Solutions

U.S. Army Combat Capabilities Development Command
Chemical Biological Center

NEWSLETTER
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DIRECTOR'S MESSAGE

Center Workforce Steps Up in Time of Crisis

Eric L. Moore, Ph.D., is the director of the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, the only chemical and biological defense technology center of its kind. He is a member of the Senior Executive Service and is an expert in chemical and biological defense and medical countermeasures.

Prior to his selection as Center director in October 2017, Moore served in various roles at the Defense Threat Reduction Agency including chief of the Advanced and Emerging Threat Division, chief of the Basic and Supporting Sciences Division and senior science and technology manager for chemical medical countermeasures.

THE WORLD HAS CHANGED IN REMARKABLE WAYS SINCE LAST ISSUE OF SOLUTIONS. As I look back at my message in that issue, published in January, I'm struck by this particular paragraph:

"I look forward to a year of challenges, a year of innovation, and a year of victories. I look forward to a year spent with the outstanding people of the CCDC Chemical Biological Center."

Little did I expect the challenges to be so great, innovation to be so needed, and victory to be so crucial. Nor did I expect that soon, my time with dedicated people of the Chemical Biological Center would be spent almost exclusively by telephone and virtual meetings.

Our Center has risen to the challenge presented by the COVID-19 pandemic in remarkable ways. Our workforce rapidly adapted to the changes that came with the Army-wide declaration of Health Protection Condition (HPCON) Charlie on March 25. HPCON Charlie requires installations to limit access to essential personnel only. Thanks to preparation by the Center's staff and directorates, including a telework exercise on March 17, we were able to quickly transition to telework for the vast majority of our workforce. Our COVID-19 crisis action team, which stood up in early March, served as a focal point for the gathering and sharing of information that was critical to Center leaders as we made decisions about how best continue executing our mission in the face of this rapidly growing challenge.

Across the Center, members of our workforce stepped up to the challenge with innovative solutions and a strong desire to help. We launched a series of network upgrades to enable teleworking across the center, and as of the end of March an average of about 85 percent of our workforce was teleworking daily. We established a COVID-19 preparedness page on our SharePoint site that quickly evolved into a one-stop-shop for information on operations during the pandemic. And the staff engaged to communicate with our workforce through e-mail, audio messages, FAQs and other media to provide information and answer questions.

On the technical side, our scientists and engineers engaged with stakeholders in pursuit innovative solutions to the operational problems posed by the pandemic. We engaged across the spectrum of protection and decontamination, seeking answers to questions as simple as "what's the most effective household material for a homemade face covering?" and addressing issues as complex as advising the Air Force on the acceptance testing of biocontainment units for installation in aircraft for the transport of COVID-19 patients. We examined disinfection and decontamination solutions for use on N95 masks, and found a solution ultimately recommended by the Defense Threat Reduction Agency for general-use decontamination against COVID-19.

We leveraged our expertise in building and deploying mobile laboratories to support the upgrade of ALS1A1 mobile laboratories with equipment to perform COVID-19 testing, and to plan the construction of more robust mobile labs for patient diagnostics to alleviate stress on hospitals.

Our experts in advanced manufacturing engaged across multiple fronts to lend support to efforts to create 3-D printed COVID-19 test swabs. They also lent expertise in developing technical data packages for face shields and face masks and advised the Navy on manufacturing support to make critical parts for ventilators to address Veterans Administration shortages.

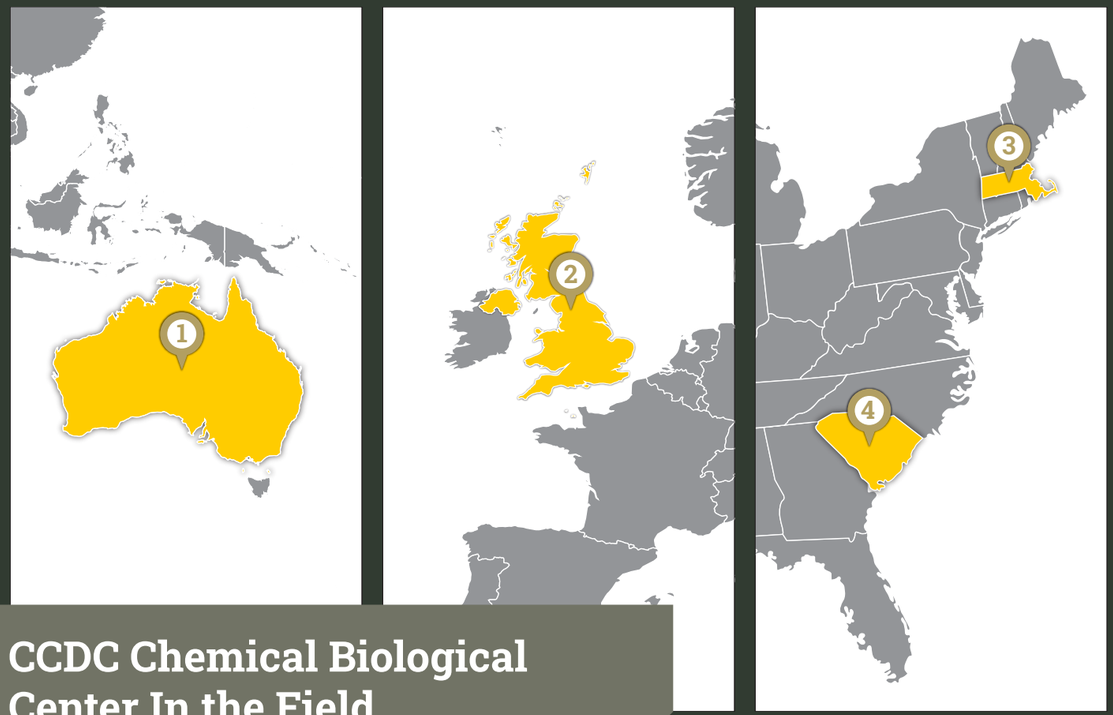
As we responded to the demands of winning the war against COVID-19, we continued to perform work to support our partners in the industrial base, such as carbon and filter production acceptance testing and technical data package updates and certifications for detection, protection and decontamination systems.

We also continued our work on the world stage in support to the Organization for the Prohibition of Chemical Weapons (OPCW). Our Forensic Analytical Branch is one of the two United States' OPCW-designated laboratories and participates in the annual April proficiency test offered by the OPCW. The goal of the proficiency tests is to ensure the designated laboratories can continue to provide the necessary chemical analyses required to support the OPCW mission.

I'm encouraged by the flexibility and resilience of our workforce in finding ways to contribute to the mission despite adversity. I'm confident we will continue to adapt in order to meet the challenges of protecting our warfighters and our Nation from chemical and biological threats. The changes we are seeing today will continue to have impacts long after the current crisis has passed, and the tools we are building today will make us more agile and better prepared to handle whatever tomorrow may bring.

"People first — winning matters — Army strong!"

Eric L. Moore, Ph.D.
Director, CCDC Chemical Biological Center



CCDC Chemical Biological Center In the Field

CCDC Chemical Biological Center is made of many parts and each part has an important role to play in the protection against and destruction of chemical and biological threats. In the past several months, personnel have traveled not only around the country, but around the world in support of our common mission. Here's a look at just a few of the many places our workforce has touched down.

1 **Australia** – A team of chemical demilitarization experts at from the CCDC Chemical Biological Center's Chemical Biological Application and Risk Reduction business unit completed an investigation and assessment at a former U.S. chemical depot in New South Wales, Australia. A team of 14 Center employees mobilized, conducted the operation and demobilized in approximately 45 days. The operation began in late February, and the team implemented rigorous COVID-19 safety measures in order to complete the mission and return home safely.

2 **United Kingdom** – CCDC Chemical Biological Center researchers collaborated with colleagues at the University of Hertfordshire Research Center for Topical Drug Delivery and Toxicology in Ludgershall, Andover, United Kingdom in late February as a part of a DTRA-funded effort to develop a better understanding of the factors which impact successful mass casualty chemical warfare agent decontamination.

3 **Massachusetts** – Center researchers participated in a preliminary design review for immediate decontamination in Cambridge, Massachusetts in late February. The review was for a sprayable decontamination slurry that was developed at the Chemical Biological Center but is now being further optimized by an industrial partner under a rapid innovation fund project. This partnership will allow the slurry technology to be transitioned to the warfighter ahead of the original schedule.

4 **South Carolina** – A Chemical Biological Center researcher supported safe-to-fly acceptance testing of the Transport Isolation System and two upgraded variants for the U.S. Air Force's Air Mobility Command for COVID-19 pandemic transport of patients. The testing took place at Joint Base Charleston, South Carolina in March and April.

In Memoriam: William C. (Bill) Klein

William C. (Bill) Klein, deputy director of engineering for the Combat Capabilities Development Command (CCDC) Chemical Biological Center, passed away suddenly on Feb. 25, 2020.

Bill directly managed more than 500 members of the Center staff, and provided leadership in efforts to design, build, test and support the acquisition and sustainment of chemical biological defense systems. He served as either deputy or associate director for engineering for the past 25 years.

"Bill led with an open heart, a keen sense for details, and a real passion for people," said Center Director Eric L. Moore, Ph.D. "Over the course of his career, Bill was a constant advocate for employee development, working with other leaders to pioneer many mentoring programs. He personally mentored countless employees over the years. Whether they were in the Engineering Directorate or not, he always lent his ear to listen and offered honest advice. Bill wanted to bring out the best in everyone, and ensure that our Center was a safe and inviting workplace."

Bill was hired as a mechanical engineer in 1980 by the Army Armament Materiel Readiness Command Maintenance Engineering Detachment located at the Edgewood area of Aberdeen Proving Ground, Maryland. He served in multiple engineering leadership positions at various agencies at Edgewood over his 40-year career – always focused on better protecting the warfighter from chemical and biological threats.

During Operations Desert Shield and Desert Storm, Bill served as a deputy program manager and was responsible for leading an effort that resulted in the fielding of a first-time-in-history biological detection capability for U.S. forces. The design served as the catalyst for the Biological Integrated Detection System Program. He served as the U.S. chemical biological defense expert to the North Atlantic Treaty Organization during the 1990s, and served as the U.S. head of delegation for the Nuclear-Biological-Chemical Quadripartite Working Group during that same period. Shortly after Sept. 11, 2001, Bill was called upon to lead an effort to develop a process for checking delivered mail for chemical, biological and radiological hazards.

"Bill has been a great friend over the years – we've shared the good and challenging times with work and raising families; we've taken turns being the boss but consistently we watched out for each other, the Center and the warfighter," said Suzanne Milchling, CCDC Chemical Biological Center director of engineering. "Bill will be greatly missed, but I know he'd want us all to move forward and continue to support the warfighter and the nation."

Bill graduated from Loyola College in Baltimore in 1980 with a degree in engineering. He was a loving father to his three children – Jonathan, Justin, and Jennifer, a caring son to his parents, the owner of an impressive historical camera collection, and a baseball and lacrosse fan. He was an advocate of the Wounded Warrior Project and Loyola College. Bill was 61 years old.

Photo(s) courtesy CCDC Chemical Biological Center Operational Applications Directorate

Members of a CBARR field team perform an investigation of potential buried chemical agent munitions in Australia.

CBARR Crew Manages COVID-19 Threat While Completing Chemical Material Assessment Work in Australia

By Brian B. Feeney, Ph.D.

THE COMBAT CAPABILITIES DEVELOPMENT COMMAND (CCDC) CHEMICAL BIOLOGICAL CENTER'S Chemical Biological Applications and Risk Reduction (CBARR) business unit travels the world performing investigation, assessment and remediation activities. At times, this includes traveling to active and former military sites that may contain suspect buried chemical warfare materials.

CBARR has been performing these missions in Australia since 2009 and is a recognized leader in performing this kind of work. In fact, the Australian Department of Defence (ADOD) maintains a list of current and former defense sites in need of CBARR investigation, and if necessary remediation, in rank order. This list is part of a broader initiative within Australia called the Wartime Remnants Clean-up Program.

Getting the Call

In December 2019, CBARR was beginning plans to investigate a site in New South Wales, Australia when a construction crew encountered magnetic anomalies while performing routine pre-construction magnetometry at an installation named Defence Establishment Orchard Hills, 50 miles west of Sydney. The installation command and construction contractor's immediate concern was the possibility of buried chemical munitions because Orchard Hills served as a U.S. Army chemical storage depot during World War II, called Kingwood Ammunition Depot.

The delay in operations for the construction crew was costing the ADOD $20,000 a day, so it was imperative for CBARR to conduct the investigation and potential remediation as quickly as possible. At the same time, CBARR had to conduct its operations – hazards assessment, safety planning, and documentation – with the same rigor that it applies to every operation.

This operation came with another twist. When the initial call came in to reprioritize work at the Orchard Hills site, coronavirus was still only known to be present in Wuhan, China. That was about to change.

Not a Typical Mission

Multiple lines of effort had to be executed to meet the ADOD's needs. It was important that CBARR complete the operation quickly and safely so that construction could be resumed at the facility. To accomplish this, CBARR deployed an advance team in late

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February to coordinate work efforts with the ADOD and begin site setup. A second CBARR team in Australia followed up in early March performing the final stages of site setup, conducting onsite training, and finalizing the operational and safety documents in preparation for the survey and excavation operations, which they call 'hot operations.' Together from March 16 to 19, CBARR and the ADOD conducted a pre-operational survey to assess the readiness for the operation to proceed. On March 28, the ADOD gave CBARR the green light to begin field operations to be performed by another CBARR team.

At this point, the magnitude of the coronavirus pandemic became clear. It had left China and was spreading to Iran and parts of Europe. The 13-member second team's flights were put on hold and travel restrictions began limiting travel globally. So the team had to stay and perform the field operations themselves. The team members took it in stride. They had deployed together many times, and they routinely did site investigations and remediation field operations, too. "When we got the news, our reaction was, 'Okay let's stay and get this done'," said Jim Swank, the CBARR operations crew chief.

Working with the on-site nurse, they immediately implemented rigorous coronavirus safety measures. That included everyone on the site having their temperatures taken as they arrived in the morning. Each of them had to sign a declaration that they were not experiencing any symptoms associated with COVID-19. They maintained six feet of social distancing from each other on the site, while traveling to and from it, and in their hotel rooms after hours. And, they were required to thoroughly wash their hands frequently, both on and off the job.

Maintaining Mission Focus

Knowing that they were taking all the proper precautions and following their safety measures helped ease their concerns, but the thoughts crept in. "Crew members worried about the possibility of bringing the virus home to their families," said Carl Tallagsen, the Center's project safety officer on site. "They were also concerned about how difficult it might be to get the multiple flights they would need to travel the 9,500 miles home."

However, the team's mission focus never wavered. CBARR systematically executed the plans that were developed for the operation and successfully investigated each anomaly. The anomalies did not turn out to be chemical warfare items, and the process and procedures used to assess the items provided ADOD decision makers with the information they needed to resume construction activities.

CBARR team members perform survey and excavation operations in late March. The team put in place COVID-19 safety precautions in order to remain on site and complete the project.

The actual survey and excavation operations, hot operations, took less than a week. The total time on site was almost 40 days. In that time, they were not able to enjoy after-hours barbeques, sight-seeing and socializing as they do during other deployments. "On our way back from the site, we typically bought the groceries we needed to make our dinners alone in the kitchenette each room had," said Swank. "Evenings were spent watching old American and Australian entertainment shows in syndication on the local television stations, there wasn't much else on. We got up-to-date news on the pandemic on the evening news shows and from the internet, and we called our families."

Returning Home

Then the email they had all been waiting for arrived. With field operations complete, they were coming home. But that was not the end of the ordeal. Most airlines had cancelled their flights between Australia and the United States. The Center made contingency arrangements with the ADOD to provide military flights home if all else failed. However, the crew members caught a break. One commercial carrier continued with U.S.-Australia flights.

"We began the 30-hour return journey by flying on a crowded plane to San Francisco, then the crew members flying home to Arkansas caught another plane to Houston while the Aberdeen-based crew members flew in a near empty aircraft to Dulles. The Pine Bluff crew, after a five-hour layover, caught a third plane to get the rest of the way home," said Tallagsen. "We then had to share rental cars to our homes. Taxis and Uber were out of the question given the social distancing we were adhering to as much as possible."

Once home, they had to quarantine themselves in their homes for 14 days, including social distancing from their family members. "We all took it well," said Swank. "We were all very happy to have accomplished the mission safely and return to our families."

A Job Well Done

Both the ADOD and the Center's leadership fully appreciated their sacrifice. "The team did an outstanding job in completing the work to the highest standards - most importantly safely - but also within schedule. Their patience and dedication to duty under uncertain times is greatly appreciated," said Mark Bowman, Ph.D., director of Contamination Assessment, Remediation and Management for the ADOD.

"The members of the crew at Orchard Hills took on the risk of coronavirus exposure to eliminate the risk of possible buried chemical agent munitions," said Eric Moore, Ph.D., director of the Chemical Biological Center. "They once again demonstrated that CBARR field teams are the best in the world at what they do, and that they do it bravely. They also showed that the U.S. Army is a force for good in the world."

Executive Officer Learns About Leadership during Time at Headquarters

Rock Island campus employee serves detail at APG

By CCDC Chemical Biological Center Public Affairs Office

Terry L. Martin has been serving a six-month detail as the Executive Officer for CCDC Chemical Biological Center's Engineering Directorate.

WHEN MARTIN JOINED THE MENTORING PROGRAM in the Combat Capabilities Development Command Chemical Biological Center campus at Rock Island Arsenal, Illinois, he had no idea it would lead to an opportunity to participate in the Executive Officer (XO) Program in Edgewood, Maryland.

"This was the first mentoring program offered at Rock Island, and throughout the program I kept hearing about the XO detail in Edgewood and how the program was designed to enhance leadership skills," Martin explained.

Chemical Biological Center Director Eric L. Moore, Ph.D., and the late William Klein, Deputy Director, Engineering Directorate, attended the graduation in Rock Island and that was when Martin had the opportunity to really learn about the XO program. When the call for applications for the developmental assignment came out in August, Martin discussed the opportunity with his wife, who agreed that it was a great opportunity and encouraged him to apply. "If Mr. Klein would not have come and taken the time to talk to me, I would not have applied. I'm grateful for him taking the time with me," Martin said.

Martin, a system administrator in the knowledge and data management branch, began serving a six-month detail in November 2019 as the XO to Engineering Director Suzanne Milchling. A typical day for him could range anywhere from participating in planning meetings; assisting the engineering director and deputy director by preparing, coordinating and maintaining presentations, schedules and minutes; serving as gatekeeper for specified and implied tasks to compiling data for Milchling to aid in her decision-making process. Using his information technology background, Martin enhanced the scheduling of Milchling's workforce engagements and the consumption of the data she received from surveys.

Throughout his time at Edgewood, he's been to Aberdeen Proving Ground Senior Leader Cohort briefs, leadership courses, one of the senior executive service classes where Milchling was the speaker and a local STEM event. He recalled one meeting that stands out in his mind. "It was one of the first meetings I participated in, where the WILE-E team was briefing Ms. Milchling. At the end, Ms. Milchling and Mr. Lowry Brooks, associate director of engineering, gave their thoughts and then she turned to me and said 'Terry, what are your thoughts?' This made me feel like part of the team, like I had something to offer and was also a reminder to always pay attention, stay engaged because you never know when someone might ask your opinion."

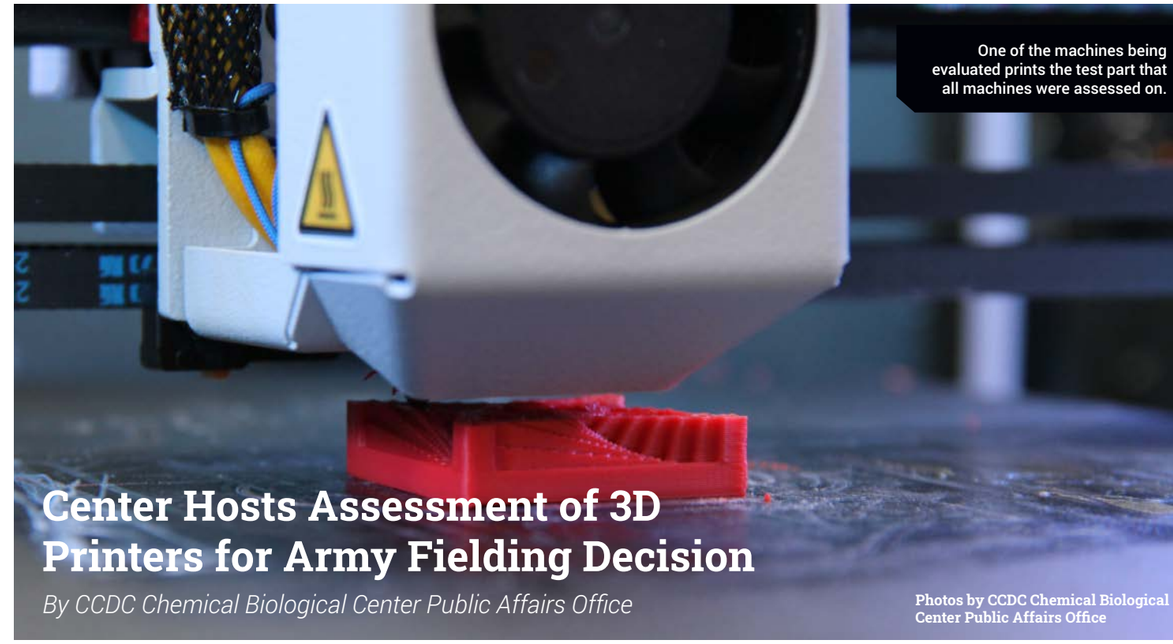
Another unforgettable moment for Martin was scheduling a two-day tour for a VIP from Army Futures Command in Austin, Texas – the Center's major Army command. Working with the operations staff and other XOs, the center-wide tour was a great "show and tell" moment that provided the new headquarters a look at the Center's capabilities.

Spending time with senior leadership throughout this detail has made him see things through different lenses. "My focus and views are different," Martin said. "There's a lot of work being done at the senior level. It's been reassuring to see that senior leaders are genuinely concerned about people. They worry about completing the mission, but they take a lot of time working to develop people and looking for future leaders."

The biggest challenge for Martin was being away from his family for six months. Although, being away from his family is not entirely new to him as he retired from the Illinois Army National Guard after serving 25 years, which included a 2010 tour in Afghanistan. He has a wife, Tricey; two adult children, Terell and Tiara; and two grandchildren, Kyrie and Kinsley. "Thank goodness for technology. Being able to FaceTime them has been helpful. We also have a Ring doorbell at home and my grandson loves to press the doorbell at our house so it shows up on my phone and I can talk to them through there."

Martin says he hopes to inspire others in Rock Island to apply for the XO Program. "I hope they can get past being away for six months. It is a great opportunity to grow and learn." His advice to those considering the program is to "take the opportunity if it presents itself. You'll be better for it, become a better person and get insight into leadership at a senior level that most people don't see, especially for those at Rock Island to be able to experience and learn the culture at headquarters."

When Martin returns to Rock Island in May, he plans to use the skills that he learned and developed during his assignment. "I learned that I like taking care of people. I want to look for opportunities to do that. I also learned that not everything works for every person. As a leader you must figure out what motivates your people to get the best out of them individually and collectively. That's leadership, providing an environment and encouraging everyone to be their best."



One of the machines being evaluated prints the test part that all machines were assessed on.

Center Hosts Assessment of 3D Printers for Army Fielding Decision

By CCDC Chemical Biological Center Public Affairs Office

Photos by CCDC Chemical Biological Center Public Affairs Office

A SELECT GROUP OF MILITARY AND CIVILIAN SUBJECT MATTER EXPERTS well-versed in additive manufacturing, specifically 3D printing, gathered at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center to assess five 3D printers for the Army's long-term use.

"The machine selected will be fielded in the next 20 Metal Working Machine Shop Sets (MWMSS) to make replacement parts on the fly as needed," explained Brad Ruprecht, additive manufacturing subject matter expert at the Center.

The MWMSS is part of the Mobile Maintenance Equipment System that provides a holistic maintenance and repair capability to the warfighter. The 3D printers will be used in an expeditionary environment to augment, and in some cases replace, the supply chain for the Army, Ruprecht said.

Ruprecht gave an overview of the assessment process and explained how the team was hand-picked by the U.S. Army's Capability Development Integration Directorate.

"A lot of these guys have years of experience with 3D printing, exploring the new world of additive manufacturing as part of their job but also as a hobby," said Adrian Bailey, who assembled the team on behalf of the Army. "There are also a few guys that have very little experience with additive manufacturing but play critical roles that necessitated their involvement."

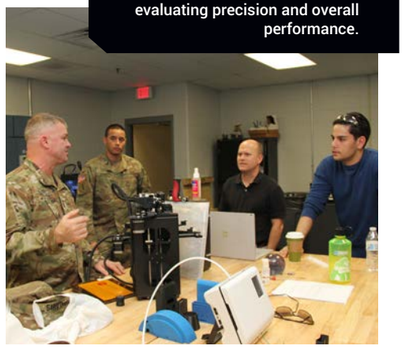
With introductions and initial questions complete, it was time to put each printer to a test by having each one print the same design. The test print was designed by Chief Warrant Officer 2 Andres Arango who made sure the design really put each printer through its paces.

"Designing a cube is one thing but we're looking for precision of the printers, among other things," said Arango. "I incorporated a staircase design into the center of the cube to complicate things. A good printer will more accurately build the entire shape where on a lesser printer, the stairs might come out more like a blob."

During the assessment, each person chose a printer to run. They used the software and the hardware to get the full feel for how the printer performed from start to finish.

Once the printers completed the job, the team assessed each printer based on the final product to determine which one performed the best. Beyond that, they will assess each printer on a host of other qualities, including physical size, weight, software compatibility and cost, to determine which printer they will recommend to Army leadership.

Army leadership will consider the team's assessment and ultimately choose the printer that best meets the needs of the warfighter. Once the printer is selected, it will be used to teach Soldiers at the Allied Trades School House at Fort Lee, Virginia.



Subject matter experts in 3D printing test several printers at the Center during an assessment evaluating precision and overall performance.

Building E-3330 on Aberdeen Proving Ground's southern annex.

Photo by Jack Bunja

Capability Spotlight: Chemical Biological Center's Drive toward Modernization Picks up Speed

By Don Kennedy, CCDC Chemical Biological Center Communications Officer

FOR MEMBERS OF THE COMBAT CAPABILITIES DEVELOPMENT COMMAND CHEMICAL BIOLOGICAL CENTER who work in the sprawling WWII-era, art deco style Building E-3330, the wait has been a long one. As they arrive at work at Aberdeen Proving Ground's southern annex, they stop at the recently constructed gate complex that caps Maryland Route 24 and feeds morning rush hour traffic into the core of the United States' chemical and biological research community.

They turn left onto Magnolia Road and pass the modern Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense, and follow the curve in the road to the right past the current construction of the massive Public Health Command complex slowly but surely rising out of a dusty lot on the left. Next they drive by the sprawling U.S. Army Research Institute of Medical Research (MRICD) headquarters completed in 2013 as the morning sun gleams off of the walls of glass that ring the building.

And before they know it, they go back in time, passing the old, one-story brick MRICD lab that once housed their staff. From there, they pass the dilapidated E-3200 compound, a haunting series of rickety old buildings covered in dingy, chipping paint and rusted-over Quonset huts that once served as home for world renowned researchers in the fledgling years of the nation's CB Defense community. Among the worn buildings is the Amos Fries laboratory, once the jewel of the Center's capabilities, now not good for much except casting a shadow on the far edges of E-3330.

Across the street, the Sample Receipt Facility (dedicated in 2011) and Advanced Chemistry Laboratory (2014), among the Center's newest and most modern facilities, stand in sharp contrast to the weathered office and lab facility just across Rickett's Point Road where 250 employees support the research and development for the nation's chemical and biological defense enterprise.

It's a three-minute drive, tops, but a decade-long journey. Those who work in the long beige building have watched through many seasons as modern facilities have sprung up on once-vacant fields. But now, their time has come. The massive nondescript building is scheduled for a massive renovation, during which it will be stripped to its studs and re-imagined as a modern high-end workspace for up to 400.

More than just a pretty space

Center-wide personnel involved in modernization projects and refurbishments over the years have provided valuable lessons that will be used to make the E-3330 project successful.

Although Dan Davis has only a small role to play in the E-3330 project, as a supervisory business manager for the Center's Research and Technology Directorate he has been intricately involved in numerous laboratory

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renovations and building projects through his years at the Chemical Biological Center. His experience provides keen insight into how the Center sets its priorities for facility upgrades.

"There are several questions we ask ourselves when we are looking at a project," he said. "The first and most obvious is whether it is worth the investment. The second -- Is there a safety issue that will be resolved by completing this project? Third -- will the current facility pass inspections of, for example, the Army, Occupational Safety and Health Administration and Environmental Protection Agency if we don't act? And finally, we take a look at Army strategy documents to determine if the upgrades we make will contribute to achieving Army goals."

Heather Robbie, the Center lead for the E-3330 project and team member of the Center's G-4 staff, has been responsible for completing the research to answer those questions. Her answers: "Yes, yes, not over the long run and yes."

You'll not get much argument from any of the current staff in E-3330 that refurbishing the building is worth the investment. The basement frequently floods during rainstorms, the roof is leaky, the access doors do not meet Americans with Disabilities Act standards, facades are crumbling, and mold remediation has become a regular occurrence for the Center's safety office. The layout of the building is a multi-generational patchwork of configurations and reconfigurations. Walk into the lobby in the front of the building and there are visible bundles of cables winding across the ceilings that were installed to accommodate technologies that didn't exist when the building was erected.

"This project will allow us to start from scratch," Robbie said. "Once everyone is moved out we'll gut the building to its studs and start with a new design. I've received lots of feedback from the workforce and management about the types of features they want to see in the building when it's all said and done. And we're trying to incorporate those features into the plans for the building."

It isn't all about beautification of workspaces and reimagining the space. The design will accommodate new and better technology that will increase capability and efficiency in the building's new labs.

Tom Hughes can attest to the value of that effort. As a chemist in the Engineering Directorate, Hughes is currently in the middle of the refurbishment project in his team's labs in E-3510, a separate project undertaken to modernize the Center's testing infrastructure.

"The chambers we use now were installed in the 80s," he said. "They were commercial units that weren't really designed to perform agent work. In order to make them work for us, we had to make modifications on the fly.

"We were able to design an environmental chamber that meets glovebox requirements," Hughes continued. "These hoods have a deeper work surface inside the hood that allows us to test larger samples, and to keep our materials stored inside to help us work more efficiently. The new units will also include noise reduction dampers and modern air handling systems."

Hughes and the design team used the expertise they gained in designing and building the NTADTS (Non-Traditional Agent Defense Test System), which began testing in 2015.

"We were able to scale down the environmental chamber designs for our use, helping to quicken the pace of testing in the NTADTS, which is in extremely high demand. That means we don't have to wait in line to do smaller tests in our facilities."

Rendering of the renovated Building E-3330, which will not only receive a cosmetic face-lift but also include modernized technology to increase capability and efficiency.

Graphic courtesy CCDC Chemical Biological Center G-4

Some of the lessons learned in the E-3510 lab refurbishment will no doubt be put to use in the labs of the new E-3330 upon completion. The environmental testing labs currently in the basement of the building will no longer flood. Lingering safety issues like mold build-up and roof leaks will be addressed, which will make it easier to pass the numerous inspections the lab is subjected to annually. And, the nation will have a more highly functioning laboratory that is more agile and capable of responding to the current and future needs of the chemical biological defense enterprise.

The color of money

The E-3330 project comes with a hefty price tag. The $49 million renovation will be paid for from programmed funding from the OMA funding, or Operations and Maintenance, Army. OMA is the cornerstone appropriation for funding everything from contractual support, to repair parts, to vehicle leases in support of U.S. military forces. The requirements for these funds to be used on existing infrastructure include a building that is already in place, like E-3330, and not meeting current codes. For example, E-3330 is currently out of code with the Americans with Disabilities Act (ADA). "The entryways of E-3330 do not currently meet codes for accessibility for new construction, and will be rectified upon completion of the project," Robbie said.

These funds are distinct from MILCON (military construction) funds used for new construction of facilities such as those labs across the street from E-3330.

But there are other "colors" of money associated the E-3330 project, and a slew of others across the Chemical Biological Center.

LS-6 funding, for example, is used to renovate aging laboratory infrastructure that has become outdated. These types of funds, which are managed at the Center by Program Analyst Troy Neville, are used exclusively for upgrades to surety labs and research facilities that are at least 25 years old and have not been previously renovated, like those in Hughes' lab at E3510. They are also specifically used for surety buildings.

Another source for modernization is 2363 funding, formerly known as 219 funding. "Every dollar that comes into the lab from customers is 'taxed'," said Neville. "These funds are used for workforce and leader development and training, as well as for innovation." One such example is the Center's IDEAS (Individual Development of Employee Advanced Development) program that offers seed money to enterprising researchers from across the Chemical Biological Center who have novel ideas for new products that advance the mission to equip and protect warfighters. These 2363 funds can also be used for infrastructure programs to modernize facilities. There are a number of project that are directly tied to the E-3330 renovation, according to Robbie.

"Basically," she said, "the $49 million price tag doesn't include anything outside the walls of E-3330 such as expanded parking areas to accommodate 400 employees instead of the current 250 or so that work in the building now.

"This funding (2363) is being used right now to renovate the Berger laboratory buildings (E-4301), where entire wings have been renovated right down to the cubicles that will house the expanded workforce who will eventually occupy that building when that project is completed – from 225 to 350. These funds are exclusively for Research, Development, Test and Evaluation projects. Most of the balance of the Engineering Directorate workforce will reside in the CBRNE Product Development Facility, where Advanced Design and Manufacturing houses development laboratories and additive manufacturing facilities, and have slowly been converting classrooms into data analytical space.

The Advanced Chemistry Laboratory and the Sample Receipt Facility across the street were MILCON projects, as was the NTADTS (the Non-traditional Agent Defense Test System), a chamber constructed in 2015 for large-scale live chemical agent testing. This one-of-a-kind facility features custom-designed environmental controls that can simulate almost all operational conditions from the Artic to the Persian Gulf, and allows for entire systems, rather than just components, to become fully immersed in a chemical atmosphere – the operationally relevant conditions necessary prior to fielding.

Each year, the Center seeks out end-of-year funds that were not used as planned from organizations across the CB Defense Enterprise. "We keep proposals for these projects on a running list of needs and wants from across the Center," said Davis. "When we

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are lucky enough to find funding from one of these sources, we have the paperwork in hand and are ready to execute these projects from unused one- or two-year funds."

"We also use overhead funds for equipment and maintenance acquisition projects as well as infrastructure," Davis explained. These are generally less expensive projects.

In recent years, funding from the Garrison to maintain facilities has been on the decline, and 2363 funds go a long way in helping the Center keep labs in tip-top shape.

With all these different colors of money, projects become fairly complex to track and keep on schedule. Neville associates the process of keeping track of projects dependent on other projects and acquiring funding of the right color to ensure a smooth program as "an orchestra."

Oftentimes, one project, the replacement flooring in E-3510 for example, has to be completed before other systems can be started. "Lining all those projects up so there is an orderly flow of work," said Neville, "can be extremely challenging."

Robbie agrees. The scale of the E-3330 project will dwarf the one happening in E-3510, or even in the Berger Laboratory. And right now, she's in the process of collaborating with all the other "musicians" to get the project off the ground.

Employee involvement

In order to get the massive renovation at E-3330 off on the right foot, Robbie has spent the past several months soliciting feedback from affected employees across the Center. She still is.

"We stood up Working Integrated Process Teams (WIPT) from all of the functional areas to come together," she said. "Each staff and each directorate has a representative to bring back information to their leadership to ensure we are all on the same page. We're still soliciting and answering questions to ensure we are listening to everyone involved ahead of the scheduled move-out of the building into temporary spaces across the Center for the two- to three-year project."

What can employees expect when the project is complete?

Since there are not many load-bearing walls in the building, the space can be taken down to its studs and reconfigured any way the Center sees fit. Spaces will have more light, and more modern environmental controls. No longer will the employee who is always too cold or too hot have to wait for the system to be switched from cold-weather mode to warm-weather mode. They'll be able to adjust their thermostats particular to their own offices.

"We're going to sign an Memorandum of Understanding with AAFES (the Army and Air Force Exchange Service) to have a stand-alone high-end vending area that will be re-stocked every 2 days," said Robbie. "If that 'micro-mart' is profitable, they will be open to a café for employees to purchase food."

There will be more access points into the building, with planned kitchenettes and locker rooms. The basement won't flood, and the facility will be wired with the latest communications equipment.

Employees who drive by all those modern buildings on their way to work will pull into an expanded parking lot in back of E-3330 where old Quonset huts and other worn out buildings used to be. They'll enter through new doorways that are code compliant, and into offices that are specifically designed for the teams who work in them, with standardized furniture and more varied conference rooms.

"We're going to try to maximize the views of outside and natural light," Robbie explained, "There will be café space for visitors to work on computers, like you would see at Starbucks. The Help Desk will be among the teams to co-locate in E-3330 which will eliminate employees having to drive across post to have their computers re-imaged."

The pesky mold problems that seem to be under constant remediation in one part of the building or the other will be a thing of the past and air quality in general will improve with the installation of new upgraded ventilation systems.

The entire G-staff will be co-located in one place to enhance collaboration and efficiencies. Laboratories will have upgraded environmental controls. And the Center will be the sole occupant of the building, as Assembled Chemical Weapons Alternatives (ACWA) has already moved out ahead of the renovation.

For every employee who has spent any part of the last decade or so watching new buildings spring up from vacant lots on Ricketts Point Road, their time is quickly approaching. "If all goes to plan," Robbie said, "we will maximize our capabilities while minimizing our footprint – the best of both worlds."

New Device Checks for Leaks around Zippers, Seams

More effective testing of protective gear increases Soldier safety

By CCDC Chemical Biological Center Public Affairs Office

Chris Steinbach places VX nerve agent onto material as part of initial testing to demonstrate that the test cell does not leak around the edges of a zipper.

Photo by CCDC Chemical Biological Center Public Affairs Office

TERRENCE D'ONOFRIO, PH.D., HAS BEEN A RESEARCH CHEMIST at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center for the past 17 years and prides himself on helping the warfighter. He does this through his knowledge of chemistry and his ability to shepherd complex projects from the laboratory to the testing community.

Recently, he led the U.S. involvement with the Porton Man full system, chemical protective ensemble research and test capability as an international partnership with the United Kingdom (UK). D'Onofrio helped transition Porton Man from a laboratory capability to be the first internationally accredited chem-bio test fixture. Now, D'Onofrio heads up a new project that tackles one of the biggest challenges warfighters face with their protective equipment – leaks at interfaces.

"We found some suit designs tested with Porton Man were great at protecting against agent contamination, except where the zipper and interfaces were, where it leaked like a sieve. That's a problem," D'Onofrio said.

D'Onofrio holds a patent on the Low Volatility Agent Permeation (LVAP) cell, a test method and device that enables researchers to quantify the amount of chemical agent that breaks through a fabric sample. The self-contained device works through a series of absorbent and protective material layers, along with a material that is exposed to chemical agent, to challenge the fabric's effectiveness. A rubber O-ring sits above the material and below a weight that applies even pressure of one psi to ensure contact of all layers. The ring acts as a gasket to keep vapors from leaking. The entire apparatus is encased in a glass container.

"The LVAP completed an entire verification, validation and accreditation procedure," D'Onofrio said. "We got it accredited through all the stakeholders in the test and evaluation community and now it is sanctioned as an official test method. We also made it a North Atlantic Treaty Organization standard and it's now being used in other locations like the UK."

While the LVAP is the standard for testing fabric against chemical weapon agents like VX, it has limitations. It can only test flat material samples.

"If you have a complicated feature like a seam or a zipper or Velcro, LVAP doesn't work because that O ring cannot seal properly, and your background level of contamination is going to be huge, leading to false results," D'Onofrio said.

Putting his head together with fellow chemist Christopher Steinbach and industrial engineer Doug Wilke, the three came up with a solution.

Through the Capability Analysis, Decision and Development (CADD) process the chemical biological defense enterprise identified the need for finding a way to test seams, zippers and other closures, and sought proposals. D'Onofrio and his team submitted a joint proposal with the West Desert Test Center and received funding in February 2019. By summer of that year, they had a working 3D-printed prototype and a patent pending on the new test cell.

The need to test seams and closures for leaks is a pressing practical requirement. "UIPE, Uniform Integrated Protective Ensemble family of systems is an acquisition program for the next generation chemical protective gear because the old Joint Service Lightweight Integrated Suit Technology ensemble is 20 to 30 years old," D'Onofrio said. "They don't make it anymore, and the DoD is finding newer, better materials and improved designs."

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The team designed multiple iterations of a new test cell and experimented with some scale models and agent to demonstrate that the guts of their design worked.

"There are two critical elements needed to make sure that this design is going to work properly," D'Onofrio said. "First, we need to make sure it's going to seal and that it doesn't leak around the edges when you have a complex structure like a seam, closure or zipper. Second, you want to make sure that the contact and its function would be similar to the LVAP."

D'Onofrio and his team started with a layer of butyl rubber, a chemically resistant material that serves as the foundation and a barrier against contaminating outside surfaces. The layering method is like the LVAP with a sorbent pad material on top of the rubber and a material sample with a seam, zipper or closure on top of that. The sorbent pad is analyzed later to measure the breakthrough. The next layer, however, is the most important piece of the design.

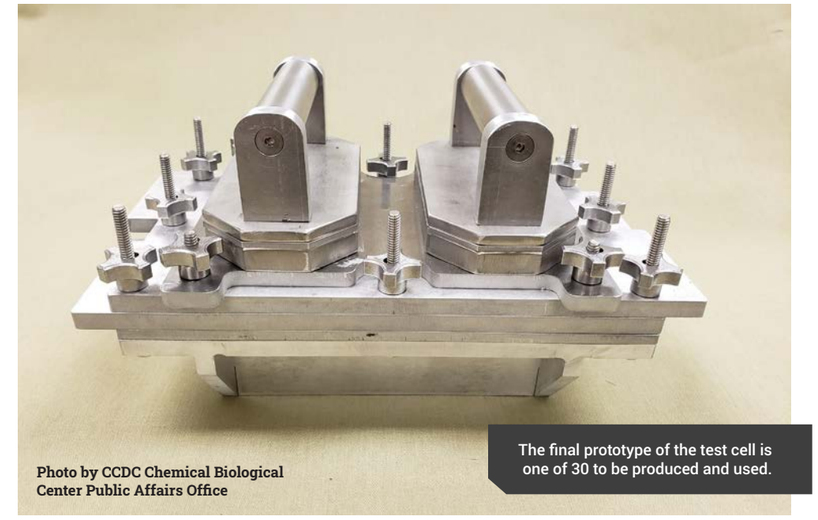
"We needed something that was going to seal and could handle that irregular material sample," he said. "What we found was a soft nitrile foam that conforms and seals around the edges. It takes the place of the O-ring."

Just like the LVAP, the 3D-printed prototype seam and closure test cell gets topped off with a weight that once again applies one psi, which is about the same pressure as a sturdy hand grip. What makes the new test cell different is the addition of a memory foam base. The researchers needed a way to apply weight to the top of the material sample and to have pressure come from under it so that the entire seam, zipper or closure has contact with the sorbent material beneath it.

"Memory foam is very soft and squishy," D'Onofrio said. "We put it on a pedestal so when we have something complex, like a zipper that has shape and dimension, the foam fills in the negative space so all the bits of the zipper will be touched."

Having a testing method for zippers, seams and other closures is a capability the Center wanted to develop for the Chemical Biological Defense Program. "Because seams and closures are a likely source of leaks, being able to quantify the level of breakthrough with confidence is important," D'Onofrio said.

To prove that their prototype did not leak agent, D'Onofrio added a layer of aluminum foil above the butyl rubber layer so no agent could permeate the fabric material. "We knew that if we measured any chemical agent it was because it went around the edges and not through. It's a way of measuring the background." Because the agents are so toxic, even small background levels could exceed the requirement levels of the material. Demonstrating that the design could seal complex features was a critical piece of the form design review process.



The final prototype of the test cell is one of 30 to be produced and used.

Photo by CCDC Chemical Biological Center Public Affairs Office

The prototype went through a few more iterations where the team made the test cell more user friendly. They added big tabs so users can handle it easily even with gloves on. D'Onofrio credits his cross-functional team for coming up with practical innovations like the tabs.

"One of the benefits of working together is we are taking advantage of everyone's individual skill sets," he said. "We've brought together researchers, bench chemists, engineers and test operators. We need all of those elements together so that it works."

Cooperation and collaboration include colleagues at the Center in Edgewood, Maryland, all the way to Dugway Proving Ground in Utah.

"This is a collaborative project. It's not just me. We have engineering design capabilities within the Respiratory Protection Branch. It is also with the Engineering Directorate because they have the infrastructure to conduct more research testing and evaluation on materials with chemical agent. We're also partnered with West Desert Test Center out of Dugway. So, we're all in this together as a community," D'Onofrio said.

D'Onofrio said the partnership with Dugway helps to ensure that whatever his team develops here, the Dugway team will be able to use there since they are the Major Range Test Facility Base charged with testing and evaluating projects like the seam and closure test cell.

"We develop it, we transition it and we partner with them so that we are working simultaneously in both labs. We have weekly telecoms and they are going to send people here to be cross-trained. We are also going to send our people over there to observe," he said.

As D'Onofrio and his team continue to meet milestones, Dugway will manufacture 30 of the final renditions of the seam and closure test cell which will be made of aluminum and stainless steel, allowing for improved consistency and durability for upcoming rigorous testing. The new version includes weights with self-aligning features that provide reproducible placement of the weight on the rest of the test cell. The West Desert Test Center at Dugway will use half of the test cells and the remaining cells will come to the Center. The two facilities will conduct a series of verification and validation tests to enable transition of this capability from the science and technology community to the test and evaluation community.

D'Onofrio is pleased with the progress the team has made. "UIPE needs this for testing as part of the acquisition program," he said. "This needs to be verified, validated and accredited by third quarter 2021. We only received the funding a year ago. Within that year, we got the design approved and partnered with Dugway to make them. Now, we have to test these to make sure they work properly and that the community will have confidence in the data."

CCDC Chemical Biological Center Outfits Mobile Labs to Screen for Coronavirus

By Brian Feeney, Ph.D.

Photo courtesy CCDC Chemical Biological Center Engineering Directorate

BioFire FilmArrays capable of detecting coronavirus rest in a custom-designed rack mount after installation in a mobile laboratory.

IN THE ALL-OF-NATION EFFORT TO FIGHT THE SPREAD OF THE CORONAVIRUS, the Combat Capabilities Development Command (CCDC) Chemical Biological Center at Aberdeen Proving Ground, MD, teamed up with the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) to provide a fast way to screen for exposure to the virus to the Department of Defense.

The Center outfitted two mobile laboratories with analytical equipment designed to determine if a person has been exposed to the virus using blood samples. Originally they were designed to screen for chemical, biological, radiological, and nuclear threats more generally. Now they form a capability that JPEO-CBRND can make available to support Army and DoD COVID-19 testing requirements.

Each mobile laboratory was outfitted with two banks of eight pieces of analytical equipment known as BioFire FilmArrays, which are designed specifically to detect viral infection. The Center's design and installation team directly connected the individual pieces of analytical equipment together into one system, known as a daisy chain, and wired each bank of eight to a single computer. This configuration not only saves space inside the cramped truck trailers, but also speeds the analysis.

"The mobile lab can produce a patient's results in 50 minutes," said Peter Emanuel. Ph.D., the Center's senior research scientist for bioengineering and leader of the Center's team. "At that rate laboratory operators can screen a total of 225 people per day for exposure to the virus. From there, medical teams can tell who to treat and who to send home."

The Center was the natural choice for this job. Over the years, the Center has outfitted mobile laboratories to perform special purposes for the Federal Bureau of Investigation, the Food and Drug Administration and National Guard units.

"Our research scientists and engineers worked together to turn a research and development concept into a ready-to-field solution for the JPEO-CBRND," said Chemical Biological Center Director Eric Moore, Ph.D. "This is the kind of experience that makes us the go-to people in a crisis, and we are very proud to work with our partners on the nation's coronavirus response."

The Center's role does not end there. The Center's Advanced CBRNE Training Branch has been training military units on how to detect and sample for chemical, biological, radiological, and nuclear threats for years. For this project they developed a training manual and the capability to conduct virtual training sessions for the operators of the mobile laboratories.

The ability of different elements of the Center to come together quickly to find innovative solutions was critical to the project. For example, when the project team realized that they needed an entirely new piece of equipment for the laboratories' daisy chain configuration, the Center's CBRNE Product Development Facility used its manufacturing shop to design and produce a part for precisely that function.

Lt. Col. Alan Stephens, JPEO-CBRND's joint product manager responsible for leading and delivering mobile laboratory capability to the DoD, was impressed. "We truly appreciate working with the Center because of their quick responsiveness, ingenuity, and ability to get the job done."

The ability to come together as one team engaged in one fight was gratifying to all of the team members. "All of us are proud to have a role in addressing this national crisis. Everyone wants to help," said Chika Nzelibe, a mechanical engineer and the Center's Engineering Design and Analysis Branch chief. "We feel very lucky that we happen to have the skill set needed to get this job done for the JPEO-CBRND and the DoD in their service to the nation."

CCDC Chemical Biological Center Tests Materials for Face Coverings

By Brian Feeney, Ph.D.

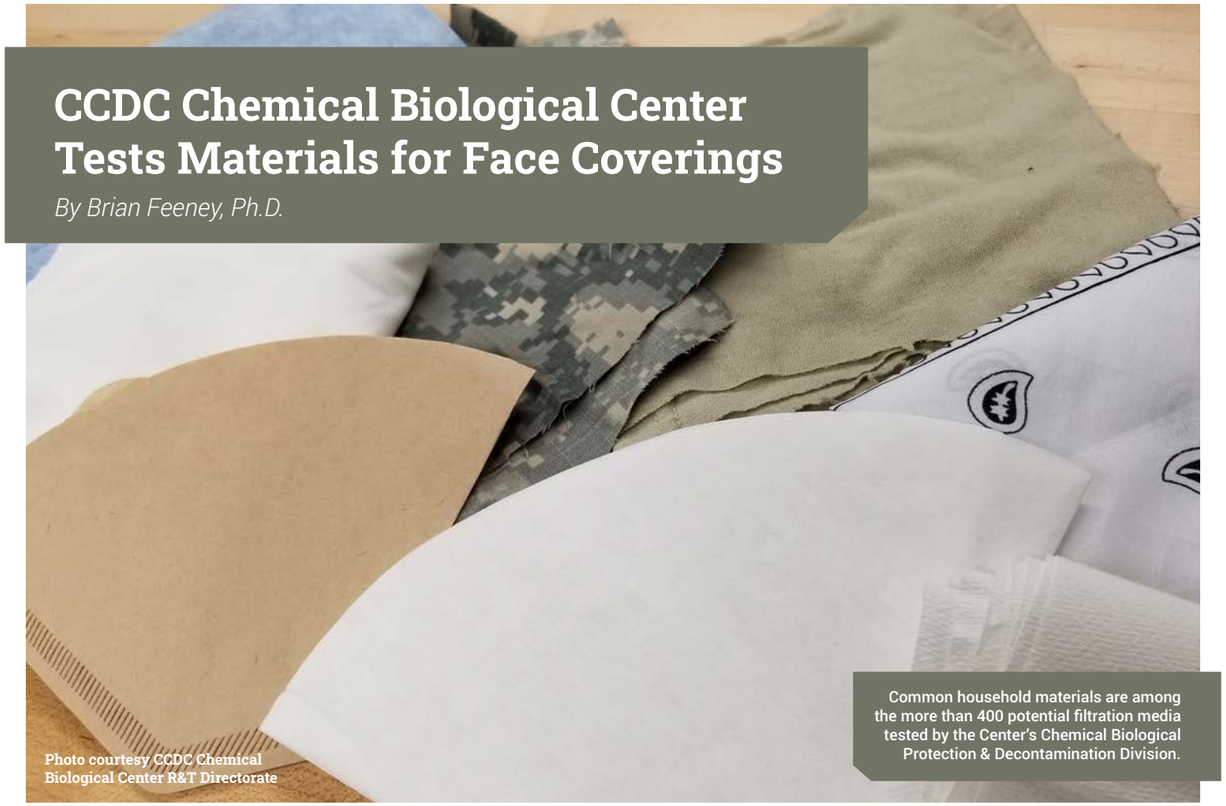


Photo courtesy CCDC Chemical Biological Center R&T Directorate

Common household materials are among the more than 400 potential filtration media tested by the Center's Chemical Biological Protection & Decontamination Division.

WHEN THE CENTERS FOR DISEASE CONTROL AND PREVENTION, the Department of Defense, and many state government began recommending or requiring that people wear face coverings when out in public and unable to maintain proper social distancing, the Combat Capabilities Development Command (CCDC) Chemical Biological Center put more than 100 years of filtration experience to use in testing materials for face coverings.

Since the COVID-19 epidemic began, the Center has been contacted by dozens of defense agencies, federal agencies and health organizations to see if its experts can help with the national shortage of personal protective equipment. The Center is one of only a handful of agencies that is experienced in performing tests that precisely measure materials' filtration efficiencies in strict accordance with National Institute for Occupational Safety and Health standards. It is also one of a very few organizations that have the Model 8130 Automated Filter Tester, which is no longer in production. So the Center was the obvious choice to perform this research.

"The challenge is to pick a material that effectively blocks the virus particles from going through the material while not being too hard to breathe through," said David Caretti, chief of the Center's Chemical Biological Protection and Decontamination Division and leader of the team testing homemade face covering materials. "If the resistance is too high, airflow will simply bypass the covering and go around the edges."

"We knew that claims about masks and face coverings were exploding all over the internet, and we wanted to make sure that any decisions about materials these agencies make will be based on proven science," said Caretti.

The Center performs its testing by spraying a salt aerosol at a swatch of material. The testing team simply measures the density of salt aerosol suspended in the air on one side and compared it to the density on the other side after it passes through the material.

The team started out by testing materials sent to them by organizations seeking their expertise, then broadened out to testing materials likely to be found in the home that members of the public could use to make their own face coverings. The team found that even a polyester bandana can be reasonably effective if it is used in layers. It will filter out 40 percent of suspended particles.

> ***"We knew that claims about masks and face coverings were exploding all over the internet, and we wanted to make sure that any decisions about materials these agencies make will be based on proven science."***
>
> *David Caretti, Chief, Chemical Biological Protection and Decontamination Division*

Thus far, the Center has tested more than 400 materials and continues to test new materials. Armed with this information, the Center is now able to give other agencies the best filtration efficiency information possible for them to pass on to their stakeholders.

Asymmetric Warfare Group Kicks Off Warfighter Forum

Workforce attends event to learn about the warfighter perspective

By CCDC Chemical Biological Center Public Affairs Office

Capt. Joshua Borland and Sgt. Maj. Amber Selko from the Asymmetric Warfare Group brief at the Center's first warfighter forum, an event that provides Soldiers an opportunity to discuss challenges and requirements they encounter in the field.

Photo by CCDC Chemical Biological Center Public Affairs Office

GETTING A SOLDIER'S PERSPECTIVE ON A CHEM-BIO PROBLEM CAN BE INVALUABLE to a scientist. Imagine if an active duty Soldier could tell you about the Chemical, Biological, Radiological, Nuclear and Explosive (CBRNE) problems they've experienced while deployed, or where they're seeing capability gaps in specific functional areas. The Asymmetric Warfare Group (AWG) does just that, and they came to tell the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center about it during the inaugural Warfighter Forum in February.

Captain Joshua Borland, CBRN officer and future operations chief, and Sergeant Major Amber Selko, operational advisor, gave the Center an overview of their mission, recent collaboration efforts and how both the Center and AWG both strive to increase Army readiness against emerging threats.

The AWG is made up of only 320 personnel, 200 of which are Soldiers, and they provide operational advisors to identify and analyze capability gaps in specific areas. Their three key tasks are to scout through observation of the operational environment and emerging threats; advise by supporting the Army across a range of military operations and needs; and integrate, by developing, demonstrating and informing solutions.

"We do a lot of the same things you do with regard to supporting warfighter lethality," said Borland. He continued to explain how the AWG provides feedback to scientists from an end-user perspective. They understand how potential solutions will be applied in real-world scenarios. "Scientists can provide insight to help the Soldier survive by providing better protection and Soldiers can provide insight to scientists to help make adjustments or refine their solutions," Borland said.

Borland continued to explain how working directly for the U.S. Army Training and Doctrine Command, their group deploys to identify and understand asymmetric threats to prepare the Army for the future fight. They also help provide their observations and thoughts to emerging technologies being developed across different functional areas.

The AWG has recently been brought in to provide their perspective on several CCDC initiatives in the areas of wearable sensors and a materiel experiment about sensing through the wall, where they ran a test with the technology developers to provide feedback.

They publish white papers on all of their various missions on the Joint Lessons Learned Information System, so that others can read their reports and learn about what's happening in an operational environment.

"A lot of time we act as connectors because there is often a lot of overlap between what the scientists and researchers are working on between organizations," Selko said. "If you provide a specific area of interest we can reach out and find out if someone is already looking into it and help to get you the right point of contact," Selko explained. This is a potential way for scientists to get information first hand on specialized topics.

Joe Gordon, the Center's assistant chief of staff for operations, helps plans the warfighter forums and encourages the workforce to attend future events. "The Warfighter Forum started as an idea from Dr. Moore and provides an opportunity for the workforce to interact with the warfighter."

Employee Spotlight: Patrick Riley

PATRICK RILEY IS A RESEARCH CHEMIST for the Detection Spectrometry Branch at the Chemical Biological Center, applying machine learning (ML) to his study of ion mobility spectrometry and chemical detection to reduce false alarms and the burden on the warfighter having to respond in the field. Solutions sat down with Riley recently to give readers an inside perspective on the role of research chemists and the type of work they perform at the Center.

Solutions Newsletter: What made you want to pursue a career in the sciences? And how did you determine what area you wanted to study?

Patrick Riley: I got involved in science because I like finding my own way to do things and trying out different solutions and science lets me to that. I get to be creative and solve problems. With science, I get to express that part of my personality.

I became interested in chemistry in high school because my AP chemistry teacher was great, and she made the class fun. Also, my grandfather, who I highly respect, suggested I become a chemical engineer.

Solutions Newsletter: How did your education and experience prepare you for the role you perform today?

Patrick Riley: I spent an extra year in undergrad to research and develop my educational background. This helped me to become better at explaining complex math and its applications to science. I have a 'Swiss army knife' background with a lot of different tools, but I ended up at the Detection Spectrometry Branch doing similar work to what I did in college.

Solutions Newsletter: What kind of project are you working on right now?

Patrick Riley: My current work is on ion mobility spectrometry, an analytical technique used to identify ionized molecules, which is the primary chemical detection capability being used in the field. I am investigating peak positions and how it affects alarm algorithm design. My research will help design alarm algorithms with low false-alarm rates so the Soldier will know when they really have a threat, and they can prepare by donning their personal protective equipment. To do this I am using ML which allows computers to learn from the large amounts of data originally collected to create the first alarm windows.

Solutions Newsletter: Can you explain how you are applying ML to your research?

Patrick Riley: I use ML in my current research to separate interferents in the chemical detector from hazardous materials. ML is math combined with computer science. It is creating algorithms and tools that can be applied to teach computers to solve problems from data. In this case, I am applying ML algorithms to chemical detection. Alarm windows in the chemical detector normally must be explicitly programmed, so using ML reduces the burden of programming individual windows in a detector, and instead allows the computer to figure it out. The end result is an alarm algorithm more robust to interferents, providing better information to the Soldier.

Solutions Newsletter: In what way is the work you are doing going to help the warfighter?

Patrick Riley: Allowing ML to process data for the warfighter will remove the burden of using multiple detectors and having to read and analyze the results. It will also reduce false alarms from the chemical detector; therefore, saving time for the warfighter to know when they need to use their PPE and when they do not.

Solutions Newsletter: What project in your career have you been most proud of and why?

Patrick Riley: I am most proud of an IDEAS project where I worked to fuse different chemical detectors to ultimately separate a true chemical alarm from an interferent. I got the idea from an event called Scientist in the Foxhole where I saw a real challenge the Soldier was dealing with. I developed this project as a way to solve it. The project led to a larger Defense Threat Reduction Agency project which uses ML to classify heterogeneous chemical sensor data, ultimately reducing false alarms in a way that hasn't been able to be fixed before.

Solutions Newsletter: What brought you to the CCDC Chemical Biological Center?

Patrick Riley: I met my wife in college and she is from Bel Air. She already worked in this area and I came across a chemist position at the Center and applied. Now that I'm here, I like the flexibility and that every day is not the same. Some days I am in the lab, doing presentations or programming on a computer. I like that part of my job.

Solutions Newsletter: What is something you would like people to know about the Center and/or the work that you do?

Patrick Riley: We're researching some of the deadliest things in the world and trying to find ways to prevent them from harming you. If they are released into the environment, my research is about letting you know if the threat is there, so that the appropriate response can be taken to keep you safe.

Photo courtesy AIM Program

One of the proposals selected for AIM involves a team of aerial and waterborne autonomous vehicles to collaboratively conduct safety surveys.

Army Takes AIM at Non-Traditional CWMD Technology Partners

By Brian B. Feeney, Ph.D.

ARMY LEADERS HAVE LONG SOUGHT TO SIMPLIFY THE PROCESS by which a good idea is transformed into innovative technology in the hands of warfighters. The steps in the conventional acquisition process – from determining requirements to exploratory research and development to prototyping – can take as long as ten years.

The Combat Capabilities Development Command (CCDC) Chemical Biological Center teamed up with the Special Operations Command Special Operations Forces Acquisition, Technology and Logistics (SOCOM SOF AT&L) Center and the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) to find an improved, more agile way to develop and field technologies that will protect warfighters from chemical, biological, radiological and nuclear (CBRN) threats. It's called Accelerator for Innovative Minds, or AIM for short.

AIM utilizes the power of partnership intermediary agreements (PIAs) to the meet the needs of the Department of Defense (DoD) and Department of Homeland Security (DHS). PIA partners and other similar technology accelerators are frequently used to help technology start-up companies grow while they develop a new technology and establish a market presence. "In the AIM acquisition model, the DoD and DHS agencies establish problem statements and invite non-traditional companies, acquisition subject matter experts, other government agency subject matter experts, academic experts, and – most importantly – warfighters and operators to use that problem statement as the starting point for a dialogue that spans all phases of the technology development process," said Michael R. Guinn, the SOCOM SOF AT&L Acquisition Agility Program Manager.

As the dialogue progresses, the participants work collaboratively. The non-traditional companies and entrepreneurial academics participating in the process contribute their knowledge of rapid technology evolution. The warfighters and operators contribute their insights into the real world demands and challenges of using CBRN technologies in the field. The participants share their knowledge, work out technology solution requirements and build relationships to share costs.

"We came together as stakeholders to find a way to bring the smartest, most innovative technology developers from non-traditional

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backgrounds together with our warfighters and subject matter experts to collaborate on finding novel, paradigm-shifting solutions," said Joshua Israel, JPEO-CBRND innovation officer. "The subject matter experts from non-traditional small businesses, startups and academia generally know very little about what we do, but at the same time, they possess tremendous knowledge of the technologies we need to meet our CBRN challenges in the field."

> ***"We came together as stakeholders to find a way to bring the smartest, most innovative technology developers from non-traditional backgrounds together with our warfighters and subject matter experts to collaborate on finding novel, paradigm-shifting solutions."***
>
> *Joshua Israel, JPEO-CBRND innovation officer*

Making this new approach possible was a new kind of platform for engaging non-traditional contractors called SOFWERX. SOCOM created it by establishing a PIA with DEFENSEWERX, which is an existing non-profit organization that stands up innovation hubs. SOFWERX, located in Ybor City, FL, is one of DEFENSEWERX's five innovation hubs. Each of them accelerates the development and fielding of new defense technologies by following a collaboration model similar to AIM'.

SOFWERX's specific charter is to create and maintain a platform to accelerate delivery of innovative capabilities to SOCOM and to facilitate defense technology advances through exploration, experimentation and assessment of promising technology. This includes a rapid prototyping workshop with 3D printers and an array of other high tech tools. "What is crucial is the collaboration amongst government agencies, non-traditional partners from industry and academia – so that's what we set out to do," said Guinn. "For this particular effort, we developed a 5-phase tailored acquisition strategy for these specific problem sets on behalf of our collaborating government agencies."

The first of the five phases was a meeting held on January 2019 where all of the government participants met at the SOFWERX facility. In their first meeting the AIM team members on the government side established problem statements for the AIM initiative and envisioned desired outcomes. In addition to members of the CCDC Chemical Biological Center, SOCOM AT&L and JPEO-CBRND, representatives from the Department of Homeland Security Countering Weapons of Mass Destruction (DHS CWMD) Office, the Defense Threat Reduction Agency, and the Defense Advanced Research Projects Agency attended. "AIM is delivering on the concept of soldier touch points, which is a priority of the DoD, by incorporating warfighter and operator input throughout the process," said Guinn.

Phase 2 occurred on February 2019. The inter-agency government team invited non-traditional solution providers from across industry and academia to an industry day at SOFTWERX where they collaboratively discussed the government's CBRN problem statements, met SOCOM warfighters, and began a dialogue with the almost 400 in attendance.

"We saw an opportunity to have a conversation with these non-traditional contractors that was not bureaucratic and fully included the warfighter perspective," said Israel. "We also used the opportunity to learn how meeting CBRN defense needs through technology development could be done at the pace at which they operate."

The partners in this initiative saw their mission as establishing a new, enduring cadre of commercial partners that can provide unique CBRN defense solutions. "The non-traditional contractors we reached out to are all on the cutting edge of advanced technology and can nimbly respond to the new ideas we generate together," said Kevin Wallace, a senior mechanical engineer at the CCDC Chemical Biological Center and a key organizer on the government team. "The Chemical Biological Center can also offer these contractors a number of partnering mechanisms through our Technology Transfer Office plus the benefits of our rapid prototyping and testing capabilities."

The industry attendees were invited to submit a two-page whitepaper and a quad chart on a CBRN defense solution that they could provide. The government received 192 submissions and from there a diverse evaluation panel narrowed the submissions down to 44 that showed exceptional promise.

In early May, the government invited the submitters of those 44 proposals back to SOFWERX in order to pitch their proposed solutions face-to-face. They were each given 45 minutes and allowed to discuss their proposed technology with government subject matter and acquisition experts. By the end of May, the government had whittled the number of submissions down to eight. In some cases, two separate submitters joined forces to advance a single technology solution by combining their respective strengths.

The eight finalists submitted a range of innovative technology approaches, including:

- A team of robots to autonomously collaborate to conduct safety surveys. It combines UAVs with waterborne autonomous vehicles that communicate with each other and work in concert to identify and then sample areas suspected of chemical or biological contamination using onboard sensors.
- An automated digital tool that surveils a global range of publicly available social media and the dark web in all source languages using advanced analytics, natural language processing and machine learning to detect near-term CBRN threats.
- A lightweight, throwable or droppable, open-source mesh networked sensor designed to detect CBRN threats and convey the information back to a graphical user interface so the warfighters and operators can determine if an area is safe.

At the beginning of June, SOCOM made their contract awards through SOFWERX and each of the winners was given six months to develop their technology to the point where it could be demonstrated in a two-day showcase event. That event was originally planned for March 25-26, 2020. However, the showcase was postponed because of limited operations at Aberdeen Proving Ground due to the COVID-19 epidemic. The AIM team looks forward to seeing those technologies demonstrated when the operating environment allows, Wallace said.

"This will be the culmination of almost two years of hard work on all our parts," said Wallace. "It will serve as a proof of concept for our vision of how a non-traditional accelerator model can serve warfighters by getting the very best, very latest technology in their hands quickly."

CCDC Chemical Biological Center research biologist Matthew Lux, Ph.D., pursues his IDEAS Program project by programming an acoustic liquid handler to operate in tandem with artificial intelligence to optimize the design of sensors made from biological components.

Center Announces Winning IDEAS for 2020

Program provides seed money for innovative solutions

By Brian B. Feeney, Ph.D.

Photo by Brian Feeney

THE NEXT MAJOR ADVANCE IN CHEMICAL BIOLOGICAL PROTECTION may be among six projects selected for study under the Combat Capabilities Development Command Chemical Biological Center Innovative Development of Employee Advanced Solutions (IDEAS) Program. The researcher responsible for the idea behind each project will receive between $40,000 and $70,000 in seed money to develop his or her brainchild and demonstrate results.

Begun in 2012, the goal of the IDEAS Program is to turn these ideas into practical solutions to chemical biological defense needs that can attract customer funding. The program's motto is "fail fast and fail early," and the Center's return on investment over the last seven years is ten dollars for every one spent.

Proposals addressing any CBRNE defense solution can be submitted by any Center employee. This year, the competition began with researchers from across the Center submitting 29 one-page whitepapers presenting their research idea. These were narrowed down to 12, each having to present to senior executive service members, the military deputy and senior research scientist to determine the six winners. They are:

- Sprayable Personal and Equipment Decontamination Emulsion (SPEDE) by Greg Peterson
- Advanced Sealing-Interface Surveillance Technology (ASIST) by Cody Kendig
- Evaluation of Waveguide Coatings for Sensitivity and Specificity in ICL-Based Chemical Detection Systems by Ian Pardoe
- Low Logistics Water-Free Terrain Decontaminant by Neil Hawbaker, Ph.D.
- Artificial Intelligence to Accelerate Design of Fieldable Biological Sensors by Matthew Lux, Ph.D.
- Non-focused Raman Spectroscopy-Based System for Standoff Detection by Eric Languirand, Ph.D.

The winning researchers are given eight months to conduct their study and compile results, at which time they will report back to Center leadership on their progress and research conclusions.

The IDEAS program ties directly into the Army Futures Command mission according to Center Director Eric Moore, Ph.D., "Part of the Army Futures Command mission is to innovate by creating and cultivating a culture that front-loads smart risks," said Moore. "The IDEAS Program is the embodiment of that philosophy because we operate it on the knowledge that the next great idea can come from anyone in the organization, and it establishes a forum in which Center leadership welcomes new ideas and pays close attention to their potential."

This year's winners expressed their appreciation of the IDEAS Program and the opportunity it gives them. Cody Kendig, a research chemical engineer in the Respiratory Protection Branch, won a grant to pursue his idea for making sure that each of the interfaces in a personal protection suit are fully sealed.

"I know from my own experience wearing them that making sure that you have a good seal at each interface, the cuffs, collar and all of the zippers is a two-man job requiring the assistance of a buddy, and even then, you can't know for sure if you have a total seal," he said.

His idea was to install a fault detection sensor in each interface location on the suit. It powers a green light if fully sealed and red if not. No formal request has ever been made from a Center customer to pursue this research, so the IDEAS Program provides Kendig with the perfect way to start.

"I plan to start by making a simple prototype in a zipper swatch, see how well it works, then try it on an actual suit cuff. I'll get feedback from warfighters and keep refining the prototype, and I hope to have fully functioning fault detection sensors for each interface as a deliverable when the eight months is over," he said.

There were repeat winners, too. Greg Peterson, a research chemical engineer in the Chemical, Biological, Radiological (CBR) Filtration Branch, won his third IDEAS Program grant this year and his enthusiasm for the program has not ebbed. His 2020 IDEAS Program research project is to develop a prototype of a sprayable powder decontamination that will come out of a can, much like a dry shampoo spray can. "The idea is that the warfighter can easily bring it along in his equipment and pull it out if he suspects that the equipment has been exposed to agent, spray it on the equipment surfaces and get back in the fight," he said.

He emphasized that his win was a team effort from across the Center. "The CBR Filtration Branch will assemble the ingredients and make the powder, and the Advanced Design and Manufacturing Division will make the prototype of the spray device and the Decontamination Sciences Branch will test it," he said. "I hope to see this product become a new and improved solution for personal and equipment decontamination."

A CCDC Chemical Biological Center researcher sprays Bioxy on contaminated panels to test its effectiveness.

Photo courtesy CCDC Chemical Biological Center R&T Directorate

DoD Identifies Commercial Decontaminant for Field Use Against COVID-19

By Brian B. Feeney, Ph.D.

A CHEMICAL AND BIOLOGICAL DECONTAMINATION SOLUTION improved through testing and evaluation by the Combat Capabilities Development Command (CCDC) Chemical Biological Center has been identified by the Defense Threat Reduction Agency (DTRA) as an effective COVID-19 disinfectant.

Center researchers have been working with Atomes, F.D., a company located in Quebec City, Canada, for more than two years. The Center provided testing and quality assurance to determine the general chemical and biological disinfecting effectiveness of their product, Bioxy. After conducting a literature review to examine disinfection options against COVID-19, DTRA identified Bioxy for use as an effective in-the-field disinfectant against COVID-19 and other viruses, according to Vipin Rastogi, Ph.D., a senior research biologist at the Center.

Rastogi and his group have been testing the effectiveness of Bioxy since the beginning of the Center's relationship with the company, which led to the DTRA-funded literature review. "Originally, the company had no idea whether it would be effective against chemical or biological agents. They were marketing it as a sanitizer and disinfectant for medical and veterinary clinics," he said. "Our work with the company was a partnership in which we performed detailed effectiveness testing against chemical and biological agents. We were able to provide Atomes with very specific advice on how to fine tune the product so that it could provide optimal protection to warfighters and the public against a broad range biological agents, spores and viruses."

The Center research group, led by Rastogi, determined that Bioxy works well against a wide range of chemical and biological agents, as well as the family of viruses which includes the pox virus, Feline calici virus and the Ebola virus. His team performed its testing using the Organization for Economic Cooperation and Development (OECD) Guidelines for the Testing of Chemicals. It is an international regulatory method for determining the efficacy of antimicrobial chemicals against spores, cells and viruses. The method is used by the 37 OECD member nations as well as the U.S. Environmental Protection Agency, much of industry and many independent laboratories.

Chlorine bleach has long been known to be an extremely effective disinfectant; but it is highly corrosive, making it unsuited for disinfecting the sensitive electronic equipment found in military vehicles. Peroxide-based disinfectants such as Bioxy achieve a high level of effectiveness without being caustic. "The active ingredients in Bioxy break the molecular bonds in the virus," said Rastogi. "Chemical bonds underlying the lipid virus envelope are what give the virus particle its structural integrity, so breaking them renders the virus particle nonfunctional. The active components may also destroy or break down bonds within the DNA or RNA that enables it to reproduce."

A Powder, Not a Liquid

"Both variants of Bioxy tested, Bioxy H and Bioxy Enviro, provide many practical advantages to its military users because they are powders, and not liquids," Rastogi said. "Bioxy, marketed as a powder, has three advantages. It's not corrosive. You can ship it without any fire hazard precautions, and when you need it, you mix it with water and you have a ready-made decontaminant." It works by generating peroxide when mixed with water.

While Bioxy still requires water to activate the peroxide, the amount of water needed is far less than the hundreds of gallons typically used by decontamination trucks. In addition, using Bioxy at higher concentrations decontaminates the biological agent with no adverse effects on the Soldier. "It is safe for the skin and is biodegradable," Rastogi said. "It decomposes to innocuous end products, oxygen and water."

It is also inexpensive and commercially available for application to warfighters' personal protective equipment, vehicles and any other potentially contaminated materials in the field with far less logistical burden than hauling large quantities of water-based decontaminants.

Program Pays Dividends

The relationship between the Center and Atomes, F.D. is the product of the Foreign Technology and Science Assessment Support Program, known as FTAS, which is funded by the Office of the Secretary of Defense. It provides seed funding for scientists to perform initial research, technology assessments and test and evaluation studies on promising defense technologies developed in other nations. Participating U.S. Army organizations, such as the Center, select foreign technology initiatives on a competitive basis. Army researchers seeking an FTAS grant submit a proposal which is evaluated by a panel of Army experts, and winning applicants are funded for one year to provide proof of their technology's effectiveness in meeting an Army need.

"Had we not formed this relationship with Atomes, DTRA would have never known about Bioxy and what a valuable broad spectrum disinfectant it is for biological agents," said Rastogi. "It is very satisfying to know that because of this work, the warfighter and the public have an inexpensive, non-corrosive environmentally safe and highly effective technology in hand."

"The Center's use of the FTAS program to contribute to the development of a new technology as useful as Bioxy is a prime example of innovation in action," said Eric Moore, Ph.D., director of the Chemical Biological Center. "Good ideas are where you find them, and we are glad we pursued this one – doubly so because it turns out that it is proving itself to be an answer to a brand new threat."

DTRA is now funding Rastogi and his team to test the effectiveness of a number of other commercially available disinfectants to destroy the COVID-19 coronavirus using the OECD method.

Photos by Brian Feeney

Chemical Biological Center research chemical engineer Michael Kim, Ph.D., and research bioengineer Krystina Hess, Ph.D., inspect a freshly manufactured batch of polymerized phages after they are synthesized in the Center's fermentation facility and heated at 1,100 °C.

CCDC Chemical Biological Center Strives to Become DoD's Biomanufacturing Leader

By Brian B. Feeney, Ph.D.

THE LAST DECADE HAS SEEN DRAMATIC ADVANCES in using micro-organisms to manufacture highly specialized chemicals that the Department of Defense needs. These materials hold the promise of advancing how Soldiers are protected from chemical agent, how energetic molecules for propellants for explosives are manufactured, and how coatings can be used to obscure objects from light sensors.

The problem is how to make these materials in large enough quantities that they can be used to make actual prototypes, such as filters in protective masks or self-decontaminating uniforms.

Right now, very few research laboratories or industry laboratories can make these materials beyond the bench scale level – between one and five liters of liquid biomanufactured material. However, the Combat Capabilities Development Command (CCDC) Chemical Biological Center has a pilot fermentation facility at its Aberdeen Proving Ground research campus that currently makes batches of up to 1,500 liters.

Much like a microbrewery that produces beer, this facility uses bacteria in vats to ferment biologically active compounds. But unlike any brewery, the bacteria in these vats are injected with genetically engineered viral phages. Inside the bacteria cells, these phages produce more phages. When they are done reproducing, they burst out of the cells and are suspended in the liquid. They are then filtered out of the liquid, coated with polymer precursors, and cooked into a powder. The result is a polymerized phage – unique in nature because it is part virus, part polymer. The final step is to heat the polymerized phages at temperatures as high as 1,100 °C, which produces a black carbon, known as BioCNFs, that is much like charcoal.

Depending on the design of the polymer precursors, the resulting carbon can then perform a variety of functions such as breaking up mustard or nerve agent into non-toxic byproducts. Currently, much of the Center's biomanufacturing has centered on creating carbon materials with high surface area and controlled porosity. This material is both very stable and very good at soaking up chemical agent.

"The phage produced in the vats is our manufacturing platform," said Jared DeCoste, Ph.D., a research chemist at the Center who is heading up this initiative. "And we have a unique foothold in this process because of our ability to scale up production to batches of up to 1,500 liters."

Bioproduction on that scale allows for entirely new research and development opportunities for research laboratories across the Department of Defense. Only a small handful of other research facilities in industry and academia can come even close to performing fermentation at this scale, and they are all overwhelmed with demand for their material. The Center is able

Continued on page 25

Center research chemist, Danielle Kuhn, uses an electrospinning unit to create polymer nanofibers containing BioCNFs.

Continued from page 24

to perform both fermentation of phages and the polymerization of phages, which makes the Center unique. That is why the Defense Advanced Research Agency (DARPA) has selected the Center's pilot plant for seed funding in 2020 as part of its Living Foundries Program.

"The CCDC Chemical Biological Center has both the capacity to scale up production of these materials and possesses a deep understanding of the military end uses for this material," said Renee Wegrzyn, Ph.D., the program manager for the Living Foundries Program at DARPA. "Ultimately, we hope to develop the ability to biomanufacture materials needed by the warfighter out in the field where they are operating. This has the potential to remove several logistical challenges by shipping out production strains to where they are needed to start the fermenting process and deliver capability in the field," she added.

She sees this as part of a larger effort by DARPA to help create a 21st Century bio-economy that will develop highly advanced coatings, adhesives and polymers, novel fuels, and liquid crystals for a wide range of defense and civilian industrial uses. DARPA sees the Center as "a reliable resource to routinely and robustly scale and deliver molecules and materials for advanced development," according to an August 2019 letter from DARPA to the deputy assistant secretary of defense for industrial policy supporting its funding for the Center's pilot plant.

> ***"Ultimately, we hope to develop the ability to biomanufacture materials needed by the warfighter out in the field where they are operating. This has the potential to remove several logistical challenges by shipping out production strains to where they are needed to start the fermenting process and deliver capability in the field."***
>
> *Renee Wegrzyn, Ph.D., Program Manager for the Living Foundries Program at DARPA*

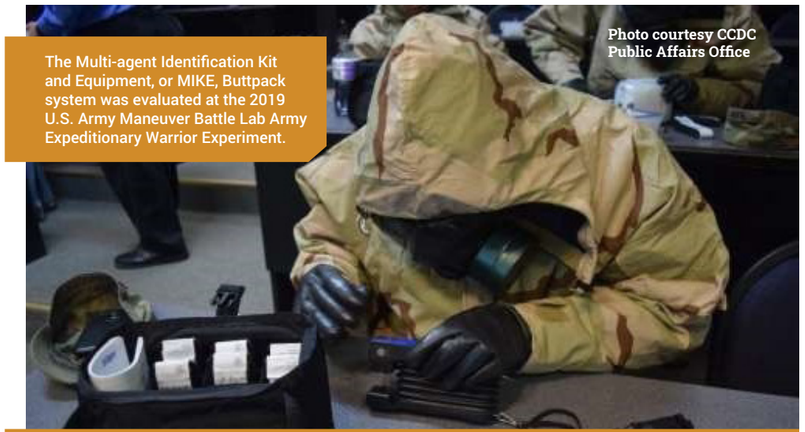
The pilot plant is located in a nondescript building at Aberdeen Proving Ground. It was originally built to replace an aging building in support of the binary chemical weapons program in the 1980s but never used. "We found a new use for it," said Michael Kim, Ph.D., a research chemical engineer who is in charge of scaling up the pilot plant. "This is a good niche for us as an Army research laboratory. We are doing something very innovative, and most important, we are directly supporting the warfighter."

Kim's partner in this effort, Krystina Hess, Ph.D., a research bioengineer at the Center, agrees. "We're working at the very forefront of an exciting new research area, and we are right up there with anything being done at the world's top research universities. It's very exciting and it fosters a lot of collaboration within the Center and with the top research universities."

Their closest partner in academia is the Massachusetts Institute of Technology. Both Kim and Hess previously worked with their chief researcher in this area, Angela Belcher, Ph.D. at her laboratory at MIT. Currently, the Center and Belcher are actively collaborating on using the pilot plant to create ever more new materials for new uses of interest to the Department of Defense and industry.

"We have a true collaborative relationship with the Chemical Biological Center. I have never worked with a team I had better cooperation and collaboration with," said Belcher. "The scientists at the Center are super smart and sharply focused on making a difference for the warfighter, as are we at MIT."

Under the conditions of DARPA's seed funding, DeCoste and his team have all of calendar year 2020 to demonstrate a success using an actual prototype. Filtration of chemical agent appears to be the most promising area for immediate results. But that is just the start. Once the pilot plant graduates from the seed funding phase to an up-scaled facility, it can supply researchers throughout the DoD with large quantities of made-to-order biomanufactured material. "We already have several DoD research laboratories and industrial partners asking to use our facility's capacity as soon as we are fully online, and that number is only going to grow," said DeCoste.



The Multi-agent Identification Kit and Equipment, or MIKE, Buttpack system was evaluated at the 2019 U.S. Army Maneuver Battle Lab Army Expeditionary Warrior Experiment.

Photo courtesy CCDC Public Affairs Office

Army Chemical Detection System to Reduce Logistics Burden for Soldiers

By Argie Sarantinos, CCDC Public Affairs Office

DEPLOYED SOLDIERS FACE THE RISK of being exposed to chemical warfare agents that can be incapacitating or life threatening. If a Soldier is exposed to a chemical agent, identifying the chemical hazard quickly is critical. The Army currently uses the M256A2 chemical detector system to test for chemical agents in the field. It takes approximately fifteen minutes to complete and requires multiple steps and verifications.

The U.S. Army Combat Capabilities Development Command Chemical Biological Center developed the Multi-agent Identification Kit and Equipment, or MIKE, Buttpack system, a low-cost test kit with components including draeger tubes, which are currently in the dismounted reconnaissance sets, kits and outfits used by non-chemical, biological and radiological personnel.

"With the MIKE Buttpack system, a Soldier follows the detector instructions on a lamented card and uses a hand pump to pass potentially contaminated air through the detector ampule. The whole process is very quick," said James Jensen, CBC senior scientist.

The project began in response to a need for maneuver, infantry and rangers in small, forward squads to have a smaller, easy-to-use capability to detect chemical hazards. The MIKE Buttpack was designed as a complimentary capability for forward, austere missions where untrained or minimally trained Soldiers can determine if chemical agent is present.

The goal of the MIKE Buttpack project was to repackage and modify a commercial-off-the-shelf product designed to detect nerve, blister and blood agents. The system uses a ruggedized, commercial detection system, the Dräger Civil Defense Set, which includes chemical detector tubes that change color if a chemical agent is present. The CBC also developed training materials and manuals for the kit.

The project is a joint effort between the Chemical Biological Center and the U.S. Army Foreign Comparative Testing program, which provided funding for initial training and warfighter experiments. The FCT program is a congressionally authorized program that is executed by the Army by the CCDC Global Technology Office, which receives oversight from the Office of the Secretary of Defense, Comparative Technology Office.

"The system is easy-to-use, lightweight and training is easy to understand and implement," Jensen said. "We anticipate the system will reduce the logistics footprint compared to the current system Soldiers use."

Plans for the MIKE Buttpack will initially include niche applications where a reduced logistics footprint is critical. These applications could include special operations missions where Soldiers may deploy without resupply for an extended period of time. If the technology is successful in niche applications, the MIKE Buttpack could transition to a larger role in the Army.

The MIKE Buttpack was evaluated at the 2019 U.S. Army Maneuver Battle Lab Army Expeditionary Warrior Experiment, or AEWE, which assesses technology in realistic environments. The event, which ran from October 2018 through March 2019, serves as venue for capability developers, the science and technology community and industry to test technology.

The AEWE was comprised of two phases: a live fire, non-network assessment and a force-on-force assessment. The overall objective of the experiment focused on increasing small tactical unit effectiveness in a multi-domain operational environment, including sustainment, mobility, lethality, survivability and mission command. Typical mission types at AEWE included: attack, defend, ambush and reconnaissance.

At the AEWE 2019, Soldiers participated in an individual assessment of the MIKE Buttpack where the training and practical exercises were specifically tailored to the technology. Soldiers at the one-day assessment received training from draeger professionals, along with government representatives. The practical, hands-on exercise tested the Soldiers' knowledge of the system and its capabilities.

Soldiers carried the MIKE Buttpack during squad, platoon and company tactical missions during both phases of AEWE where they were exposed to simulated chemical threats multiple times. The simulants are non-toxic chemicals that react with a sensor to provide a color change that simulates a real chemical attack. A chemically contaminated environment presents unique requirements for Soldiers. In addition to wearing personal protective clothing in contaminated environments, Soldiers are trained to operate in Mission Oriented Protective Posture, or MOPP, levels, which range from one to four. The MOPP level at AEWE was four, which requires the highest level of protection.

Fourteen Soldiers completed electronic surveys at AEWE on size and weight, training and areas to improve the MIKE Buttpack system. The analytical team conducted interviews with the Soldiers to gather their initial impressions of the system, as well as their views on the effectiveness of the system.

"The MIKE Buttpack system was well received by Soldiers during AEWE. The Soldiers noted that it was easy to learn how to use the system. The AEWE final assessment stated the MIKE Buttpack offers improvements that would support maneuver as compared to the current M256A2 kit," Jensen said.

Working for the Warfighter

Center Partners with Pine Bluff Arsenal to Increase CBRNE Response

By Shelby L. Bartram

Shelby Bartram is a Biomedical Engineer with the Engineering Design and Analysis Branch at the U.S. Army Combat Capabilities Development Command Chemical Biological Center. She graduated from Western New England University with a bachelor's degree in Biomedical Engineering and with a master's degree in Engineering Management. She has been executing chemical biological projects for the Army for four years.

IMAGINE WHAT WOULD HAPPEN DURING a chemical, biological, radiological, nuclear and explosive (CBRNE) threat. How would military personnel react? How would they communicate critical information to one another? Are they equipped to analyze large-scale incidents? Are the Soldiers protected? The U.S. Army's Combat Capabilities Development Command (CCDC) Chemical Biological Center is partnering with Pine Bluff Arsenal to research, develop and design products to keep warfighters safe should this type of threat occur, while providing the rapid response needed for commanders and local authorities. The latest innovation stemming from the collaboration is the Analytical Laboratory Suite-Modified Work Order (ALS-MWO).

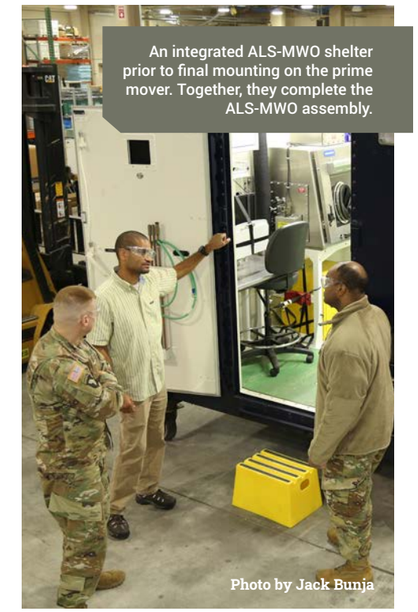
The ALS-MWO is a mobile laboratory designed to help units analyze environmental samples for chemical and biological materials. It provides them with the ability to share information with other units in the area of operations as well as joint task force commanders. The upgraded vehicle employs chemical, biological and radiological detectors and analyzes environmental samples when information is collected from units which allows for decisions regarding protection, treatment, decontamination and planning to be made quickly without having to send samples to a lab. This is not only efficient in the time of a threat, but it also ensures everyone's safety.

While the intent of these vehicles is not for use in war situations, they will provide a great benefit to the warfighter from a homeland security standpoint in order to protect our Nation.

Joint Product Manager CBRNE Analytics & Response Systems requested the support of the Engineering Directorate's Advanced Design and Manufacturing (ADM) Division and Pine Bluff Arsenal in order to produce the ALS-MWO to replace the current ALS platform. The current platform has been in use for more than 10 years and is due for an upgrade to keep up with evolving technology and threats.

Production of the ALS-MWO was conducted at PBA, while ADM provided project management, procurement, fabrication, and integration support.

With user feedback in mind, the ALS-MWO upgrades include updated software, an updated database, more space inside the unit and an updated outer structure that can be removed and replaced if needed. The new software and database capabilities allow for improved process flow integration and help identify previous unknowns.



An integrated ALS-MWO shelter prior to final mounting on the prime mover. Together, they complete the ALS-MWO assembly.

Photo by Jack Bunja

A total of 66 units are expected to be fielded to the National Guard Bureau Civil Support Teams (NGB-CST) by Fiscal Year 2022. ADM and Pine Bluff Arsenal have already produced 12 ALS-MWO systems: most recently, the Center retrofitted a Maine NGB-CST ALS vehicle, preparing them to respond to CBRNE incidents quickly and efficiently.

ADM is continuing to support the fielding of the vehicles and monitor and correct any potential issues to ensure the vehicles are in good long-term operating order. To ensure DoD and homeland defense readiness, the Center will continue to support NGB-CSTs with onsite capabilities.

Photo by CCDC Chemical Biological Center Public Affairs Office

Danielle Kuhn, Ph.D, explains her career in STEM to college students at Harford Community College's fourth annual STEM Day.

In the Community: Army Scientist Shares Experience with HCC Students at STEM Day

CCDC Chemical Biological Center Public Affairs Office

MANY STUDENTS ARE CONSIDERING STEM MAJORS TO PREPARE THEMSELVES for a career in the future. While they have heard that scientific degrees require rigorous studies, they are often left wondering what the subsequent career looks like. That's where U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center's Danielle Kuhn, Ph.D., helped by presenting an overview of her work at Harford Community College's (HCC) fourth annual STEM Day.

"STEM Day is a great way to engage those students with an interest in science, technology, engineering or mathematics," Kuhn said. "Instead of just feeding them a lot of facts and figures, it gives us a way to show them how STEM degrees are applied in the real world. It provides a window into the experience of being a researcher rather than just a student in the sciences."

Kuhn's presentation was among several offered throughout the day, spanning the disciplines from environmental sciences to astronomy and physics. Kuhn focused on the direction the Army's Smoke and Target Defeat Branch is taking to counteract growing threats posed by technology advancements by near-peer adversaries.

With a bachelor's degree in chemistry from Cortland State University and a doctorate from Binghamton University, Kuhn engaged the room of approximately 30 students with a sense of humor and authenticity regarding her experience as a research chemist. She credits her post-doctoral advisor and CCDC Chemical Biological Center colleague Brendan DeLacy, Ph.D., for setting a stellar example for public speaking.

"He has an incredible ability to captivate the audience while explaining complex material at an understandable level, and keeping everyone engaged throughout," Kuhn said.

Aside from telling students that it's impossible to pull a pin from a grenade with one's teeth, Kuhn shared the mission of the Smoke and Target Defeat Branch, which is to conduct research in the areas of obscurants, aerodynamics, non-lethal, flame, incendiary and unconventional technologies. She followed up with information on the Center's obscurant capabilities and shared Beer's law which deals with transmittance and the extinction coefficient—how strongly a substance absorbs and/or scatters light to obscure view.

Kuhn gave an introduction to the nanotechnology her research uses by referring to the ancient Romans and the Lycurgus Cup. The fourth century cup appears light green when lit from the front but blood-red when lit from behind or from the inside. She explained how similar plasmonic nanoparticles can be used to improve obscurants used by Soldiers. She also discussed how advancements in 3D printing of nanoparticles could represent the future in materials development.

Kuhn taught general chemistry at HCC in 2018 and was thrilled to have the opportunity to rekindle the relationship by participating in this year's STEM Day. "To see all those eager students at HCC and encourage them toward STEM careers, to express to them how important this is for our society, that experience really validates for me that I chose the right career path," she said. "We are looking at the next generation of scientists who will help create tomorrow's solutions, advance our world and continue spreading awareness of the importance of STEM. I am honored to be a part of that, a part of their journey."

Photo by CCDC Chemical Biological Center Public Affairs Office

A lateral flow immunoassay test strip shows a negative result for fentanyl.

Collaboration Corner: Army Works with State and Local Governments to Assess Fentanyl Screening Test

Forensics labs in Maryland and Delaware will take part in project

By CCDC Chemical Biological Center Public Affairs Office

THE U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND (CCDC) CHEMICAL BIOLOGICAL CENTER has entered a cooperative research and development agreement (CRADA) with the Anne Arundel County Crime Lab and the State of Delaware Division of Forensic Science to determine the effectiveness of a fentanyl detection test strip.

The test strip, a lateral flow immunoassay (LFI), is a simple paper strip developed to detect fentanyl in liquid samples without the use of expensive laboratory equipment. Similar to how a home pregnancy test works, the strip has built in indicators for positive results and negative results. Results appear within three to four minutes after the strip is exposed to a fluid — one line means fentanyl is present, two lines means fentanyl was not detected.

The U.S. Army is constantly assessing domestic and international technologies to determine which technologies could play a role in supporting the warfighter. In this case, the LFI is considered an international technology, developed by a Canadian company based in Markham, Ontario.

The research team is led by U.S. Army biologist Daniel Angelini, Ph.D., who, along with his colleagues Tracey Biggs, Amber Prugh, and Jennifer Sekowski, Ph.D., have conducted extensive laboratory assessments using the LFI in an effort to gather unbiased data on the technology.

"Our laboratory assessment included a full evaluation of the LFI, including limits of detection, cross reactivity and evaluation following surface sampling," Angelini said. "In addition to gathering data, we're designing testing protocols for our partner organizations so they can replicate the test effectively."

Real-world samples will be gathered by the Anne Arundel County Crime Lab and the State of Delaware Division of Forensic Science who will share the results with the CCDC Chemical Biological Center as part of the CRADA.

A CRADA provides a means for industry, academia, and other government agencies to collaborate with Army research and development activities. The parties in a CRADA may exchange intellectual property, expertise and data or they may hire personnel or rent services or materials, equipment and facilities during the period of performance.

Jessica Smith, chief forensic toxicologist at the State of Delaware Division of Forensic Science, looks forward to the opportunity to use the LFI in her labs to support the Army's objectives. Her lab is responsible for performing toxicological testing on specimens collected during autopsies. For their postmortem casework, they test for drugs and alcohol to help the Medical Examiners determine if they contributed to or caused death.

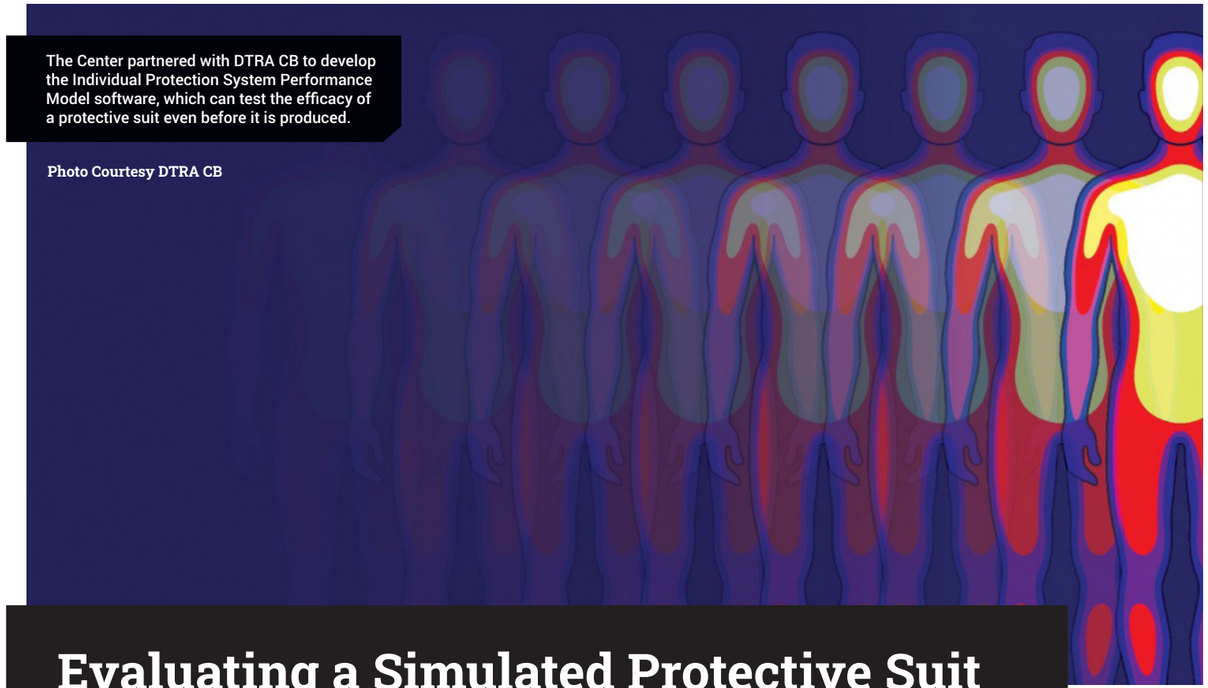
"Fentanyl is a problem in Delaware, but the entire nation is subject to its scourge," Smith said. "Fentanyl was confirmed in 74 percent of overdose-related deaths in 2018 in the state, and 36 percent of all postmortem screenings we conducted tested positive for the drug."

For the study, Smith and her team will test postmortem urine samples using the LFI, delivering the final results to Angelini for publishing.

Excited and grateful for the opportunity to contribute to the project, Smith has interest in a rapid screening test for her office.

"We're interested in seeing the results to assess the feasibility of bringing a rapid test like this to our office for our use in the future as a preliminary test," Smith said.

Each lab will collect and test samples throughout the period of performance, ending in June 2020, and relay the data back to Angelini at the Center who will publish the findings in a peer-reviewed scientific journal and deliver an assessment of the technology to the Army.



The Center partnered with DTRA CB to develop the Individual Protection System Performance Model software, which can test the efficacy of a protective suit even before it is produced.

Photo Courtesy DTRA CB

Evaluating a Simulated Protective Suit

By The Defense Threat Reduction Agency's Chemical and Biological Technologies Department

A NEW PHYSICS-BASED COMPUTER MODEL CAN EVALUATE THE PERFORMANCE of a protective suit even before the suit is manufactured. The Individual Protection System Performance Model (IP SPM) software was developed by the Defense Threat Reduction Agency's Chemical and Biological Technologies Department (DTRA CB), in collaboration with the Combat Capabilities Development Command (CCDC) Chemical Biological Center. The IP SPM software allows researchers to digitally evaluate the efficacy of a proposed protective suit in its conceptual phase — when it is just a small swatch of material.

Currently, a new protective suit must first be manufactured as a garment before any testing can begin. Researchers then challenge a manikin or robot wearing a proposed suit with chemical and biological warfare agents. Multiple suits, manikins, and robots are needed to conduct these assessments, which are lengthy and costly. Even more labor, money, and material are required to evaluate a suit's barrier quality for the many ways in which warfighters can be exposed to chemical and biological agents.

The IP SPM software improves upon current evaluation methods and is undergoing independent verification, validation, and accreditation for use by operational testing agencies. The software measures the physical characteristics of a swatch of material and then simulates how well the material would safeguard a warfighter's skin from contacting hazardous agents in various atmospheric conditions. The software rapidly produces data on many factors associated with the performance of the material-as-protective-suit, including:

- How the material performs when challenged with varying concentrations of chemical and biological agents
- How the material performs as a barrier when it is wet
- How the material performs when exposed to varying airflow patterns and other environmental conditions
- How well the material keeps away hazards depending on the warfighter's body position and activity
- How much body heat the material entraps (i.e., thermal burden for the warfighter)
- How well the material performs when manufactured into different suits
- How much toxicity the warfighter would sustain if agents were to seep through the material (through seams, zippers, etc.)

With only a swatch of material, the IP SPM software can illustrate a digitally simulated protective suit — and undergarments — upon a digital warfighter and analyze the suit's protective performance under various conditions. Using the software, researchers can simulate and evaluate several suit designs to determine the ensemble configuration best capable of safeguarding warfighters. The software will be used by the Uniform Integrated Protection Ensemble Family of Systems.

The IP SPM software not only saves money and labor associated with testing manufactured garments but also allows a swatch of material to undergo multiple and repeated tests for a thorough evaluation of the material's quality as a toxicological barrier. The collaborative effort of DTRA CB and CCDC Chemical Biological Center will continue to be instrumental in developing and evaluating new, innovative protective suits and other equipment that protect warfighters.

Publications and Patents

Quarterly Listing

This page contains the peer-reviewed journal articles recently published on research conducted by Center scientists and U.S. patents recently awarded to the Center between November 2019 and December 2019.

PUBLICATIONS

Title: Integration of Metal-Organic Frameworks on Protective Layers for Destruction of Nerve Agents under Relevant Conditions
Author(s): Chen, ZJ; Ma, KK; Mahle, JJ; Wang, H; Syed, ZH; Atilgan, A; Chen, YW; Xin, JH ; Islamoglu, T; Peterson, GW; Farha, OK
Source: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY **Volume**: 141 **Issue**: 51 **Pages**: 20016-20021 **DOI**: 10.1021/jacs.9b11172 **Published**: DEC 25 2019
ISSN: 0002-7863 eISSN: 1520-5126

Title: Effect of Carbon Dioxide on the Degradation of Chemical Warfare Agent Simulant in the Presence of Zr Metal Organic Framework MOF-808
Author(s): Plonka, AM; Grissom, TG; Musaev, DG; Balboa, A; Gordon, WO; Collins-Wildman, DL; Ghose, SK; Tian, YY; Ebrahim, AM; Mitchell, MB; Hill, CL; Morris, JR; Frenkel, AI
Source: CHEMISTRY OF MATERIALS **Volume**: 31 **Issue**: 23 **Pages**: 9904-9914 **DOI**: 10.1021/acs.chemmater.9b04565 **Published**: DEC 10 2019
ISSN: 0897-4756 eISSN: 1520-5002

Title: Organism Engineering for the Bioproduction of the Triaminotrinitrobenzene (TATB) Precursor Phloroglucinol (PG)
Author(s): Meyer, A; Saaem, I; Silverman, A; Varaljay, VA; Mickol, R; Blum, S; Tobias, AV; Schwalm, ND; Mojadedi, W; Onderko, E; Bristol, C; Liu, ST; Pratt, K; Casini, A; Eluere, R; Moser, F; Drake, C; Gupta, M; Kelley-Loughnane, N; Lucks, JP; Akingbade, KL; Lux, MP; Glaven, S; Crookes-Goodson, W; Jewett, MC; Gordon, DB; Voigt, CA
Source: ACS SYNTHETIC BIOLOGY **Volume**: 8 **Issue**: 12 **Pages**: 2746-2755 **DOI**: 10.1021/acssynbio.9b00393 **Published**: DEC 2019
ISSN: 2161-5063

Title: Insights into the solvent-assisted degradation of organophosphorus compounds by a Zr-based metal-organic framework
Author(s): Harvey, JA; Pearce, CJ; Hall, MG; Bruni, EJ; DeCoste, JB; Gallis, DFS
Source: DALTON TRANSACTIONS **Volume**: 48 **Issue**: 43 **Pages**: 16153-16157 **DOI**: 10.1039/c9dt03710a **Published**: NOV 21 2019
ISSN: 1477-9226 eISSN: 1477-9234

Title: Synthesis and mu-Opioid Activity of the Primary Metabolites of Carfentanil
Author(s): Hsu, FL; Walz, AJ; Myslinski, JM; Kong, L; Feasel, MG; Goralski, TDP; Rose, T; Cooper, NJ; Roughley, N; Timperley, CM
Source: ACS MEDICINAL CHEMISTRY LETTERS **Volume**: 10 **Issue**: 11 **Pages**: 1568-1572 **DOI**: 10.1021/acsmedchemlett.9b00404 **Published**: NOV 2019
ISSN: 1948-5875

Title: Negative Thermal Expansion of Mercurous Halides
Author(s): Amarasinghe, PM; Kim, JS; Trivedi, S; Qadri, SB; Gorzkowski, EP; Imler, G; Soos, J; Gupta, N; Jensen, J
Source: JOURNAL OF ELECTRONIC MATERIALS **Volume**: 48 **Issue**: 11 Special **Issue**: SI **DOI**: 10.1007/s11664-019-07518-7 **Published**: NOV 2019
ISSN: 0361-5235 eISSN: 1543-186X

Title: Multivariate CuBTC Metal-Organic Framework with Enhanced Selectivity, Stability, Compatibility, and Processability
Author(s): Peterson, GW; Au, K; Tovar, TM; Epps, TH
Source: CHEMISTRY OF MATERIALS **Volume**: 31 **Issue**: 20 **Pages**: 8459-8465 **DOI**: 10.1021/acs.chemmater.9b02756 **Published**: OCT 22 2019
ISSN: 0897-4756 eISSN: 1520-5002

Title: A Method for Cost-Effective and Rapid Characterization of Engineered T7-Based Transcription Factors by Cell-Free Protein Synthesis Reveals Insights Into the Regulation of T7 RNA Polymerase-Driven Expression
Author(s): McManus, JB; Emanuel, PA; Murray, RM; Lux, MW
Source: ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS **Volume**: 674 Article Nubmer: 108045
Published: OCT 15 2019
ISSN: 0003-9861

Title: Composition-dependent multicomponent diffusivity of 2,5-lutidine with acetonitrile in polyurethane
Author(s): Varady, MJ; Boyne, DA; Pearl, TP; Lambeth, RH; Mantooth, BA
Source: POLYMER **Volume**: 180 Article Number: UNSP 121697 **DOI**: 10.1016/j.polymer.2019.121697 **Published**: OCT 10 2019
ISSN: 0032-3861 eISSN: 1873-2291

Title: Scalable and Template-Free Aqueous Synthesis of Zirconium-Based Metal-Organic Framework Coating on Textile Fiber
Author(s): Ma, KK; Islamoglu, T; Chen, ZJ; Li, P; Wasson, MC; Chen, YW; Wang, YF; Peterson, GW; Xin, JH; Farha, OK
Source: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY **Volume**: 141 **Issue**: 39 **Pages**: 15626-15633 **DOI**: 10.1021/jacs.9b07301 **Published**: OCT 2 2019
ISSN: 0002-7863 eISSN: 1520-5126

Title: Two-dimensional MS/MS scans on a linear ion trap mass analyzer: Identification of V-series chemical warfare agents
Author(s): Snyder, DT; Demond, PS; Szalwinski, LJ; Dhummakupt, ES; McBride, EM; Cooks, RG; Glaros, T; Mach, PM
Source: INTERNATIONAL JOURNAL OF MASS SPECTROMETRY **Volume**: 444 Article Number: UNSP 116171 **DOI**: 10.1016/j.ijms.2019.06.007 **Published**: OCT 2019
ISSN: 1387-3806 eISSN: 1873-2798

PATENTS

Helmet Mounted Protective Shroud
Patent number: 10,595,580
Issued: March 24, 2020

Direct Capture and Analysis of Aerosols and Vapors by Paper Spray Mass Spectrometry
Patent number: 10,591,390
Issued: March 17, 2020

Combustion Aerosol Generator System
Patent number: 10,539,320
Issued: January 21, 2020

White Smoke Mix
Patent number: 10,539,270
Issued: January 21, 2020

Solutions

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