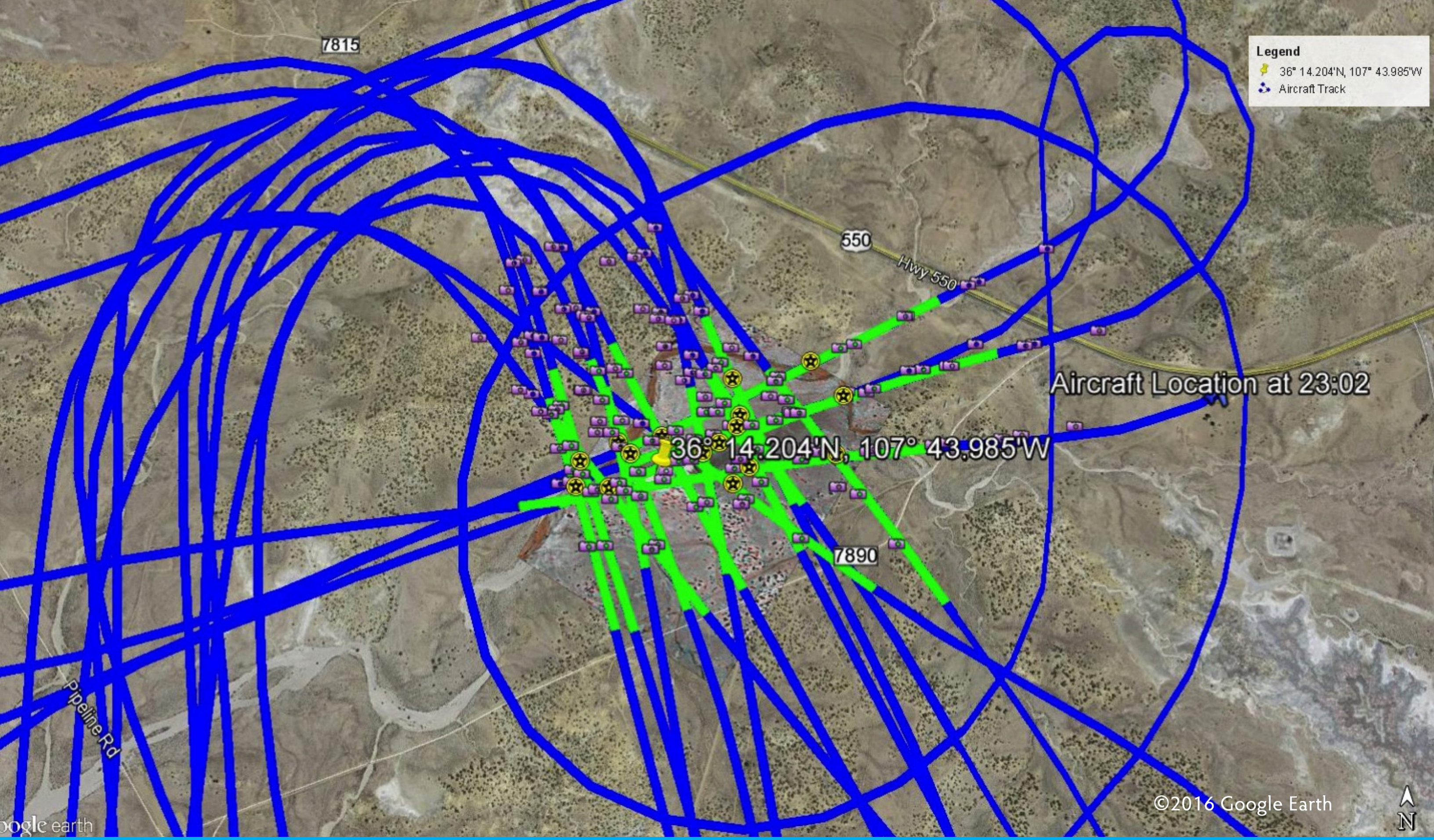
After the chemical scan was complete, ASPECT then conducted a radiological survey over the Motiva Refinery site from 6:15 to 6:35 p.m. EDT. The aircraft flew at 500 feet above ground level (AGL), with a distance between flight passes of 750 feet. The entire survey covered about 2 square miles around the site.

The survey data were analyzed for anomalies, and no anomalies were detected. An exposure rate contour was provided to the OSC at 7:30 p.m. EDT. The contour figure in the bottom right corner showed that all radiation measurements were within normal background levels. The ASPECT aircraft flew three infrared imaging passes over the Motiva Refinery between 6:45 and 7:00 p.m. EDT. Because the fire was under control by the time the ASPECT aircraft arrived at the site, no images showed significant heat signatures beyond normal background variations. The figure in the bottom left corner shows an infrared image of the site taken by the ASPECT aircraft.

The ASPECT mission was completed by 7:15 p.m. EDT, and the aircraft was released by the OSC by 7:30 p.m. EDT. The successful deployment of the ASPECT aircraft during the fire allowed real-time assessment of potential threats related to chemical detections, heat signatures, and radiological anomalies. No threats were identified during the deployment. For more information about CMAD involvement, contact Mark Thomas at thomas.markj@epa.gov.

ASPECT infrared image over Motiva Refinery fire

Radiation exposure rate contour map over Motiva Refinery



REGION 6

Region 6 supported by ASPECT for monitoring support to the Nageezi oil tank battery fire

ASPECT aircraft flight track for flight 1 (above)

At approximately 2215 Mountain Standard Time (MST) on July 11, 2016, an explosion and fire occurred at a WPX Energy well site (Site) consisting of six wells and 36 tanks near Nageezi, NM. According to the media, all of the tanks were involved in the fire. The cause of the explosion and fire was unknown at that time.

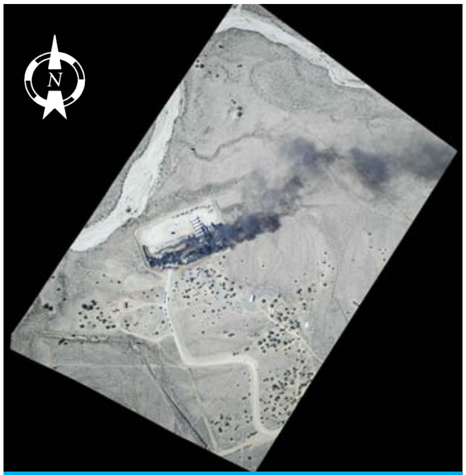
On July 12, 2016, the EPA Region 6 Emergency Operations Center (EOC) requested that the Airborne Spectral Photometric Environmental Collection Technology (ASPECT) aircraft mobilize to support air monitoring activities at the site. The ASPECT response to this incident was conducted in support of Region 6 EPA On-Scene Coordinator (OSC) Bryant Smalley. The ASPECT results were used to identify compounds of significance posing potential threats.

The ASPECT aircraft flew two flights, one on July 12 (Flight 1) and the other on July 13, 2016 (Flight 2). During the Nageezi oil tank battery fire, EPA's ASPECT system collected airborne infrared (IR) images and chemical screening data from a safe distance over the site. The ASPECT system offers remote detection capabilities to support first responders. The ASPECT aircraft is a Cessna 208B Caravan containing a wide-area IR line scanner (IRLS) with a high-speed Fourier transform infrared (FTIR) spectrometer for chemical detection. The ASPECT IR system can detect compounds in both the 8- to 12-micron (800- to 1,200-cm^{-1}) and 3- to 5-micron (2,000- to 3,200-cm^{-1}) regions. The 8- to 12-micron region typically is known as the "atmospheric window" region because the band is reasonably free of water and carbon dioxide influence. Spectrally, this region is used to detect carbon—non-carbon bonded compounds. The 3- to 5-micron region also is free of water and carbon dioxide but typically does not have sufficient energy for use. However, this band is useful in high-energy environments such as fires. Onboard algorithms process collected data while the aircraft is in flight, and a satellite system sends preliminary data results to the ASPECT scientific reach-back team for quality assurance/quality control (QA/QC) review.

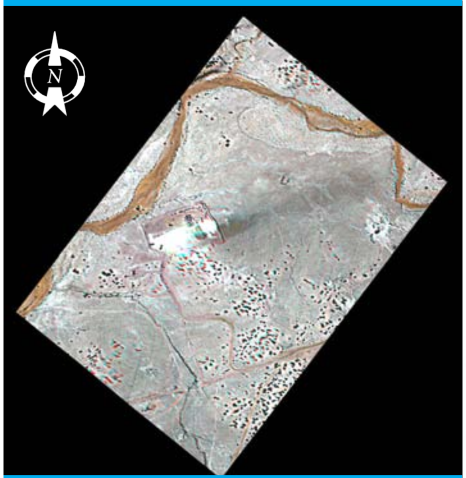
Flight 1

A total of 16 flight passes were made over the incident site, including passes downwind from the fire, up the plume, and upwind from the fire. The first picture shows the ASPECT aircraft flight track for Flight 1. Flight passes over the Site are shown in green. Weather conditions (in Cuba, NM) at the time of data collection consisted of clear skies and a visibility of about 10 miles. Winds were from the west at 5 knots. The surface temperature was 34 °C, with a dew point of -6 °C. The surface pressure was 1,023 millibars. Flight conditions were mildly turbulent, with a strong head wind from the west. A plume was visible for about 12 miles, close to the ground. Plume movement generally was northeast. The figure immediately below shows an aerial image of the plume leaving the oil tank battery.

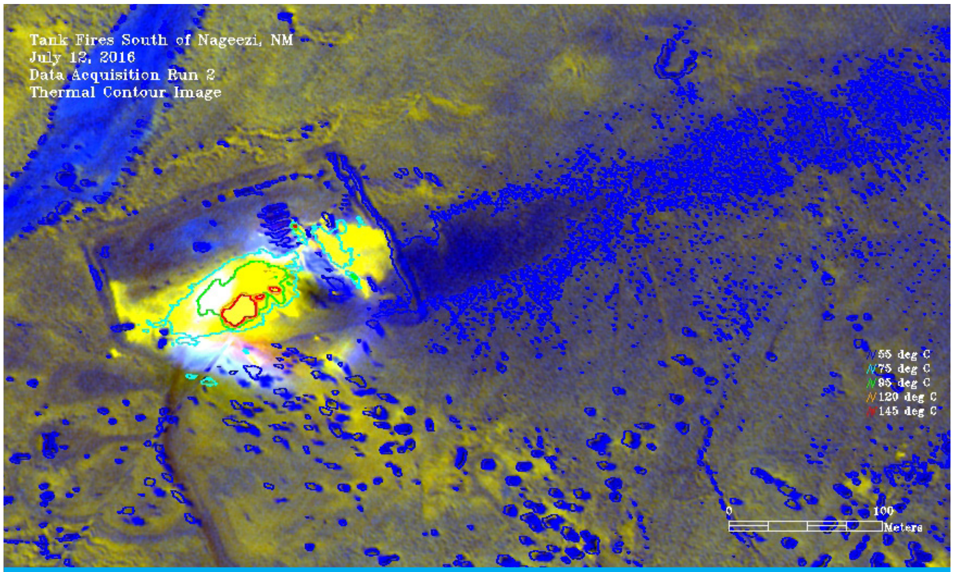
An IRLS image was generated for each of the 16 flight passes. The image in the bottom left corner shows an IR image generated from Flight 1 Pass 2 data using three spectral band pass channels. The white area in the image is the active fire area. A very light plume is visible moving northeast. This plume most likely consists of hot carbon (soot) emitted by the fire. The above image shows a thermal contour of the fire processed for the same flight pass. The active area of the fire is clearly shown by red contours. The plume (in blue) is much cooler and moving northeast.



Aerial image of plume leaving oil tank battery, Flight 1, Pass 2



IR image, Flight 1, Pass 2



Thermal contour, Flight 1, Pass 2

During each of the 16 flight passes for Flight 1, the FTIR spectrometer collected spectral data. A spectral resolution of 16 wave numbers was used for all flight passes. The ASPECT system uses an automated detection algorithm to permit compound analysis while the aircraft is in flight. The algorithm includes 78 compounds in the ASPECT chemical library. In addition, the ASPECT team also compares the detected spectral signatures to a collection of published library spectra.

Data review indicated slightly elevated levels of peroxyacyl nitrate (PAN) and ozone and trace levels of m-Cresol immediately over the fire (see the two figures on the next page). These compounds are commonly formed in fires and tend to be amplified by the slightly elevated temperature of the plume. No other compounds of significance were detected during any of the passes, suggesting that volatile components of the oil were being consumed in the fire. IR images over the site clearly showed a fire with a defined but declining plume.

Spectral analysis of FTIR spectrometer data showed trace to low levels of PAN, ozone, and m-Cresol. No other compounds were detected, suggesting that volatile components of the oil were being consumed in the fire.

Flight 2

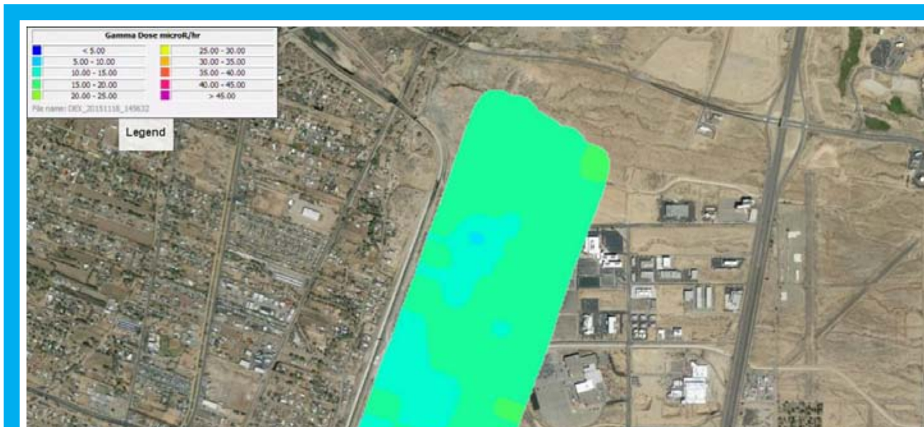
The order to launch the ASPECT aircraft for Flight 2 was given at 0945 MST on July 13, 2016. The purpose of the second flight was to confirm that the fire had largely burned out. A total of eight flight passes were made over the incident site, including two low-altitude (500 feet above ground level [AGL]) photographic passes over the site and adjacent river. Weather conditions (in Cuba, NM) at the time of data collection consisted of clear skies and a visibility of about 10 miles. Winds were from the west (230) at 5 knots. The surface temperature was 28 °C, with a dew point of -1 °C. The surface pressure was 1,028 millibars. Flight conditions were reported as some turbulence.

The fire was greatly attenuated from the previous day, but some fire and a light plume were observed. Any smoke generated rapidly dissipated, with the plume moving east to northeast. In addition to the normal photography at 2,800 feet AGL, the ASPECT aircraft was requested to take a series of low-level (500 feet AGL) photographs of the river adjacent to the site to determine if any material had migrated off the site. No incident-related materials had entered the river from the site.

An IRLS image was generated for each of the eight flight passes. The figure on the bottom right shows an IR image generated from Flight 2 Pass 5 data using three spectral band pass channels. IR data collected on July 13, 2016, showed significantly less energy than images collected on July 12, indicating that the fire largely was out. The image in the figure on the bottom left of this page shows an aboveground tank on the western edge of the battery, which is the source of residual smoke. The image does not show any plume, indicating that little soot was being formed. Spectral analysis of FTIR spectrometer data collected during Flight 2 did not reveal any significant detections. Low levels of ozone and PAN were detected over the oil tank battery, but no other compounds were detected. Analysis of IR imagery collected during Flight 2 indicates that the fire still was present in the oil tank battery but greatly attenuated from the previous day. Spectral analysis of FTIR spectrometer data showed no significant detections.

The successful deployment of the ASPECT aircraft during the two flights over the Nageezi oil tank battery fire allowed real-time assessment of IRLS images showing the area of the fire, the plume, and soot generation as well as FTIR spectral data for compounds of significance. No significant threats from the fire were identified during the deployment. After the completion of this mission, the aircraft demobilized for Addison, TX. For more information about CMAD involvement, contact Mark Thomas at thomas.markj@epa.gov.

Flight 1 Pass 3 spectral plot of ozone



Flight 1Pass 2 spectral plot of PAN and m-Cresol

Aerial image of oil tank battery, Flight 2

IR image, Flight 2, Pass 5

Potentially contaminated soil and sediment to be sampled and analyzed for PCBs and a variety of hazardous semi volatile chemicals

REGION 1

Region 1 supported by PHILIS team for PCB analysis in site investigation at the Jones and Lamson Machine Tool Company site

The Jones and Lamson Machine Tool Company (J & L) site in Springfield, VT, was closed in 1985. Since the late 1990s, the on-site building has become dilapidated, with several areas of the roof collapsing and impacting potentially hazardous building materials. EPA Region 1 collected soil, sediment, pore water, groundwater, and surface water samples from the site for analysis for polychlorinated biphenyls (PCB), metals, semivolatile organic compounds (SVOC), and oil. EPA Region 1 also collected material samples from the building to identify asbestos-containing materials (ACM). PCBs were detected in building materials, soil, and groundwater at the site at levels exceeding the Toxic Substances Control Act (TSCA) hazardous waste thresholds. These findings prompted Region 1 to conduct a more thorough site investigation.

To conduct the J & L site investigation, Region 1 On-Scene Coordinator (OSC) Rich Haworth contacted the Consequence Management Advisory Division (CMAD) to determine if the Portable High-Throughput Integrated Laboratory Identification System (PHILIS) laboratory could analyze soil and sediment samples from the site for PCBs. Region 1 project objectives for the site investigation were to obtain sufficient data to support the decisions by the EPA and to determine if further actions by the Emergency Preparedness and Response Branch (EPRB) are necessary at the site. The following is a summary of the specific project objectives.

- Determine if a removal action is warranted, and if so, if the response should be classified as an emergency, time-critical, or non-time-critical removal action.
- Rapidly assess and evaluate the urgency, magnitude, extent, and impact of a release or threatened release of hazardous substances, pollutants, or contaminants, and their impact on human health and the environment.
- Supply the Agency for Toxic Substances and Disease Registry (ATSDR) or others with information about the nature and magnitude of any health threat, and support subsequent public health advisories.
- Determine a remedy to eliminate, reduce, or control risks to human health and the environment, and support an Action Decision memorandum documenting the identified removal approach.
- Categorize waste materials to support timely transportation and disposal decisions.
- Support a Closure Decision memorandum after the removal site evaluation.

The PHILIS laboratory provided Region 1 with timely PCB analysis of more than 60 soil and sediment samples to support this project including 24-hour turn-around times for results. The samples were analyzed for PCBs using EPA Method 8028a. The PHILIS laboratory located in Edison, NJ is accredited under the National Environmental Laboratory Accreditation Program (NELAP) for this analysis. Based on the expedited analytical results provided by CMAD, the Region 1 OSC and site decision makers were able to determine and prioritize future actions at the site more quickly. This saved the EPA Region both time and money towards the eventual goals to clean the site and return it to productive use. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

Aerial photo of the Jones and Lamson Machine Tool Company site

Sample preparation in PHILIS laboratory trailer

REGION 3

Region 3 assisted by PHILIS team with on site analytical capability for NSSE Papal visit to Philadelphia

In September 2015, Region 3 requested that the Consequence Management Advisory Division (CMAD) provide on-site analytical support during the Papal visit to the Philadelphia area. On September 21, 2015, the Portable High-Throughput Integrated Laboratory Identification System (PHILIS) team deployed to Philadelphia, PA, and coordinated with On-Scene Coordinator (OSC) Mike Towle to provide chemical analysis support to the special security team during the visit of Pope Francis. Starting on September 24, the analytical teams were on duty 24 hours per day to provide support in the event of a chemical release during the Pope's visit. The on-site analytical specifications required deployment of PHILIS laboratory assets to Region 3 warehouse facilities in Boothwyn, PA. The PHILIS laboratory assets were set up to analyze environmental samples for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and chemical warfare agents (CWA).

To achieve full-time all-hazards response capabilities during the Papal visit, CMAD provided the Papal Response Unified Command with on-site laboratory support using the PHILIS laboratory assets. This was in concert with real-time air monitoring equipment, VIPER network support and sampling efforts provided by Region 3, the Environmental Response Team (ERT), and National Guard Civilian Support Teams (CST). The deployment provided Region 3 OSCs and CMAD the opportunity to conduct "just-in-time" training on CWA sampling techniques and response issues to refresh and strengthen EPA's preparedness for CWA responses.

CMAD PHILIS vehicles deployed to provide laboratory support to the Papal Response Unified Command

The PHILIS PAL analytical laboratory, PHILIS laboratory unit (LU), SPA-01, and APL01 mobile laboratory vehicles were deployed and set up for full-service operations at local EPA warehouse facilities in Linwood, PA. The gas chromatography/mass spectrometry (GC/MS) time-of-flight (TOF) systems in the LU mobile laboratory were set up for identification and quantitation of CWAs and semivolatile organic compounds. The GC/MS purge and trap and thermal desorption units in the APL01 mobile laboratory were set up for volatile organic analysis. The SPA-01 laboratory was used for sample preparation using liquid/liquid, solid/liquid, and air/thermal desorption tube methods.

The laboratories were demobilized on September 28, 2015. No chemical agent releases were reported for the Papal visit. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

Sample preparation in PHILIS laboratory trailer

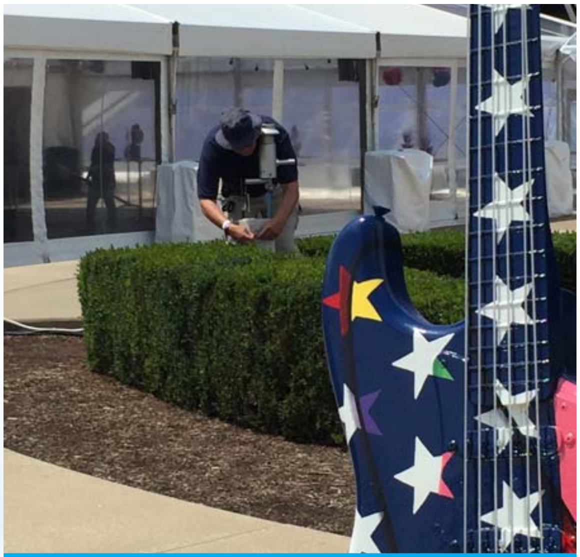
Sample preparation in PHILIS laboratory trailer

CMAD's Mike Nalipinski holding an Area RAE and Genitron, which were used to monitor the RNC venues.

RNC

Region 5 receives air monitoring and on-site analytical capability during the 2016 Republican National Convention in Cleveland, OH

On July 17 through 23, 2016, team members from the Consequence Management Advisory Division (CMAD) and Environmental Response Team (ERT) provided 24-hour chemical air monitoring, data management, and Viper Deployment Manager support to Region 5 On-Scene Coordinator (OSC) James Justice during the 2016 Republican National Convention (RNC) at the Great Lakes Science Center in Cleveland, OH. CMAD's Portable High-Throughput Integrated Laboratory Integration System (PHILIS) assets from warehouses in both New Jersey and Colorado were deployed to the Region 5 facility in Westlake, OH, in a "hot stand-by mode" (ready to receive samples 24 hours a day, 7 days a week). During the RNC, the PHILIS units conducted performance sampling, calibration, and quality assurance (QA)/quality control (QC) activities for chemical air monitoring for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and chemical warfare agents (CWA).



Air monitor deployment by CMAD personnel

The EPA team provided seamless operations as well as period transitions during the event. The team kept in constant coordination with the All Hazards Center (AHC) to ensure that decision makers were well informed of any chemical monitoring incidents and actions the field monitoring team had taken.

One of the "sticker" samples

"Sticker" samples being prepared for analysis

Midway through the RNC, a small group of protesters started applying stickers to the skin of law enforcement personnel. The officers began complaining of disorientation and other minor abnormalities. Several officers were evaluated at hospital. The AHC directed the Joint Hazard Assessment Teams, consisting of: the Federal Bureau of Investigation (FBI), Civil Support Team (CST), and Cleveland Fire Department members, to obtain the stickers being distributed. A small (about 1-quart) bag of the stickers were secured and brought to the Cleveland Fire Training Area for evidence processing and analysis. The FBI Weapons of Mass Destruction (WMD) Coordinator requested EPA to analyze the stickers for CWAs and other compounds.

At the time the samples were collected, the PHILIS laboratories were the only laboratories in the RNC area that could analyze these types of samples. The PHILIS laboratories accepted two stickers and a surface wipe sample at approximately 2000 hours on July 21, 2016. Analytical results revealed that the stickers contained no CWAs at levels above the method detection limits for sarin, soman, cyclosarin, sulfur mustard, and VX. In addition, the samples were analyzed for a suite of eight common degradation products of nerve and blister agents, which also were not detected. In addition, a spectral library search for LSD, cocaine, and lidocaine was performed on the samples, yielding no detectable peaks for these compounds. Preliminary results were verbally provided to the AHC within 2 hours of receipt of the analytical results, and the spectral search results were reported less than 3 hours after receipt.

The Secret Service Agent-In-Charge and the FBI WMD Coordinator were very complimentary of EPA's ability to provide rapid analysis of the stickers, which did not result in a significant security issue.

The EPA team established working relations with local entities, such as the Great Lakes Science Center and the Rock and Roll Hall of Fame, and with other federal agencies, including the Secret Service, U.S. Coast Guard (Atlantic Strike Team), National Oceanic and Atmospheric Administration (NOAA), and CSTs. The team's efforts ensured that chemical monitors at venues for major events during the week were operational and that attendees and VIPs were protected. For more information about CMAD involvement, contact Mike Nalipinski at nalipinski.mike@epa.gov.

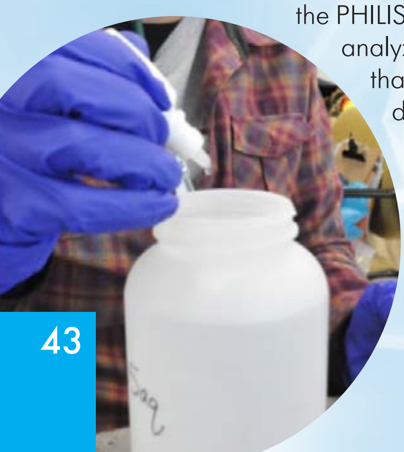
EPA and PHILIS support personnel reviewing analytical results

EPA Region 5 collects samples for analysis

FLINT

Region 5 activates PHILIS team resources to provide analytical support for the Flint Drinking Water Response in Flint, MI

The Consequence Management Advisory Division (CMAD) Portable High-Throughput Integrated Laboratory Identification System (PHILIS) Program provided analytical testing, data review, and coordination support for the EPA Region 5 Flint Drinking Water Response in MI. The PHILIS laboratories provide real-time, fixed-laboratory, sample analytical data to response personnel for timely and cost-effective emergency response and other regional response actions. Over the course of the response action in Flint, the PHILIS laboratories analyzed more than 2,500 drinking water samples for total metals, water quality, wet chemistry, disinfection by-products (DBP), chlorinated organics, and other organic compounds.



During the response action, EPA Region 5 sampled cold and hot water in 880 homes to determine the impact of stagnation and heat on drinking water quality. Water samples were analyzed for 13 total metals (including lead and copper).

The PHILIS laboratories also supported a pilot health study to assess potential chemical sources for skin rashes reported by residents. This testing differed from the routine water sampling and was conducted throughout Flint and focused on identifying concentrations of metals and other water quality factors potentially associated with the rashes. Water samples were analyzed for metals (24 compounds), volatile organic compounds (VOC) with total halomethanes (THM), DBPs, chloral hydrate, and haloacetic acids (HAA).

Drinking water sample collection from bathroom faucet

Shower water sample collection

Samples of residues found in faucet aerators were also collected and tested for metals to determine potential contamination source(s).

Faucet aerator residue sampled for metals

The collected samples were preserved before priority overnight shipment to the PHILIS laboratories for a turnaround time for results ranging from 24 hours to 5 days, depending on site-specific project needs.

The PHILIS team coordinated site activities and sample shipments with the analytical laboratories. Upon arrival at the laboratory, the samples were unpacked, verified for proper preservation, and logged into the laboratory information management system (LIMS) for processing. The turnaround time for results ranged from 8 hours to 5 days for issue of the electronic data deliverable (EDD).

Samples packed for shipment to the laboratory

Samples that required metals analysis were shipped to the PHILIS contract fixed laboratory. The samples were prepared using Method 3050B, Acid Digestion of Aqueous Samples and Extracts for Total Metals. Sample digestates were analyzed using Method 200.8, Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry. Reporting limits for this method ranged from 0.5 to 200 micrograms per liter (µg/L). The contract laboratory also analyzed samples for water quality wet chemical parameters that included alkalinity using Method 2320B, anions using Method 300.0, turbidity using Method 180.1, hardness using Method 2340, and total dissolved solids using Method 2540c.

Samples that required organic analysis were shipped to the PHILIS laboratory at the EPA Region 2 facility in Edison, NJ. These samples were analyzed for HAAs, DBPs, haloacetonitriles (HAN), and THMs.

Sample bottles received in Edison for HAA, HAN, and THM analysis

Samples analyzed for HAAs were evaluated using EPA Method 552.3, which uses liquid-liquid microextraction, derivitization, and analysis using gas chromatography (GC) with electron capture detection. Reporting limits for this method ranged from 1 to 10 µg/L. An example chromatogram for determining HAA compounds is provided below.

Samples analyzed for DBPs and HANs were evaluated using EPA Method 551.1, which uses liquid-liquid microextraction and analysis using GC with electron capture detection. The reporting limit for this method was 0.2 µg/L.

Review of analytical data for DBPs

Samples analyzed for THMs were evaluated using Method 524.2 for purgeable organics in drinking water, which uses purge and trap collection with GC/MS analysis. The reporting limit for this method ranged from 0.5 to 2.5 µg/L.

PHILIS delivered sample results to the site staff in SCRIBE EDD format, which provided the information needed to make site activity decisions.

PHILIS delivered Level 4 (Contract Laboratory Program [CLP]-like) data packages to Region 5 in electronic format through the PHILISLab.org website data package distribution portal. An independent third-party quality control (QC) investigator reviewed the data packages, and data validation reports were prepared.

To access the PHILISLab.org website, project managers were provided with user name identifications (ID) and passwords. The website provides users with access to project plans and documents, standard operating procedures (SOP) for laboratory methods, chain-of-custody forms, SCRIBE EDDs, and data package deliverables. Files are downloaded in required formats from project-specific directories encrypted for restricted access. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

PFCs

PHILIS team develops a new method to detect perfluorinated compounds in water samples

The Portable High-Throughput Integrated Laboratory Identification System (PHILIS) team has developed an internal Liquid Chromatograph Tandem Mass Spectrometry (LC/MS/MS) method to identify perfluorinated compounds (PFC) in water samples. The method is a hybrid partially based on EPA Method 537 for determining PFCs (perfluoroalkyl and sulfonate compounds) in drinking water through solid-phase extraction and analysis by LC/MS/MS, and other LC/MS/MS methods developed by EPA Regional laboratories. Liquid Chromatographic technology is required, as the PFC structures are complex and are not applicable to Gas Chromatographic technology. The LC allows for rapid and effective separation of the analytes in a sample extract, and the tandem mass spectrometry allows for the identification of the analyte based on mass spectrometry ionization principals in which each analyte's unique ionic "transition" from a precursor ion to a product ion can be monitored in the mass spectrometer.

Before performing the method, the PHILIS team spent an extensive effort to eliminate all potential sources of PFCs and Teflon® from the laboratory, including equipment and instrumentation used for sample analysis. The team also tested all reagents and materials to eliminate potential sources of contamination. Reagent bottle packaging, aluminum foil, reagents, disposable laboratory coats, and some personal protective equipment (PPE) were identified as potential sources of laboratory contamination. All glassware and solid reagents were treated in a muffle furnace before use in the liquid chromatography laboratory.

To perform the method, a 50-milliliter (mL) water sample was extracted though a preconditioned OASIS HLB extraction cartridge (225 mg, 60 μm) on a Teflon®-free syringe. To elute the analytes, 2 mL of methanol was passed through the cartridge and collected. Before instrumental analysis, 500 microliters (μL) of the extract was pipetted into 500 μL of 0.1% acetic acid in water and spiked with 10 μL of internal standard. The table at the top of the following page summarizes the analytes of interest for the method.

Analytes of Interest					
Entry	**Compound Name**	**Abbreviation**	**Transition**	**Type**	**Retention Time (min)**
1	Perfluorobutanoate	PFBA	213 > 169	Analyte	3.01
2	Perfluoropentanoate	PFPeA	263 > 219	Analyte	4.70
3	Perfluorobutyl sulfonate	PFBS	299 > 80	Analyte	5.02
4	Perfluorohexanoate	PFHxA	313 > 269	Analyte	5.83
5	Perfluoroheptanoate	PFHpA	362 > 319	Analyte	6.62
6	Perfluorohexyl sulfanoate	PFHxS	399 > 80	Analyte	6.68
7	Perfluorooctanoate	PFOA	413 > 369	Analyte	7.21
8	Perfluorooctanoate	PFNA	463 > 419	Analyte	7.71
9	Perfluorooctyl sulfonate	PFOS	499 > 80	Analyte	7.72
10	Perfluorodecanoate	PFDA	513 > 469	Analyte	8.13
11	Perfluoroundecanoate	PFuNA	563 > 519	Analyte	8.48
12	Perfluorododecanoate	PFDoA	613 > 569	Analyte	8.74
13	Perfluorotridecanoate	PFTriA	663 > 619	Analyte	8.93
14	Perfluorotetradecanoate	PFTreA	713 > 669	Analyte	9.09
15	Perfluoro-n-[1,2-$^{13}C_2$]hexanoic acid	13C-MPFHxA	315 > 270	Surrogate	5.83
16	Perfluoro-n-[1,2-$^{13}C_2$]decanoic acid	13C-PFDA	515 > 470	Surrogate	8.12
17	N-deuterioethylperfluoro-1-ocatnesulfonamidoacetic acid	d5-N-EtFOSAA	589 > 419	Surrogate	8.47
18	Perfluoro-[1,2-$^{13}C_2$]octanoic acid	13C-PFOA	415 > 370	Internal Standard	7.22
19	Na perfluoro-1-[1,2,3,4-$^{13}C_4$] octanesulfonate	13C-PFOS	503 > 80	Internal Standard	7.72
20	N-deuteriomethylperfluoro-1-ocatnesulfonamidoacetic acid	d3-N-MeFOSAA	573 > 419	Internal Standard	8.30

A precision and accuracy test was performed by spiking water samples with the analytes of interest at 200 parts per trillion (ppt). The table below summarizes the average percent recovery (%R) values.

Average %R Values for Analytes of Interest								
Entry	**Compound**	**Detected Result (ppt)**				**Average (ppt)**	**% RSD**	**Average %R**
		1	**2**	**3**	**4**			
1	PFBA	160.0	162.9	187.1	136.2	161.6	12.9	80.8
2	PFPeA	179.4	191.2	209.6	192.6	193.2	6.4	96.6
3	PFBS	189.5	196.1	220.1	211.0	204.2	6.8	102.1
4	PFHxA	184.9	192.3	212.2	199.1	197.1	5.9	98.5
5	PFHpA	181.3	190.8	205.1	197.2	193.6	5.2	96.8
6	PFHxS	181.7	188.5	211.0	206.2	196.9	7.1	98.4
7	PFOA	175.7	181.3	186.2	193.5	184.2	4.1	92.1
8	PFNA	169.6	176.9	184.7	191.2	180.6	5.2	90.3
9	PFOS	171.0	177.6	181.2	201.9	182.9	7.3	91.5
10	PFDA	158.4	164.7	162.9	208.0	173.5	13.4	86.8
11	PFuNA	162.7	169.1	155.0	189.3	169.0	8.7	84.5
12	PFDoA	206.5	208.7	202.7	226.8	211.2	5.1	105.6
13	PFTriA	238.3	228.0	237.0	202.6	226.5	7.3	113.2
14	PFTreA	233.6	219.0	206.0	146.9	201.4	18.9	100.7

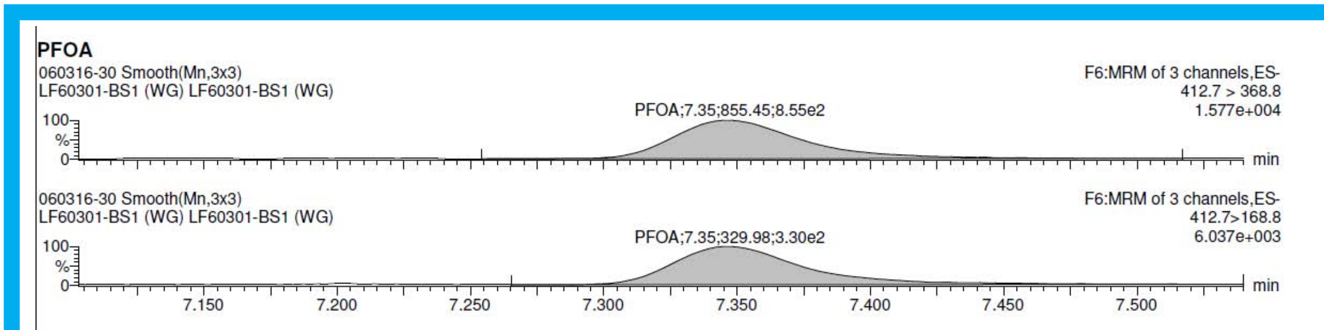
Method detection limits (MDL) were calculated by spiking seven water samples at 25 parts per trillion (ppt). The table at right summarizes the calculated MDL values.

CMAD will continue to work with EPA regional laboratories, and other EPA Program Offices, including the Office of Superfund Remediation and Technology Innovation (OSRTI), Office of Resource Conservation and Recovery (ORCR), Office of Research and Development (ORD), and Office of Enforcement and Compliance Assurance (OECA) to further define method parameters, such as an expanded analyte list, appropriate detection levels, quality assurance parameters, and other parameters. Once method parameters are consensus-approved, a multi-laboratory validation study will be conducted using three to eight laboratories to evaluate the applicability of the method on multiple environmental matrices (such as surface water, soil, and sludge). The validation study will involve each laboratory analyzing replicate PFC-spiked analytes at three concentration levels for each matrix studied, followed by statistical evaluation of the pooled results. For more information about CMAD involvement, contact Terry Smith at smith.terry@epa.gov.

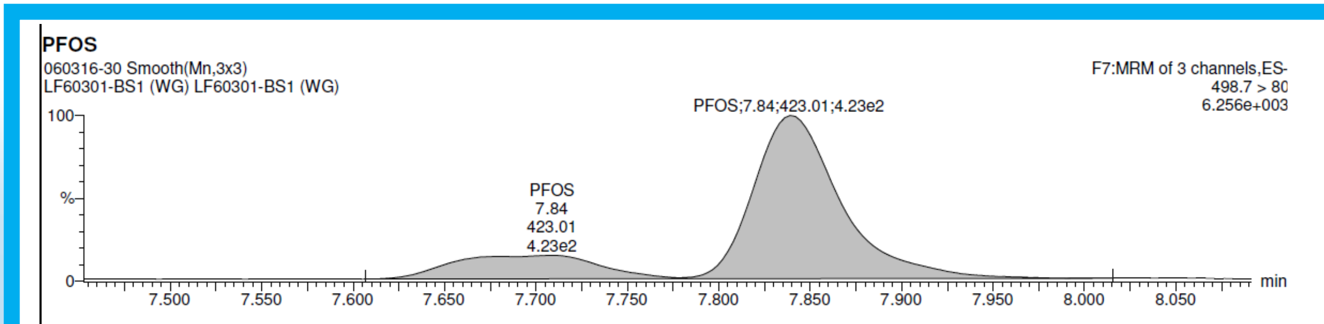
MDLs for analytes of interest

Entry	Compound	MDL (ppt)
1	PFBA	9.4
2	PFPeA	6.4
3	PFBS	6.3
4	PFHxA	7.6
5	PFHpA	7.2
6	PFHxS	8.9
7	PFOA	10.5
8	PFNA	7.4
9	PFOS	10.3
10	PFDA	5.2
11	PFuNA	7.0
12	PFDoA	20.8
13	PFTriA	10.9
14	PFTreA	5.2

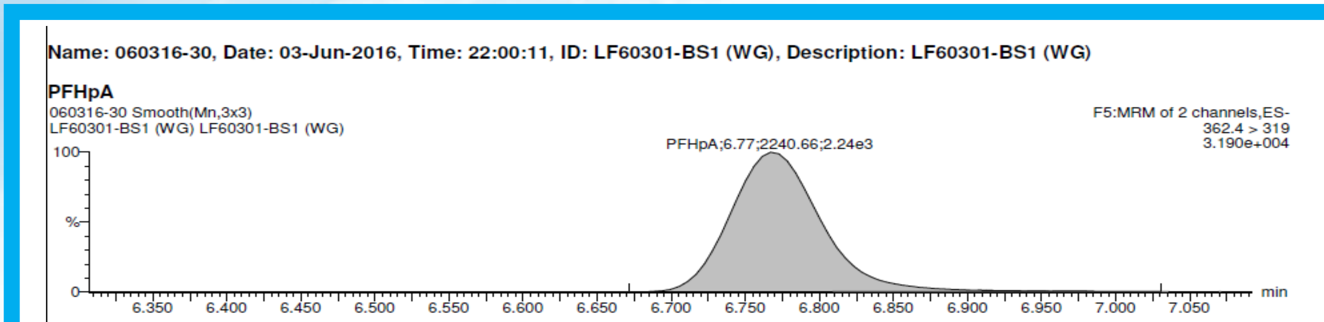
Three example chromatograms are provided below.



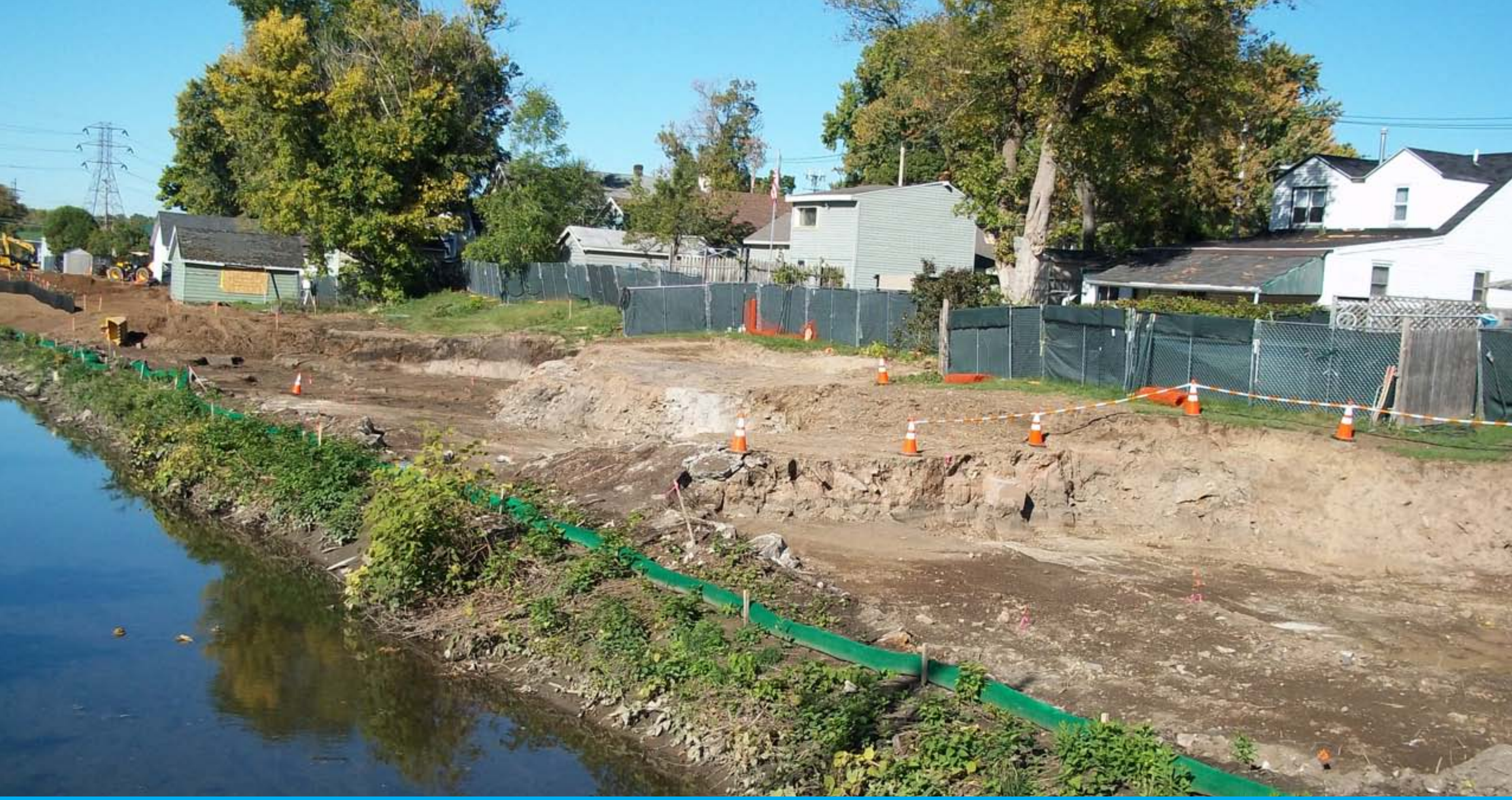
Graphic 1 | PFOA: Primary Transition 417.7 > 368.8. Conf. 412.7>168.8



Graphic 2 | PFOS: Primary Transition 498.7> 80. Branched Chain Isomers Seen Preceding the Main Peak, Included in Integration



Graphic 3 | PFHpA: Primary Transition 362.4>319



REGION 2

Region 2 supported by PHILIS team with on site PCB analytical capabilities at the General Motors Inland Fisher Guide site in Salina, NY

The New York State Department of Environmental Conservation (NYSDEC) conducted work to address contamination related to the General Motors (GM) Inland Fisher Guide site in Salina, Onondaga County, NY. The Revitalizing Auto Communities Environmental Response Trust currently owns the site. The work was performed under the NY State Superfund Program and included the excavation and off-site disposal of surface and subsurface soil from 19 residential properties that abut Ley Creek. The soil contained polychlorinated biphenyls (PCB) exceeding 1 part per million (ppm) total PCBs by dry weight and was excavated under NYSDEC's oversight. Several residences required evacuation during excavation activities.

EPA Region 2 Remedial Project Manager (RPM), Anne Kelly, requested assistance from the Portable High-Throughput Integrated Laboratory Identification System (PHILIS) Program to provide on-site PCB analytical support for the removal action. PHILIS Edison Operations mobilized laboratory vehicles to the GM Inland Fisher Guide site for 6 weeks. The deployed assets included the SPA01 sample preparation laboratory and the APL02 analytical laboratory equipped with two dual-micro electron capture detector (ECD) gas chromatography (GC) instruments for the analysis of low-level PCBs.

The project required the extraction and analysis of 102 samples over a 2-day period. Analytical results from collected soil samples were provided to project management within 24 hours of sample receipt. Both on-site staff and off-site PHILIS staff participated in sample analysis, data review, and report preparation to provide analytical data that met the rapid turnaround requirements under unexpected and accelerated deadline demands.

During the Remedial Action, the PHILIS team received and processed a total of 600 soil samples for PCB analysis. Analysts provided results as required while ensuring the continued operation of all units without significant delay. Additionally, analysts were necessary to be on-site to log in and label all samples, perform instrument maintenance, prepare and clean glassware and equipment, track samples and inventory, order and log supplies and materials, and segregate and characterize waste for disposal. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

PHILIS laboratory vehicles deployed at GM Inland Fisher Guide site, Salina, NY

Electrochemiluminescence (ECL) device can be used to detect biotoxins such as ricin

BSL-2E LAB

CMAD enhances EPA's biological analytical capability with staffed BSL 2E biological laboratory

As part of ongoing efforts to enhance the Consequence Management Advisory Division (CMAD) field support capability to On-Scene Coordinators (OSC), a Biosafety Level 2 Enhanced (BSL-2E) laboratory has been certified to support biological analytical needs. CMAD's BSL-2E laboratory is co-located at EPA's Enforcement Investigations Center in Lakewood, Colorado, and has been certified to process and analyze samples for potential contamination by biological agents. The laboratory has been specially designed and constructed to safely analyze samples potentially contaminated with biological agents, with features such as its own air supply, a liquid waste bio-tank, and a dedicated exhaust system that keeps the laboratory isolated from the rest of the building.

The CMAD BSL-2E laboratory is staffed by a PhD molecular biologist who is familiar with common molecular and microbiological analytical methods and their development. The laboratory equipment can conduct molecular and microbiological analysis and includes the following:

- Two Applied Biosystems 7500/7500 Fast Real-Time Polymerase Chain Reaction (PCR) System thermal cyclers capable of conducting specific gene express analysis with a 96-well reaction plate in under 1 hour
- JANUS® Modular Dispense Technology (MDT)™ Automated Workstation capable of high- throughput screening with automated plating and pipetting
- AirClean® Systems AC600 Series PCR Workstation, a "clean" workstation that minimizes DNA contamination
- IKA® microbial culture shaker
- Qubit® 3.0 Fluorometer allowing instant quantification of DNA, RNA, and protein samples
- Class II Biosafety Cabinet
- Pass-through two-door autoclave allowing in-laboratory waste sterilization to prevent facility contamination and secondary waste decontamination to ensure "cradle-to-grave" disposal

The mission of the laboratory is to support OSC analytical needs during a biological incident, and CMAD will be partnering with the Office of Research and Development (ORD) to assist in biological analyses that may be required as part of ongoing research studies. Additionally, the laboratory will help analyze hundreds of samples from the New York City Underground Transport Restoration Project, which is part of the Department of Homeland Security's Underground Transport Restoration initiative. These partnerships will ensure that the laboratory is current with the state-of-the-science.

The laboratory will play a vital role in developing and ensuring that OSCs have access to the latest laboratory science. In partnership with ORD, the laboratory will be developing methods to address gaps in ricin analysis and using Rapid Viability PCR (RV-PCR). RV-PCR is a molecular biology method that will allow EPA to analyze for the viability of a pathogen in a sample, saving significant time over more traditional culture-plating methods. For the latest information on the CMAD BSL-2E laboratory's capabilities, please contact Francisco Cruz at cruz.franciscoj@epa.gov.

REGION 5

Region 5 assisted by PHILIS team with on site analytical support for the sunken ARGO Barge leaking solvents into Lake Erie

APL01 mobile laboratory parked at Port Clinton, OH

Interior of APL01 mobile laboratory

Sampling equipment inside the APL01 mobile laboratory

In Fall 2015, Region 5 On-Scene Coordinator (OSC), John Gulch, called CMAD for response support during an emergency cleanup of a spill on Lake Erie. The spill material was leaking from the ARGO Barge, which sank in October 1937 about 9 miles north of Kelleys Island just south of the U.S. – Canada border. The leaked material contained benzol, toluene, xylene, and trace amounts of petroleum.

The Portable High-Throughput Integrated Laboratory Identification System (PHILIS) team analyzed samples from the spill area for volatile organic compounds (VOC), including benzene, toluene, xylene, and for other compounds in an effort to detect trace amounts of other petroleum products. The analytical results were provided to OSC Gulch, within several hours of receipt of the samples. For more information about CMAD involvement contact Larry Kaelin at kaelin.lawrence@epa.gov.

CWA

PHILIS team participates with DoD CSEPP from Pueblo Chemical Depot in field and table-top exercises

Beginning in 2014, the Consequence Management Advisory Division (CMAD) and the Department of Defense (DoD) Chemical Safety and Environmental Protection Program (CSEPP) have participated in numerous field and table-top exercises at DoD demilitarization (demil) locations in KY and CO. During the exercises, participants explored sampling and analytical issues and protocols related to chemical warfare agent (CWA) response at a demil facility. As a result of the exercises, CSEPP staff at the Pueblo Chemical Depot (PCD) asked CMAD if the EPA and PCD can share analytical assets during PCD's ongoing demil facility clearance activities, which began in 2016 and will continue in 2017. PCD was especially interested in the analytical capabilities of the Portable High-Throughput Integrated Laboratory Identification System (PHILIS) laboratories in Castle Rock, CO, to provide confirmatory CWA analysis during

PCD MiniCAM GC/FPD system for CWA air monitoring

air sampling and screening activities at numerous underground storage bunker igloos used to store munitions containing primarily mustard gas at the PCD site.

During demil facility clearance activities, PCD uses small gas chromatographs linked with flame-photometric detectors (GC/FPD) called MiniCAMs to perform near real-time air monitoring of the igloos. The MiniCAMs are housed in a mobile laboratory truck called a Real-Time Analytical Platform (RTAP) that can stage outside an igloo to monitor air inside the igloo. The GC/FPD technology is not a definitive analysis in its own right. Therefore, confirmatory analysis is needed using a more sophisticated technology, such as gas chromatography/mass spectrometry (GC/MS). The PHILIS laboratories in Castle Rock, CO, can provide GC/MS analytical capabilities. CMAD and PHILIS staff met with PCD staff to develop plans for final demil clearance of the igloos. Confirmatory air samples from the bunkers will be collected using thermal desorption tubes for PHILIS laboratory GC/MS analysis.

Interior of munitions storage bunker igloo

Staff at the Chemical Material Agency (CMA) of DoD are subject matter experts (SME) on analytical issues related to the demil of DoD facilities. For the PHILIS laboratory to be certified to perform the confirmatory analyses, CMA's analytical quality assurance (QA)/quality control (QC) procedures must be followed. The PHILIS laboratories will use CMA-provided dilute standards (2 milligrams per milliliter) and will conduct a specific precision and accuracy study over several days to meet CMA standards before samples are analyzed for demil activities. Once established, the PHILIS laboratories will be able to perform confirmatory analyses to support clearance goals at PCD during clearance and demil activities. This capability may also allow the PHILIS laboratories to provide similar services at other DoD facilities in the future. For more information about CMAD involvement, contact Larry Kaelin at kaelin.lawrence@epa.gov.

Interior of RTAP truck containing two MiniCAM systems

PHILIS 2016

DEPLOYMENTS:

12 Separate Deployments

NSSEs:

Supported ***3*** National Special Security Events

PROJECTS:

33 On-site and Laboratory Projects

MILES:

9,800 Miles Traveled

REGIONS:

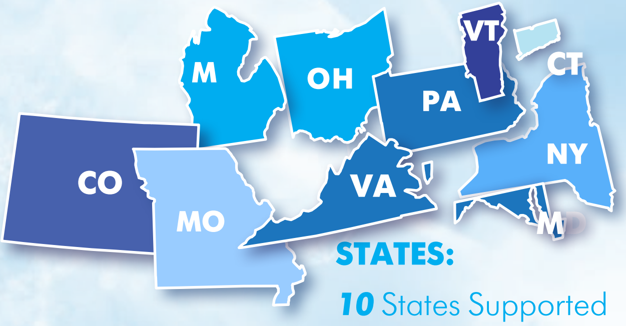
Provided Support to ***6*** Regions: Regions 1, 2, 3, 5, 7 and 8 and Headquarters

SAMPLES:

4,970 Samples Analyzed

PERFORMANCE SCORES:

PHILIS achieved ***Perfect Scores*** on their semi-annual Performance Testing (PT) evaluation samples for autumn 2016 NELAP (National Environmental Laboratory Accreditation Program) evaluation and ***99%*** for the 2016 NELAP evaluation year



STATES:

10 States Supported

A monthly report listing the current methods, all analytes, the method detection limits, and the status of the instruments for PHILIS can be accessed in the PHILIS Monthly Readiness Reports found at http://tinyurl.com/htwz7ck

CBRN CMAD
RADIATION SOURCE PROGRAM
FACT SHEET

"How can I test my field protocols in an elevated but safe radioactive environment?"

?

"How can I get a rad source larger than the 'button' source I typically train with?"

RADIATION SOURCE PROGRAM: Radiation sources licensed by the Chemical, Biological, Radiological, and Nuclear (CBRN) Consequence Management Advisory Division (CMAD) and the Nuclear Regulatory Commission can be used ANYWHERE in the United States. Several gamma-emitting sources and a neutron source are available! Sources can be used to validate ASPECT algorithms, calibrate instruments, conduct field exercises and demonstrations, and train individuals in civil defense activities.

WHO CONTROLS SOURCES IN THE FIELD? CBRN CMAD-authorized users control the sources in the field and also take care of shipping and handling as well as local transportation. It's a "turn-key" operation!

WHAT IS THE COST? There are no costs if the request is pre-planned and has been authorized by EPA Headquarters! You may be asked to pay travel costs for EPA personnel.

CONTACT THE RADIATION SAFETY OFFICER AND PROVIDE THE FOLLOWING INFORMATION:

1. Your contact information
2. Date(s) needed
3. Do you have dosimetry?
4. Purpose (training, exercise, demonstration, or other)
5. Other services desired, including:
   a. ASPECT aircraft
   b. Chemical plume generator
   c. Ground-based detection instrumentation
   d. Hand-held instrumentation
   e. Training or support on the basics of ionizing radiation

WHAT IS EXPECTED FROM YOU? Help identify temporary storage locations. Follow your own health and safety plan, which may include dosimetry. Help coordinate the activity with local officials as necessary. Identify areas where the sources can be used.

CONTACT: Captain John Cardarelli II, Radiation Safety Officer (RSO)
Cardarelli.john@epa.gov or 859-594-6529

^{60}Co & ^{137}Cs

CMAD provides its licensed radiation sources during the 2nd Marine Air Wing field training exercise

USMC personnel training to locate radioactive sources

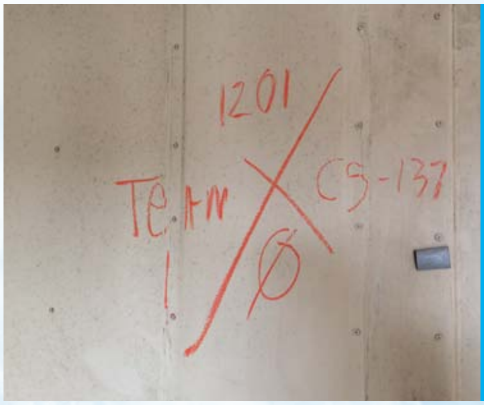
In January 2016, the 2nd Marine Air Wing (MAW) requested the use of Consequence Management Advisory Division (CMAD) radioactive sources in a field training exercise. CMAD is licensed by the Nuclear Regulatory Commission to maintain a series of radioactive sources (gamma and neutron emitters). CMAD provides access to these sources to state and federal partners for training purposes.

The exercise was conducted on February 17 and 18, 2016, to replicate an incident involving a stolen radioactive source that could be used in a radiological dispersal device. CMAD provided the use of its radioactive sources to generate an elevated but safe radioactive environment and to allow exercise participants to gain experience in using field instruments in a practical, real-world setting. CMAD personnel handled all field logistics for the sources, such as health and safety, transportation, and storage, but did not provide tactical directions or guidance on U.S. Marine Corps (USMC) field protocols or operations.

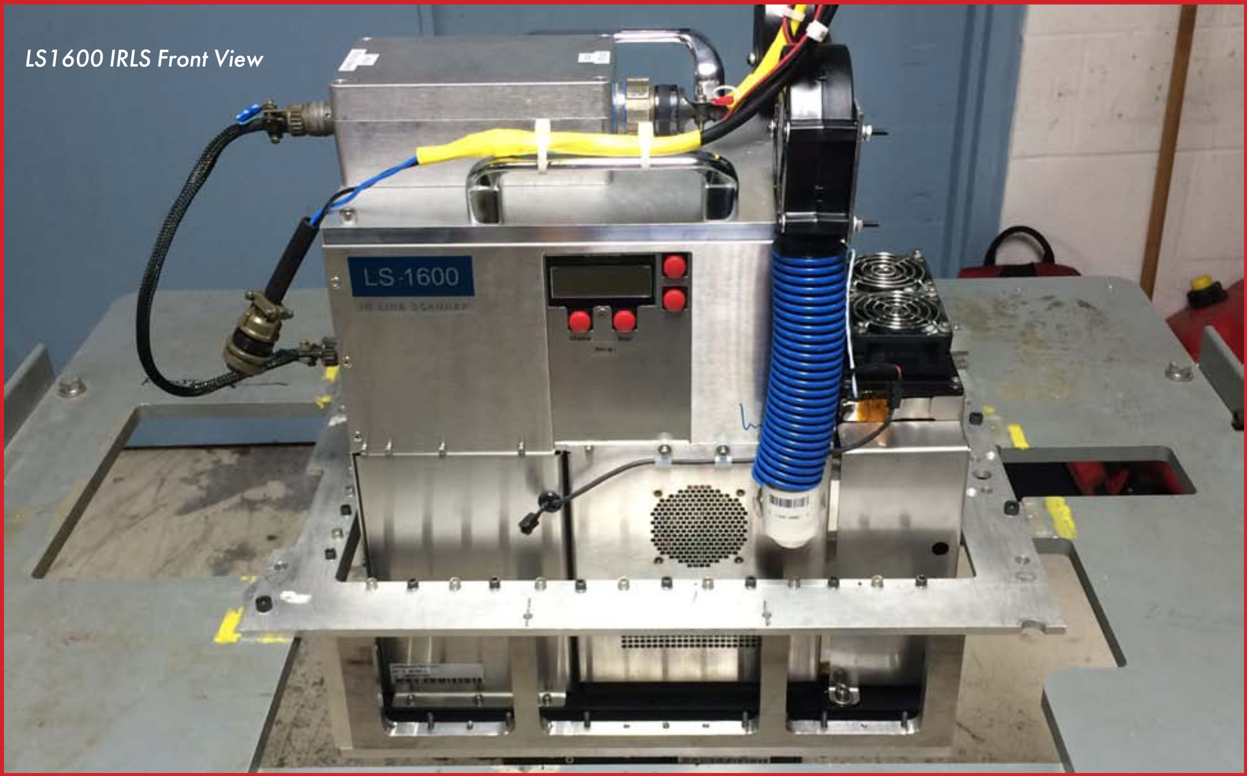
The exercise consisted of concealing two Cesium-137 sources and a Cobalt-60 source at various locations in training buildings on the Marine Corps Outlying Field Atlantic site. USMC personnel were to locate, identify, and secure the source(s). As the exercise progressed, USMC contract support training staff were able to engage participants in "teaching moments" to stress critical thinking skills during environmental assessment and the efficient use of equipment down range.

Overall, the exercise taught USMC and CMAD personnel many valuable lessons about instrument response, effects from shielding, and USMC radiation field protocols. This type of training prepares personnel for interpreting equipment readings and rapidly detecting, identifying, and isolating radiation sources. The training is a good example showing that practical field experience cannot be obtained by using smaller check or "button" sources. The exercise also provided both organizations with issues to consider for future training exercises and demonstrates that a live-agent radiation exercise should be part of the mix of technologies used to train emergency responders in operations involving Chemical, Biological, Radiological and Nuclear (CBRN) areas.

For more information about the CMAD source inventory and how to request their use for civil defense training purposes, contact the CMAD Radiation Safety Officer, Captain John Cardarelli (U.S. Public Health Service) at cardarelli.john@epa.gov.



FEMA search & rescue markings indicating search results



LS1600 IRLS Front View

ASPECT

New ASPECT Sensor – LS1600 Infrared Line Scanner

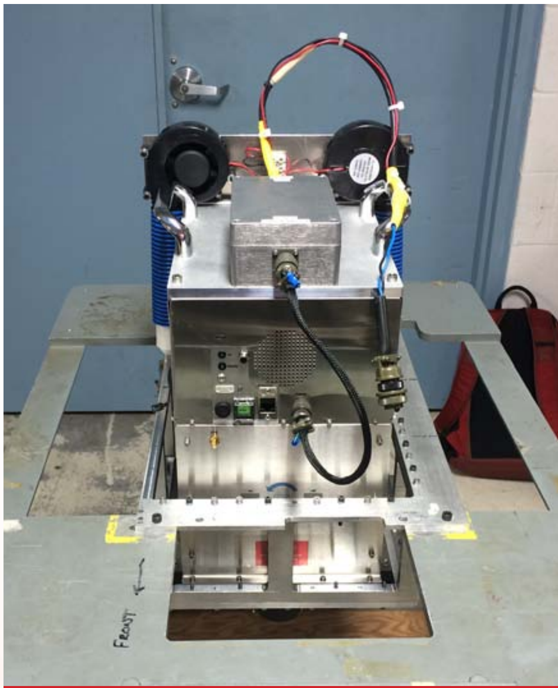
The saying, "A picture is worth a thousand words," is especially true in the business of emergency response. One of the features of the Airborne Spectral Photometric Environmental Collection Technology (ASPECT) program that sets it apart from other types of environmental sensing is its wide-area infrared line scanner (IRLS), which provides a precise but simple aerial image showing the location of a plume referenced to the real world, allowing the ultimate in situational awareness. The IRLS is mounted on the ASPECT aircraft to generate aerial images of chemical plumes and thermal maps.

Since the ASPECT program was started in 2001, it used a modified model RS-800 multispectral IRLS (Texas Instruments, McKinney, TX). Although this sensor has served the program well, due to age of both the primary electronics and the supporting computer systems, in 2014, the ASPECT program initiated a project to replace this unit with an improved sensor.

Specifically, the ASPECT team specified a new sensor that would provide the following:

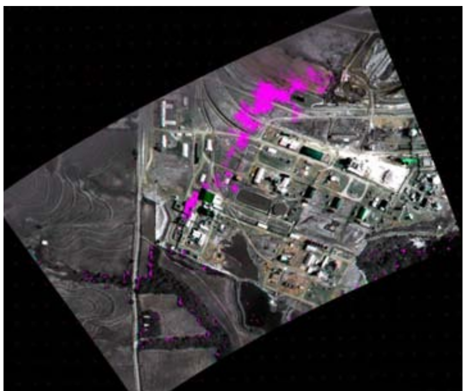
- Superior signal-to-noise ratio
- Dynamic range as good as or better than the current system
- More systematic spectral design on the channels
- Simplified pitch/roll correction of the data
- Simpler system startup and operation

These specifications were developed based on limitations observed when using the old sensor and more importantly on detection needs required to support the mission of the EPA On-Scene Coordinators (OSCs) and the Regions. Based on these specifications, the ASPECT program has chosen the new LS1600 IRLS to collect data with significant improvements over the older RS-800 IRLS.



LS1600 IRLS back view

The ASPECT program does not use a forward-looking infrared (FLIR) system due to field of view (resolution) and spectral bandwidth sensitivity. An FLIR system collects images similar to a digital camera. The FLIR system has a limited photo array that is significantly less than the effective resolution of an IRLS. An aircraft-mounted IRLS is a very efficient imaging system that allows a wide area (wide field of view) to be covered while not overloading the data collection system with an enormous amount of data throughput. The IRLS scanning device images a narrow strip of the ground about 0.5 mile wide at a rapid scan rate. For the ASPECT program, the ground is scanned from right to left at a rate of 60 times per second from an altitude of 2,800 feet above ground level. Each scan line is about 1.5 feet deep and consists of 1,400 individual samples or pixels. As the aircraft progresses forward, these scan lines generate a high-resolution image in a way similar to a television picture. A typical image may be 1 mile long and have an effective pixel count of 5 million pixels. The ASPECT IRLS configuration is not only efficient in the data collection rate, but the scanner system consisting of a gallium arsenide prism and reflective mirrors is extremely efficient in collecting photons.

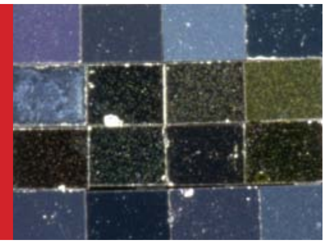


Typical chemical image (methanol plume) generated by ASPECT aircraft

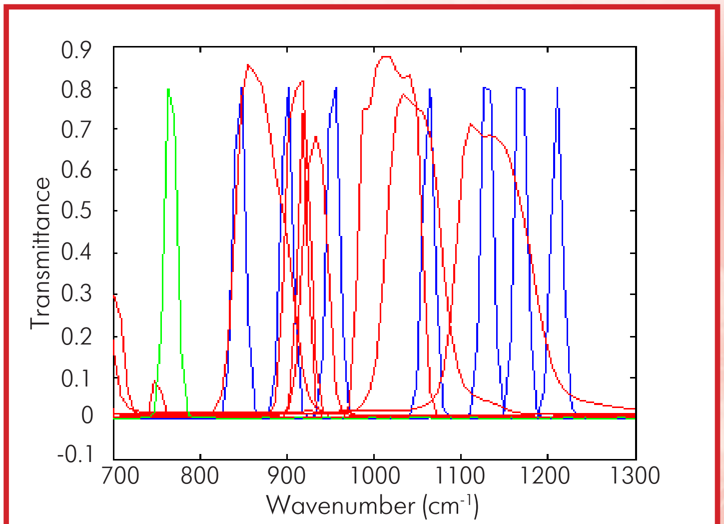
A more significant advantage of the IRLS over the FLIR system is the spectral bandwidth sensitivity. An FLIR system typically has no spectral selectivity (no filters), and if the FLIR system is equipped with filters, the filters are mounted external to the array, are at room temperature, and provide no weak-signature detection capability. The ASPECT IRLS, on the other hand, has an array of cold optical filters attached to each detector element. These filters are very small (0.010- by 0.010-inch square) and are cooled along with the mercury cadmium telluride detector to 77° K. This cryogenic temperature significantly reduces the noise of both the filter ("thermal noise") and the detector ("band gap noise") and allows the system to detect narrow-width infrared signals to allow the detection of weak chemical signatures.

The most significant improvement with the new system is the array of cold optical filters used. The ASPECT team designed the cold optical filters of the new LS1600 system and tested them by running a number of chemical detection simulations to compare the spectral bandwidth of known chemical spectral signatures with the bandwidth of the filter. The testing indicated that both narrow (about 20 wave numbers) and wide (about 40 wave numbers) filters were required. Test results also provided the technical data needed to develop specifications for the new cold optical filters to be manufactured and then assembled on a device called a "cold frame." This frame is less than 1 millimeter square and supports the checkerboard arrangement filters over the detector. To further enhance the system, a detector design operating temperature of 72° K was selected to reduce the band gap noise of the detector as low as reasonably possible using standard cryogenic pumps. In addition, the dynamic range of the new unit was increased from the old 14-bit external data collection system to a new, internal 16-bit system while maintaining efficient treatment of the lower bit range of the signal. Pitch/roll correction of the data was greatly enhanced by replacing the old mechanical gyroscope system with a new, solid-state, nine-dimensional gyro system that provides 200 times per second feedback to the system. This attitude system, called an "Inertial Navigation Unit (INU)," provides over 20 degrees of roll (wings up and down) correction and 20 degrees of pitch (nose up and down) correction. Yaw correction is provided by a combination of data from a Global Positioning System (GPS) and the solid-state gyro to provide better than 0.25 degree of residual error. Finally, the new LS1600 system is a fully self-contained unit requiring only 28 volts of DC power, a GPS antenna, an Ethernet cable, and a control cable. Specific sensor configurations can be accomplished using an internal sensor website.

Cold frame assembly



The ASPECT team has recently completed LS1600 system acceptance testing, and the system will be flight-tested during the week of February 27, 2017 and made operational soon after. Following a short break-in period, the ASPECT program plans to initiate a pattern recognition development project using algorithms similar to those currently used by the ASPECT Fourier Transform Infrared Spectrometer (FTIR) and the gamma ray spectrometers. The new algorithms are expected to be operational in 6 to 9 months. For more information, please contact Mark Thomas at thomas.markj@epa.gov



Cold optical filter design

RAD

CMAD developed Rad Decon App, a computer application to aid in early phase decision-making in the event of a large, wide-spread radiological incident

The Rad Decon App (Version 1.0) (http://RadDecon.gtri.gatech.edu) meets a need identified by the U.S. Department of Homeland Security to provide responders with a readily available software application that can help early-phase decision-making regarding containment, decontamination, waste staging, and storage and disposal after a large-scale radiological incident. The Rad Decon App is a fast and powerful tool that can assist users in quickly prioritizing possible decontamination technologies for any large-scale radiological response. The application can be used in both preparedness and response settings.

L-R Captain John Cardarelli II; U.S. EPA CMAD, Dr. Anne Nisbet, UK Public Health, Wendy Skavlem, SRA; Dennis Carney, CSS-Dynamac

Stakeholder outreach has been a critical feature throughout the development of the Rad Decon App. Stakeholder visits to three U.S. cities resulted in over 60 participants confirming the need for this software application and offering outstanding advice on its content and format. The participants represented firefighters, public health officials, emergency planners, health physicists, federal and state responders, and others. Upon completion of a prototype application, user tests were conducted by dozens of individuals at multiple locations. The users offered excellent feedback and suggestions that were subsequently incorporated in the application to improve its look, feel, and functionality.

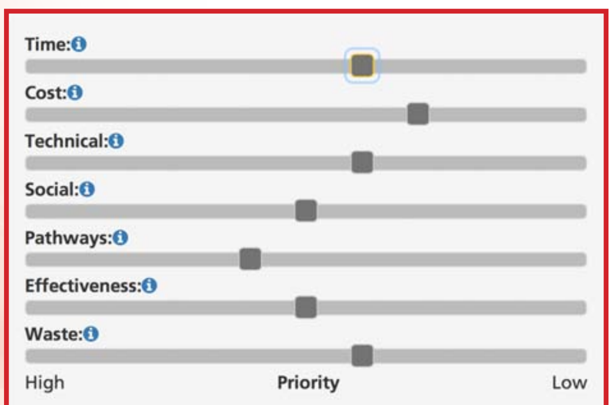
During the conceptual design phase of the app, partnerships were formed with a number of organizations in the United States and the United Kingdom. These partnerships served as the core of the app development team. The Rad Decon App also is based on years of research and development efforts in the United Kingdom, including information gathered after the Chernobyl and Fukushima nuclear disasters. The "UK Recovery Handbooks for Radiation Incidents" (UK Handbook) first published in 2005 and most recently updated in 2015 are proven aids in the selection of response options. The Rad Decon App converts the processes and databases inherent in the UK Handbook into a quick and simple tool to aid decision making that also incorporates recent EPA research and development information on radiation response technologies.

Users need only two pieces of information as inputs to the app software: the surfaces impacted by radiation and the radionuclides present (or alternatively, the type of radiation incident). The app enables users at all levels of government to quickly move through a series of nine steps. These steps lead to a prioritized list of response alternatives or "management options" ready for incident-specific stakeholder discussion. Response options can range from controlling site access, collecting leaves, pressure washing to fixable or strippable coatings, and surface washing. Stakeholders (including federal On-Scene Coordinators; other federal, state and local responders; scientific support personnel; and the impacted community) can then make adjustments to the initial results, as appropriate, based on the unique circumstances and conditions of the actual incident.

Some key features of the Rad Decon App are summarized below.

1) The app can evaluate 28 possible response alternatives researched and evaluated in the United Kingdom or the United States. The app provides a detailed data sheet for each alternative.
2) Users can scale seven factors to evaluate possible response options: time, cost, technical, social, pathways, effectiveness, and waste (see below). Based on values for these factors, the list of decontamination options is prioritized using algorithms.
3) The app provides hyperlinks allowing access to other reference sources as well as the data sheets to provide stakeholders with detailed information on response alternatives.
4) Pop-ups are incorporated to provide users with definitions for terms used in the app.
5) An "audit" function documents decisions made throughout the process and ensures their availability for review by others.
6) The app can be used to print or e-mail a Final Report in a pdf format.
7) The app runs on all devices (including laptops, smart phones, and tablets), with internet access using various browsers, including Internet Explorer, Chrome, Firefox, and Safari.

For more information, please contact Captain John Cardarelli (U.S. Public Health Service) at cardarelli.john@epa.gov.



Scalable factors that allow stakeholders to prioritize the most important factors during the response and recovery phases

CMAD

CMAD hires a new chemist in the Field Operations Division

The Consequence Management Advisory Division (CMAD) would like to introduce David Bright, our new chemist in the Field Operations Branch. David is located in Kansas City and will work on chemical warfare agent preparedness and response, and work on other CMAD efforts as needed.

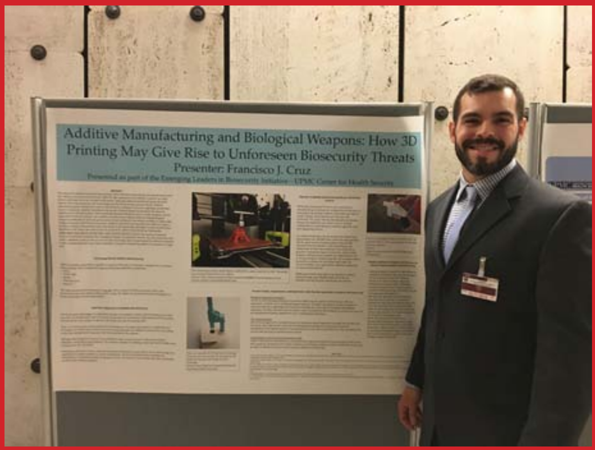
David is a co-recipient of the 2013 Nobel Peace Prize. David received the award for his work as a weapons inspector and analytical chemist for the Organization for the Prohibition of Chemical Weapons (OPCW). Earlier in his career, David was a lead analyst at a chemical weapons destruction facility on Johnston Island and also a chemist/test engineer with the Department of the Navy in Florida. Previously, he was a quality manager for the Nebraska Department of Agriculture Laboratory, where his duties were to develop and implement an ISO/IEC 17025 accredited quality management system. Most recently, David worked at the U.S. Department of Agriculture (USDA) National Grain Center as a chemist in the Analytical Chemistry Branch. His hobbies include international travel, photography, mineralogy, and outdoor activities such as hiking, camping, fishing, and canoeing.

David Bright

CMAD biologist receives Emerging Leaders in Biosecurity Initiative Fellowship

Biologist Francisco J. Cruz of the Consequence Management Advisory Division (CMAD) was selected in 2016 to receive a fellowship under the Emerging Leaders in Biosecurity Initiative (ELBI) program. The fellowship program is run by the University of Pittsburgh Medical Center's (UPMC) Center for Health Security, the leading think tank in the United States in the fields of biodefense and global health security.

Under the ELBI program, fellowship recipients will take two week-long trips to Washington, DC, and San Francisco, CA, to receive biodefense and global health security training. Over the course of a year, fellows also will participate in several web seminars on topics of interest and will have networking opportunities to interact with leaders and decision makers in the biodefense field. Through the fellowship program, Francisco has been fortunate enough to interact with National Security Council staff at the White House; visit biodefense laboratories at Fort Detrick; and participate in briefings by leaders at the Defense Threat Reduction Agency (DTRA), Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDC), and Senate Select Committee on Intelligence.



Francisco J. Cruz

ELBI is a competitive fellowship program designed to create and sustain an energetic, multidisciplinary, and intergenerational biosecurity community of motivated young professionals as well as current leaders. Each year, this program selects a group of the "best and brightest" talented career professionals from government, defense, private industry, science, law, public health, medicine, global health, journalism, social sciences, and academia to receive fellowships. By participating in conferences, seminars, networking events, a writing competition, and educational webinars, fellowship recipients deepen their expertise, expand their professional contacts, and build their leadership skills. In 2016, 28 individuals received ELBI fellowships.

Francisco has the honor of being the first person from EPA ever selected to receive an ELBI fellowship. He is a biologist in the Field Operations Branch of CMAD. Francisco holds a M.S. in Biodefense from George Mason University, a Graduate Certificate in Critical Analysis and Strategic Responses to Terrorism from George Mason University, and a B.A. in Biological Sciences from the University of Delaware.

CBRN CMAD

First row (left to right): *Larry Kaelin (Chemist/Environmental Scientist), Dr. Mark Thomas (Physicist), Lessa Givens (Program Analyst), Leroy Mickelsen, PE (Chemical Engineer), Elise Jakabhazy (Environmental/Geotechnical Engineer), David Bright (Analytical Chemist)*

Second row: *Tim Curry, PE (Engineer), Scott Hudson (Certified Health Physicist), Jayson Griffin (Environmental Protection Specialist), Natalie Koch (Environmental Protection Specialist), Francisco Cruz (Biologist)*

Third Row: *Terry Smith (Chemist/Geochemist), Dr. Shannon Serre (Chemical Engineer), Captain John Cardarelli, Ph.D. (Certified Health Physicist), Mike Nalipinski (Associate Director), Paul Kudarauskas (Branch Chief), and Sam Waltzer (former Acting Director, September – October 2016)*

David Charters, Acting Director
Washington, DC

Mike Nalipinski, Associate Director
Boston, MA

CBRN Operational Planning Team (COPT)

Elise Jakabhazy, Team Leader
Boston, MA

Lessa Givens
Natalie Koch
Sandra Whittle (SEE)
Erlanger, KY

Jayson Griffin
Leroy Mickelsen
Shannon Serre
Research Triangle Park, NC

Michael Ottlinger **
*** Currently on detail*

Field Operations Branch (FOB)

Paul Kudarauskas, Branch Chief
Washington, DC

Larry Kaelin
Edison, NJ

John Cardarelli
Scott Hudson
Erlanger, KY

David Bright
Tim Curry
Mark Thomas
Lenexa, KS

Francisco J. Cruz
Terry Smith
Washington, DC

MISSION

Serve as EPA's national operational preparedness and response organization that provides expertise and leadership of CBRN consequence management.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Chemical, Biological, Radiological and Nuclear
Consequence Management Advisory Division

To contact CMAD for deployment of ASPECT, PHILIS, or technical support,
please call EPA HQ EOC at 202-564-3850

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