U.S. ARMY

2025 | YEAR IN REVIEW

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND CHEMICAL BIOLOGICAL CENTER

DEVCOM CHEMICAL BIOLOGICAL CENTER

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) is aligned under the U.S. Army Transformation and Training Command (T2COM), which advances the Force in readiness and lethality. DEVCOM, a major subordinate command of T2COM, is a team of world-class scientists, engineers, analysts, technicians, and support staff who are fully focused on empowering our Soldiers today and in the future. DEVCOM CBC provides innovative chemical, biological, radiological, nuclear and explosive (CBRNE) defense capabilities to the Joint Warfighter and uses a hands-on approach of research, engineering and operations in the development of CBRNE defense solutions. DEVCOM CBC is headquartered at Aberdeen Proving Ground—Edgewood Area, Maryland. The DEVCOM CBC 2025 Year in Review is an authorized publication for members of the Department of War. The contents of DEVCOM CBC 2025 Year in Review are not necessarily the official views of, or endorsed by, the U.S. Government or the U. S. Army. Editorial content of this publication is the responsibility of the DEVCOM CBC Office of Public Affairs. References to commercial products or entities in this publication do not constitute endorsement by the U.S. Army of the products or services offered.

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DIRECTOR'S MESSAGE

DRIVING INNOVATION TO SUPPORT ARMY TRANSFORMATION

The year 2025 challenged, stretched, and ultimately strengthened the DEVCOM Chemical Biological Center. It was a period of rapid transformation—not just for our Center, but for many organizations throughout the Department of War and federal government. Through every challenge presented to the Center, we demonstrated great resolve and commitment to our mission of providing innovative CBRNE defense capabilities that enable the warfighters' dominance on the battlefield and interagency defense of the homeland.

During 2025 we navigated an evolving and complex federal landscape that included direct impacts from reorganization and consolidation across many Army organizations as well as a lengthy government shutdown. We witnessed a notable number of retirements and deferred resignations as experienced professionals departed the Center. We are grateful for their contributions and the wealth of knowledge that they passed down through the training and mentorship of colleagues over the years. Mentorship is incredibly important to us. Whether it's bringing in students from universities and colleges over the summer internship programs or seeing a pair of our own be nominated for the DoW SMART Scholar and Mentor of the Year, I'm proud that our workforce sees the value in helping educate the next generation to solve tough problems and to better understand our purpose and mission here at DEVCOM CBC.

In our labs and in the field, we executed innovative research, engineering and operations to generate and deploy CBRNE solutions that will increase the lethality and readiness of the warfighter. We've advanced the Portable Microscopy Chemical Detection System to a 10-pound device that warfighters can easily transport in the field, helping them detect minimal amounts of chemical threat particles, such as fentanyl and other narcotics. We transitioned the Chemical Hot Air Decontamination project to a program of record with our partners at the Capability Program Executive Chemical, Biological, Radiological and Nuclear Defense (CPE-CBRND), a crucial step in providing a decontamination method for sensitive electronics and materials. We continued to work in the field at events like the Maneuver Support and Protection Integration eXperiments and CPE-CBRND's Technology Capstone Event to put emerging protection, detection, and decontamination technologies in the hands of warfighters for evaluation and input.

We also had successes in partnering with academia and industry this year, completing a patent transition with the Center's TACBIO 2 capability and establishing research agreements with several universities. We've also built upon our knowledge and understanding through international partnerships, taking successes from the United Kingdom's "Porton Man" as we bring the Agent Mannikin Integrated Ensemble Examination project to Aberdeen Proving Ground and continue to improve the testing of chemical protective equipment for the warfighter.

In a time of great transformation within the Army and other DoW organizations, we know we must be thinking ahead of our adversaries and looking for more efficient ways to integrate our capabilities. Through initiatives such as forward-deployable biomanufacturing, leveraging autonomized technologies, and integrating artificial intelligence into our workstreams, the Center's team of experts demonstrated resiliency and agility in 2025.

In a year in which the Army celebrated its 250th birthday, it's important to note that the Center has evolved since its creation in 1917 to meet the needs of the warfighter and Nation. I am confident that our people and institutional knowledge in chemical and biological defense will enable us to continue to provide impactful solutions. There is a lot to appreciate in 2025 and it's because of the hard work and dedication shown by so many here that we can see ideas and innovation come to fruition. Congratulations on the completion of a great year and I look forward to showing the world what DEVCOM CBC can do in 2026.

Sincerely,

Michael Bailey
Director
U.S. Army Combat Capabilities Development Command
Chemical Biological Center

CENTER OVERVIEW

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) is the primary Department of War (DoW) technical organization for chemical and biological defense. It is aligned under the U.S. Army Transformation and Training Command (T2COM) and U.S. Army Combat Capabilities Development Command. The Center's mission is to provide innovative CBRNE defense capabilities to enable the Joint Warfighter's dominance on the battlefield and interagency defense of the homeland. Its vision is to be the Army's premier research and engineering center generating CBRNE solutions for the Army, DoW, the Nation, and our allies. At DEVCOM CBC we specialize in research, development and engineering combined with testing, training, and field operations to develop innovative, effective CBRNE defense solutions. We integrate a hands-on approach to science and experimentation, partnering with other government agencies, industry, and academia. CBC develops, tests, and applies technologies for the protection of warfighters, first responders, and the Nation from chemical and biological warfare threats. The Center is developing and refining enhanced capabilities to improve safety and accuracy in the detection and decontamination of chemical and biological materials. DEVCOM CBC is also developing a new generation of technologies to counter future and unconventional threats and spearheading efforts related to biomanufacturing and synthetic biology to scale up materials production. DEVCOM CBC's multifaceted workforce is comprised of a team of problem solvers and innovators, including scientists, specialists, engineers, technicians and subject matter experts. Our people, along with our unique infrastructure and partnerships, allow us to conduct joint CBRNE defense research and development efforts in support of the Nation's defense technology needs and goals.

Mission

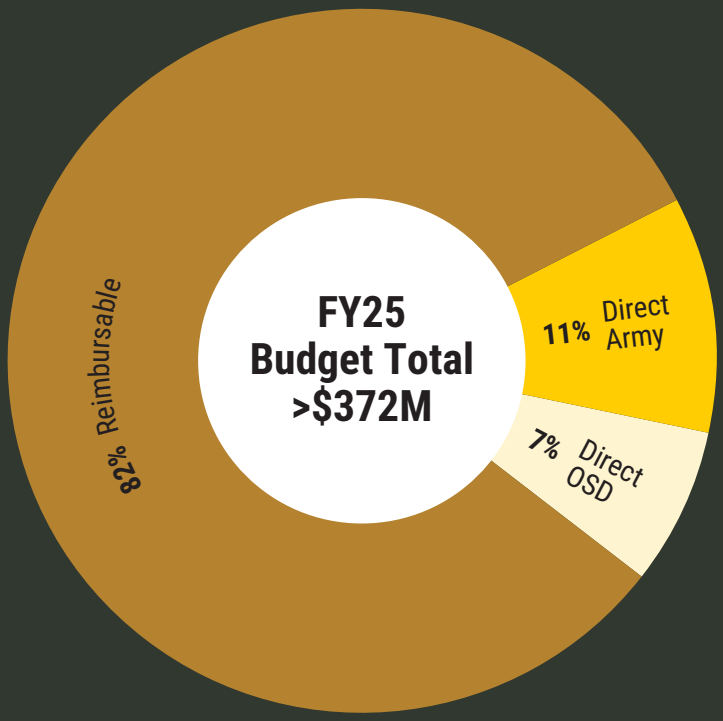
Provide innovative chemical, biological, radiological, nuclear and explosive (CBRNE) defense capabilities to enable the Joint Warfighters' dominance on the battlefield and interagency defense of the homeland.

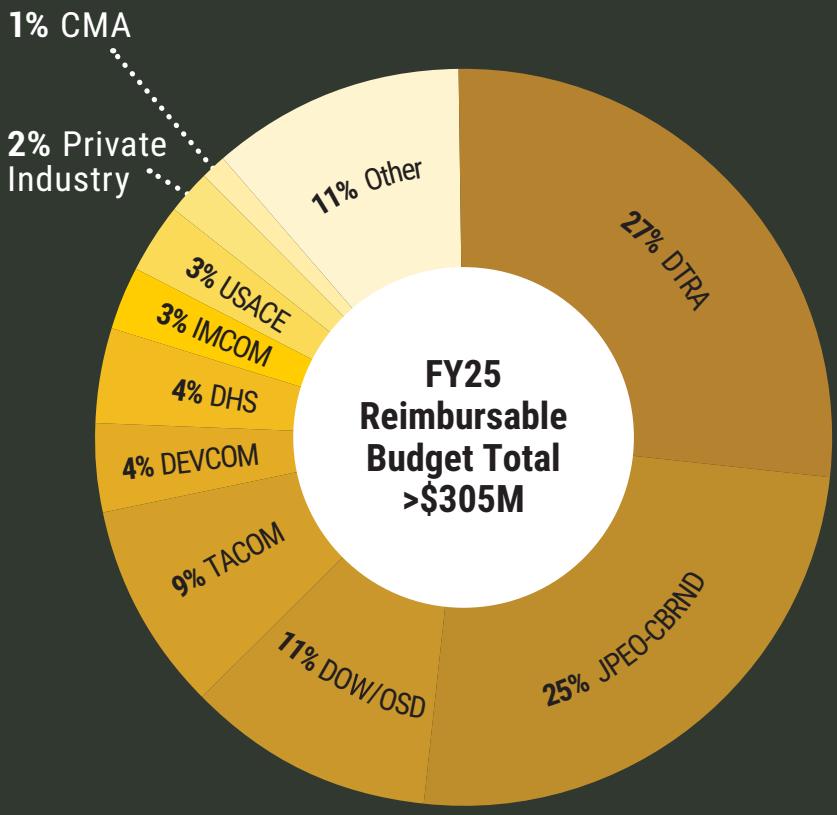
Vision

To be the Army's premier research and engineering center generating CBRNE solutions for the Army, DoW, the Nation, and our Allies.

ANNUAL REPORT

Budgetary Information





>$3.8M

DEVCOM CBC researchers received in funding through the FY25 In-House Laboratory Independent Research (ILIR) and Chemical Biological Advanced Materials and Manufacturing Science (CBAMMS) programs.

82%

of DEVCOM CBC's programs were funded by external customers using a fee-for-service model, distinguishing the Center from other Army laboratories in FY25.

>$428K

was invested into seedling research projects, which are smaller-scale exploratory basic research projects with a high potential for future funding opportunities.

DEVCOM Welcomes New Commanding General on Path Through Army Transformation

Story originally posted to devcom.army.mil by DEVCOM Public Affairs, on June 27, 2025.

Brig. Gen. Robert Born assumed command of U.S. Army Combat Capabilities Development Command, or DEVCOM, from Maj. Gen. John Cushing June 27, 2025, at Aberdeen Proving Ground, Maryland.

Brig. Gen. Robert Born, the U.S. Army Combat Capabilities Development Command, or DEVCOM, incoming commanding general, center, receives the DEVCOM colors from Lt. Gen. Miles Brown, the Army Futures Command deputy commanding general, June 27, 2025, at Aberdeen Proving Ground, Maryland. Born previously served as the Deputy Commanding General (Maneuver) for 1st Calvary Division at Fort Hood, Texas.

"I want to thank Lt. Gen. Miles Brown and Gen. James Rainey for entrusting me with this extremely important mission and command," Born said. "I am truly honored."

Cushing, who will next serve as the Army Futures Command, or AFC, chief of staff, prioritized empowering the workforce to deliver the best technologies to Soldiers.

"There are so many amazing people in this organization," he said. "The quality of the civilian workforce has just been simply amazing. Listening to them talk about what they do and seeing the depth of knowledge they have, they really are so talented, and the Soldiers that work in the command are critical in terms of providing feedback to our scientists and engineers."

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Born, a graduate of the U.S. Military Academy at West Point, New York, previously served as the Deputy Commanding General (Maneuver) and the Deputy Commanding General (Support) of 1st Cavalry Division at Fort Hood, Texas.

He takes charge of DEVCOM on the cusp of a merger between AFC and U.S. Army Training and Doctrine Command, or TRADOC, as part of the Army Transformation Initiative which will deliver critical warfighting capabilities and optimize force structures.

"To my DEVCOM teammates, I am honored and excited to join your ranks at this decisive time in our Army's history," Born said. "We have a critical mission, and I am dedicated to providing the best leadership I can. We will ensure that our Soldiers have a decisive advantage on the next battlefield, and I cannot think of a more honorable calling."

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During the ceremony, presiding officer Lt. Gen. Miles Brown, the Army Futures Command deputy commanding general and former DEVCOM commanding general, spoke to the scope and scale of the DEVCOM mission and highlighted DEVCOM's motto, Pro Futuro, or Fight for the Future. He challenged Born to lead as an expert and to continue pushing DEVCOM to fight for the future on behalf of the Soldiers who will depend on the technologies developed by the command.

Born wrapped up the ceremony in a similar way to how Cushing started it: acknowledging the DEVCOM workforce.

"I have been so impressed with the skill, professionalism and commitment of the DEVCOM team, and I am proud to move forward as the DEVCOM commander."

The new U.S. Army Transformation and Training Command (T2COM) patch worn during the official activation ceremony held at Lady Bird Johnson Auditorium on October 2, 2025.

U.S. Army Transformation and Training Command Activated

Story originally posted to Army.mil by Nina Borgeson, U.S. Army Transformation and Training Command Public Affairs, on November 14, 2025.

The U.S. Army Transformation and Training Command (T2COM) was officially activated during a ceremony held at Lady Bird Johnson Auditorium on Oct. 2. This new command brings together key efforts into a unified headquarters responsible for force generation, force design, and force development. Gen. David M. Hodne assumed command as the U.S. Army Transformation and Training Command commanding general and Command Sgt. Maj. Raymond Harris assumed responsibility as the command sergeant major.

The establishment of the U.S. Army Transformation and Training Command comes after Secretary of the Army Daniel Driscoll announced an effort aimed to accelerate transformation and improve force structure to ensure the Army remains the world's more lethal and ready land force.

The U.S. Army Recruiting Command, Combined Arms Command, and Futures and Concepts Command will function as subordinate commands to enhance the Army through unifying recruitment, training, and combat development, ensuring a cohesive and agile force ready for future challenges.

Gen. Randy George, Chief of Staff, Army, presided over the ceremony and acknowledged the need for the Army to integrate how we train, fight and modernize.

"T2COM will help our Army change how we operate. As we all know, transformation is not just about product innovation, it's about process innovation… T2COM will help us cut our redundancy, reverse stagnation and push talent and leaders into our fighting formations," George said.

Lt. Gen. (P) David M. Hodne assumed command as the T2COM commanding general on October 2, 2025.

During his remarks, Hodne outlined his vision and goals for the new command, emphasizing a focus on turning war-fighting concepts into war-winning capabilities.

"Our mission is clear. From vision to victory, we lead the Army's continuous transformation, modernizing capabilities, developing leaders, and advancing the profession to deliver decisive readiness," Hodne said.

The creation of the U.S. Army Transformation and Training Command represents a significant investment in the Army's future and reflects the Army's ongoing effort to modernize and prepare for future challenges.

2025 By The Numbers

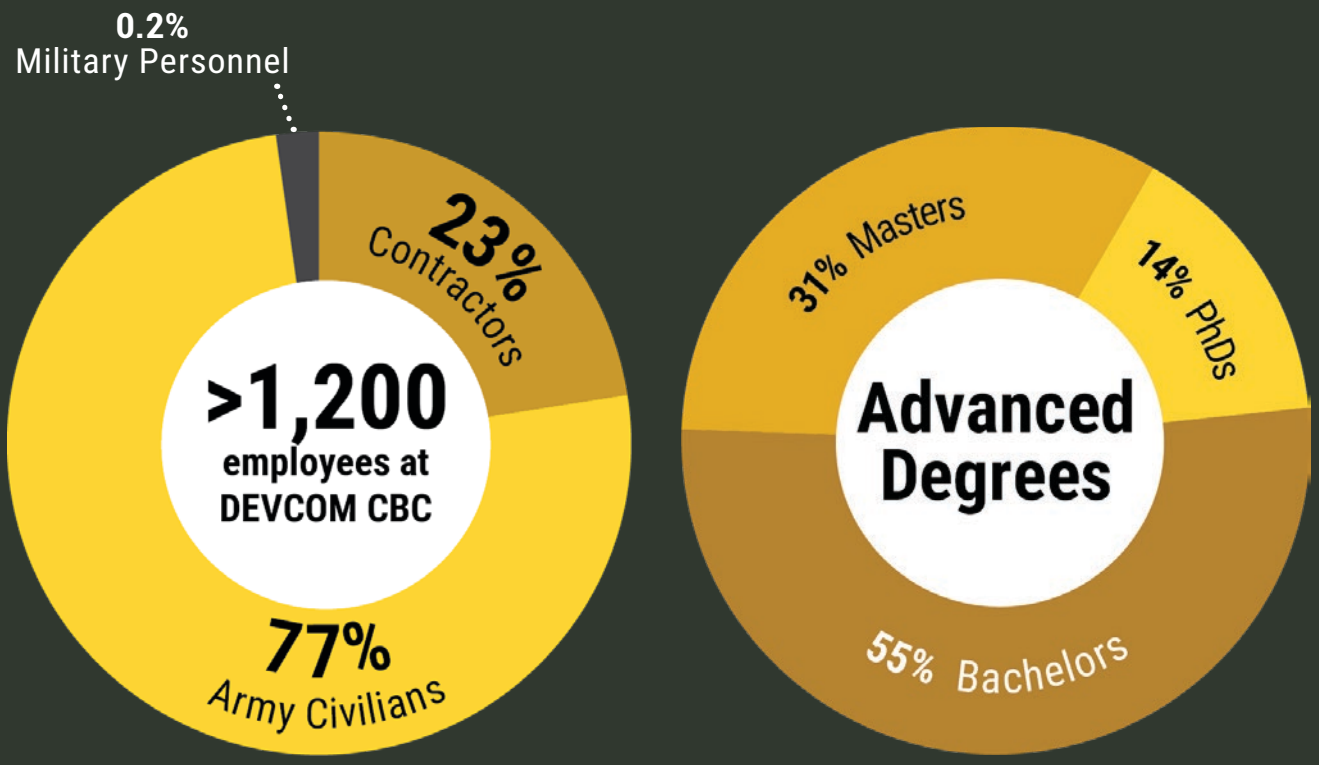
$4.4M
in funding from Testing and Cooperative Research and Development Agreements

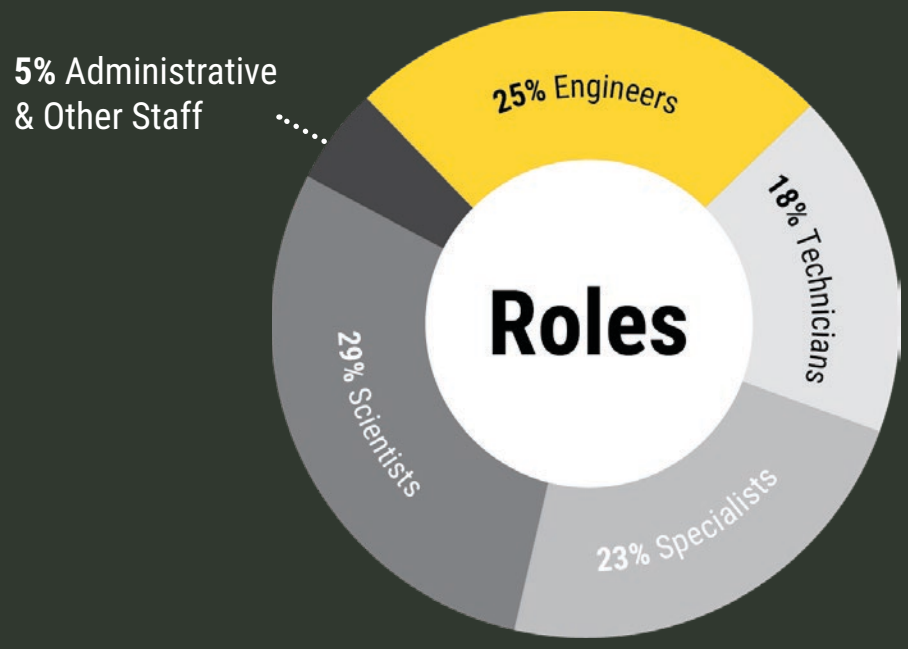
11
patents awarded in 2025

57
students and trainees grew their skillsets at DEVCOM CBC

31
peer-reviewed publications (FY25)

Workforce Information





LEADERSHIP INSIGHTS

DR. FREDERICK COX

Director of Research & Operations
U.S. Army Combat Capabilities Development Command
Chemical Biological Center

2025 has been a whirlwind of a year, full of change, challenges, opportunities, and successes. I am grateful for the hardworking, mission-driven workforce of the U.S. Army Combat Capabilities Development Command Chemical Biological Center Research and Operations (R&O) Directorate because without them, we would not be where we are today. It is because of them that the directorate has persevered this year and continued to support the warfighter and provide value in the chemical biological defense community.

This year was different for me in that I was on a detail as the Acting Director of the Army Research Office (ARO) at the Army Research Laboratory. Being away from DEVCOM CBC gave me an even greater appreciation for the people who work here, and their ability to adapt and lead. During my detail, I also learned a great deal from working with ARO and, while our missions are different, we have many commonalities in our talented workforce and innovative thought. I look forward to a continued collaboration and partnership with them in the future.

Returning AEOP intern, Logan Szewczyk, works with his mentor, Dr. Jessica Tague, to produce bacterial cellulose as part of his continuing studies in biochemistry and molecular biology with a focus in biotechnology.

Over the summer, the R&O team continued delivering to our customers while also mentoring and coaching the next generation of scientists through the summer internship program. One intern in particular decided to come back to DEVCOM CBC after completing an internship studying biomanufacturing last year and plans to continue his education in biochemistry or molecular biology, with a focus in biotechnology. In addition, two of our researchers were recognized in this year's Department of War Science, Mathematics, and Research for Transformation (SMART) Scholarship Program's Scholar and Mentor of the Year awards for their innovative research on transforming in-vitro platforms and capabilities for emerging chemical and biological threats.

In 2025, the R&O directorate continued to enhance its biomanufacturing capability, partnering with organizations like the Advanced Biofuels and Bioproducts Process Development Unit based at Lawrence Berkeley National Laboratory in order to develop trainings to educate stakeholders across the Department of War. We also continued research on metal organic frameworks, developing new forms and applications to protect the warfighter, as well as research on canine olfactory performance. Other accomplishments for this year included the expanded Dial-a-Threat (DaT): Antigen and the Portable Microscopy Chemical Detection System, a small, lightweight device that can detect trace amounts of substances.

Engagement and partnership were a highlight of 2025. We partnered with the University of North Carolina Wilmington to drive forward innovative microalgae research and the University of Hawaii to enhance bioprinting and advanced manufacturing. The team celebrated the success of signing a patent license agreement for the Tactical Biological Generation 2 (TACBIO® 2) sensor as well as the major accomplishment of a bill signing which provides the ability to develop and test chemical agent thermal destruction technologies at Edgewood.

I am so proud of the R&O team and what they have been able to achieve this year, even in the face of uncertainty and adversity. In 2026, I look forward to being back at DEVCOM CBC, continuing partnerships with industry, academia, and our stakeholders; and discovering new and innovative ways to protect and enable the warfighter on the battlefield.

DR. JAMES WATSON

Director of Engineering
U.S. Army Combat Capabilities Development Command
Chemical Biological Center

This has truly been a year of transformation for the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) Engineering Directorate. While 2025 presented us with many changes, our workforce rose to the occasion and saw challenges as opportunities. We persevered together, as one team, and came out of the year with many accomplishments to be proud of.

I'd like to recognize the exceptional people that make up the DEVCOM CBC Engineering Directorate. Our success would not be possible without such talented and dedicated professionals leading by example. We had graduates from the Practical Introduction to Supervising Employees VI Program and the Aberdeen Proving Ground Senior Leadership Cohort, as well as four graduates from the Journey to Leadership Tier II course. The Engineering Directorate also hosted over 20 summer interns this year, each paired with a mentor who guided them throughout their experience working at the Center and learning what it is like to generate innovative solutions to protect our warfighters.

The Engineering Directorate was busy this year participating in many exercises and demonstrations, such as Project Convergence, Chemical Biological Operational Analysis, Maneuver Support & Protection Integration eXperiments, Prairie Broom, and more. We were able to showcase our innovative capabilities, collaborate with our partners, and continue to drive the chemical biological defense mission forward. These engagements are a critical part of the transformation process to deliver concept-driven capabilities now and in the future.

One of Engineering's major accomplishments for this year was the support provided by our Equipment Assessment Unit. Our team of experts worked directly with Soldiers to ensure they were prepared to defend against chemical and biological threats by servicing and maintaining their fielded equipment. We were able to adapt to each unit's specific requirements and, therefore, able to gain invaluable insights into what they need to complete their missions. This is an ongoing effort that will continue to provide value to both the Soldiers and our team.

A member of the Equipment Assessment Unit checks to make sure equipment is working correctly.

Other highlights of the year included efforts such as the Expeditionary Lab, or ExLab, a mobile engineering and advanced manufacturing platform that can be used in the battlefield; the successful transition of the Residual Life Indicator from the Defense Threat Reduction Agency to the Joint Project Manager for Chemical, Biological, Radiological and Nuclear Protection; the Agent Manikin Integrated Ensemble Examination, or AMIEE; Glove as a Glove testing; the Tactical Biological Generation 2 (TACBIO® 2) sensor patent license agreement; and the Tactical Water Purification System prototype and production.

As we look forward to 2026, I am excited to continue this transformation journey. Our team is driven by DEVCOM CBC's mission to protect the warfighter and solve complex problems to ensure their safety. The Engineering Directorate is ready to hit the ground running with innovative ideas and make an impact. To our customers, partners, and stakeholders - thank you all for a wonderful year and we can't wait to continue collaborating with you.

SUPPORTING WARFIGHTER READINESS & LETHALITY

Soldiers and scientists work in Laboratory No. 1 during Edgewood Arsenal's early years.

The M40 Protective Mask was first approved in 1987 and was used during Operation Desert Shield/Storm in 1990-1991.

Army 250: DEVCOM CBC Reflects on History of Chem-Bio Defense

By Parker Martin

In 1917, the United States formally entered World War I, joining the Allied Forces on the Western Front. As one of the first wars in modern history to usher in the use of chemical weapons, the need arose for the U.S. to have a fully-fledged chemical warfare research facility. The U.S. Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) can trace its lineage back to this original wartime complex.

While just a chapter in the span of the Army's 250-year story, chemical and biological defense remains at the forefront of today's conflicts. The Army celebrated its 250th birthday in 2025, and we took a look back at how DEVCOM CBC, in all its iterations, has enabled Soldiers to stay ready and lethal against a variety of adversaries. Its people continue to be the go-to experts in the laboratory and on the battlefield, providing transformational chemical, biological, radiological, nuclear and explosive defense capabilities for the warfighter.

Prior to WWI, chemical agent research was conducted at the American University in Washington, D.C., while gas mask production took place on Long Island, New York. The United States centralized the scattered approach to CBRN defense by bringing all these moving parts together under one roof with the establishment of the U.S. Army Chemical Warfare Service. This centralization relocated many assets to Edgewood Arsenal, located outside of Edgewood, Maryland, which had previously served only as a chemical munitions plant.

At this time, the Army stood up and staffed early laboratories, producing leaps in technology from within Edgewood Arsenal's borders. These advancements equipped U.S. Soldiers with new designs in respirators and masks, as well as the earliest collective protective technology—the gas-proof blanket. Treated with a coating to ensure resistance against chemical agents, Soldiers would use these blankets to seal off rooms or create an area in their trenches to remove their masks. Edgewood Arsenal continued to assist troops with improved manufacturing methods and was capable of producing several tons of agent and incendiary/mustard munitions per day.

While these physical technologies helped to turn the tide of battle during WWI, Edgewood Arsenal's greatest strength was its growing workforce. By the start of World War II, the U.S. Army's efforts in recruiting the best scholars and minds from universities and industry meant that the nation now possessed the expertise and efficiency to surpass all other superpowers in the realm of chemical and biological warfare, providing an effective deterrent in future conflicts.

The Army's first biological weapon, the ricin artillery shell, would never see the battlefield due to the end of WWII. The war's end also marked the slowing of the Army's efforts for CBRN offense as the Cold War ushered in an era of domestic defense and technological bolstering. During the Cold War, the United States and the Soviet Union both maintained large stockpiles of chemical weapons, amounting to tens of thousands of tons.

The Technical Escort Detachment was established to provide a rapid response force capable of addressing chemical incidents and ensuring environmental remediation. This detachment would later evolve into the 20th CBRNE Command. Edgewood garnered even more expertise as more scientists with advanced degrees came to work for the Army to further defend against growing international threats and chemical stockpiles.

The M18 Chemical Agent Detector Kit, consisting of colored strips of paper that react and change colors when exposed to various agents, made significant improvements in terms of simplicity and mobility for Soldiers in compromised environments. Over 3 million M17 gas masks were produced between 1967 and 1986, further protecting warfighters with more effectiveness, comfort and features to sustain the fight.

The Biological Weapons Convention of 1975 and the Chemical Weapons Convention of 1997 changed the global defense posture related to these weapons. The United States led other world powers in campaigns to destroy aging chemical weapons stockpiles while redirecting chemical and biological defense research and technology efforts to focus on protection, identification and decontamination, and demilitarization.

The post-9/11 world of CBRN defense saw the Army field prepackaged, ready-to-go response kits, such as the Mass Casualty Decontamination System, that contained everything a Soldier would need for incident response from a larger-scale attack: PPE, tents, decontamination, and cleanup equipment were rucksack-ready in a modular package. Soldiers also now had access to the M4 Joint Chemical Agent Detector (JCAD), a lightweight, portable, and rugged detector capable of identifying nerve, blister, and blood agents, as well as industrial compounds.

The Edgewood Chemical Biological Center (ECBC) would see the international spotlight in 2014 with the Cape Ray mission, where the Center outfitted a 700-foot container ship to destroy Syria's declared 600-metric-ton chemical agent stockpile in international waters. ECBC's experts conceived, designed, and fabricated a field-deployable system in just six months and then joined the ship's crew to neutralize the stockpile's compounds into an inert industrial waste in just 42 days in the Mediterranean Sea. The achievement solidified the Center's reputation on the world stage as the authority in dealing with chemical and biological threats.

As unit realignments brought the Center under the U.S. Army Combat Capabilities Development Command (DEVCOM), it continued to remain at the forefront of CBRN technology and defense. Its true decisive advantage, however, continues to be the men and women who create these transformational capabilities. DEVCOM CBC accomplishes its mission thanks to the efforts of more than 1,200 civilian experts in mechanical engineering, chemistry, microbiology, and other fields, with more than 160 holding doctorates in their respective areas of expertise.

Today, DEVCOM CBC holds a unique role in technology development, with an unrivaled chemical and biological defense research and development capability comprised of its workforce and infrastructure located nationwide at Aberdeen Proving Ground, Maryland; Pine Bluff Arsenal, Arkansas; Rock Island Arsenal, Illinois; and Dugway Proving Ground, Utah. DEVCOM CBC researchers are currently working with biomanufacturing, artificial intelligence, autonomous vehicles, metal organic frameworks, deployable microsensors, advanced obscurants, and other technologies to defend U.S. and allied warfighters on the battlefield today and in the future.

Local women employed at Edgewood Arsenal work at a gas mask assembly factory between World Wars.

A U.S. Soldier in full protective gear charges through smoke during WWII.

During the Vietnam War, Edgewood Arsenal provided protective masks, riot control equipment and flame and incendiary materiel.

MOF Advances May Lead to New Applications for Warfighter

By Dr. Brian Feeney

In the world of chemical biological defense research, new technologies are typically highly specific and developed in response to a specific threat. Research on metal organic frameworks (MOFs) is the exception because it can meet a wide variety of chemical agent threats. Its applications span protection, decontamination and detection of a wide range of chemical warfare agents (CWAs) and toxic industrial chemicals (TICs) and biological aerosols. They can even be used for gas storage such as oxygen tanks or other forms of supplied air. And now, MOF research is taking another leap in developing this protective material that comes in the form of a bead, a foam, a fiber, or a film, each with its own set of applications for protecting the warfighter.

DEVCOM CBC chief scientist Dr. Greg Peterson, who leads the MOF research team, holds two containers of MOFs in their bead form.

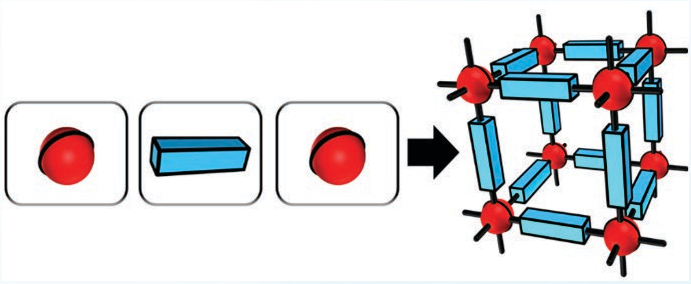
U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) scientists first started working with MOFs in 2008. Collaborating with research universities such as Northwestern University, Berkeley and North Carolina State plus a variety of small research companies through the Department of War Small Business Innovation Research (SBIR) Program and the U.S. Army Manufacturing Technology Program, they have advanced their research into entirely new areas, finding new MOF forms and applications, all to the benefit of warfighters and first responders.

WHAT IS A MOF?

MOFs are nano-constructed materials made of organic struts consisting of oxygen, hydrogen and carbon, and metals, commonly copper, zinc, or zirconium, acting as nodes. Additional functional groups and metals can be added allowing for a vast range of MOFs and resulting in a range of protective properties. They form three-dimensional crystalline structures much like an erector set. The lattice-shaped structures have large void spaces, called pores. The pores are readily filled by whatever liquid or gas flows through it, giving MOFs phenomenal adsorption capacity.

These modular building blocks are organic and inorganic molecular hybrids that take on the advantages of each. The inorganic characteristics give MOFs a very stable compartmentalized structure while the organic component gives them the dynamic quality of interacting with molecules that come into contact with them. Both the organic and inorganic components can be interchanged to create an incredible variety of structures and properties designed to absorb or catalyze chemical warfare agents, toxic industrial chemicals and other gases as desired. Thus, MOFs are truly nano-constructed designer materials.

"Metal-organic interactions have been known for decades; however, only in the late 1990s and early 2000s did research on MOFs accelerate because of the energy industry's interest in their potential for capturing and storing hydrogen gas," said DEVCOM CBC chief scientist Dr. Greg Peterson. His initial interest in MOFs was in creating a MOF that would vastly improve upon the carbon filters that Soldiers and first responders have relied on since World War I. As his research has progressed over the last 16 years, he and his research team have developed ever more capable MOFs that can perform a wide variety of functions.



MOFs are metal oxide clusters connected by organic linkers, resulting in formation of 3-dimensional, highly porous, crystalline structures.

In the form of a squishy foam, MOFs can be used in gas masks that interfere less with a Soldier's ability to aim a rifle.

Starting in 2016, the Center started funding small research startup companies through the SBIR program to take these improved MOFs from the milligram-production phase created in academic research laboratories up to quantities suitable for commercial production.

NEW APPLICATIONS

In 2020, the team started performing research into how their MOF crystals could be placed inside beads not only to trap chemical agents, but to detoxify them once trapped. They received funding from the Defense Threat Reduction Agency and transitioned the technology to the U.S. Army Soldier Center in Natick, Massachusetts which is responsible for researching how to make warfighters' uniforms more protective. Together they worked on placing multiple MOF crystals in a single bead, each crystal designed to detoxify a different agent.

The trick they mastered was to place inside the same bead a MOF crystal for neutralizing base agents and another MOF crystal for neutralizing acidic agents in a way that prevents them from interfering with each other as would normally be the case. They also succeeded in making the beads squishy so that they do not fracture under pressure. They now have MOFs in a form that can ultimately enhance the carbon routinely used in respirators.

Peterson and his team decided that they also wanted to find a way to stick their beads directly on to fibers. They went to a commercial fabric store to find a nylon that would work. They ironed on decals containing the MOF crystals and discovered that this simple method actually worked well for adhering their crystals to a combat uniform. They then introduced the technique to small startup companies participating in the SBIR Program for them to scale up for commercial production.

FOAM: GETTING THE FILTER OFF THE FACE

At the same time they were pursuing beads, Peterson and his research team knew that they wanted to get chemical agent filters off the face of warfighters while providing the same protection. Wearing a filter over the nose and mouth is uncomfortable and degrades combat effectiveness.

They began working with the U.S. Army Research Laboratory and North Carolina State University to find ways to make MOF-containing filters squishy so that a rifleman can press his chin against the stock of the rifle to take aim while wearing a mask. Foam also allows for moving the filter to a less obtrusive location such as integrating it into the foam already being used for shock and ballistic protection on the top of head. The air inside the helmet gets filtered on the head and circulated down to the nose and mouth. In addition, MOF foam can be 3D printed.

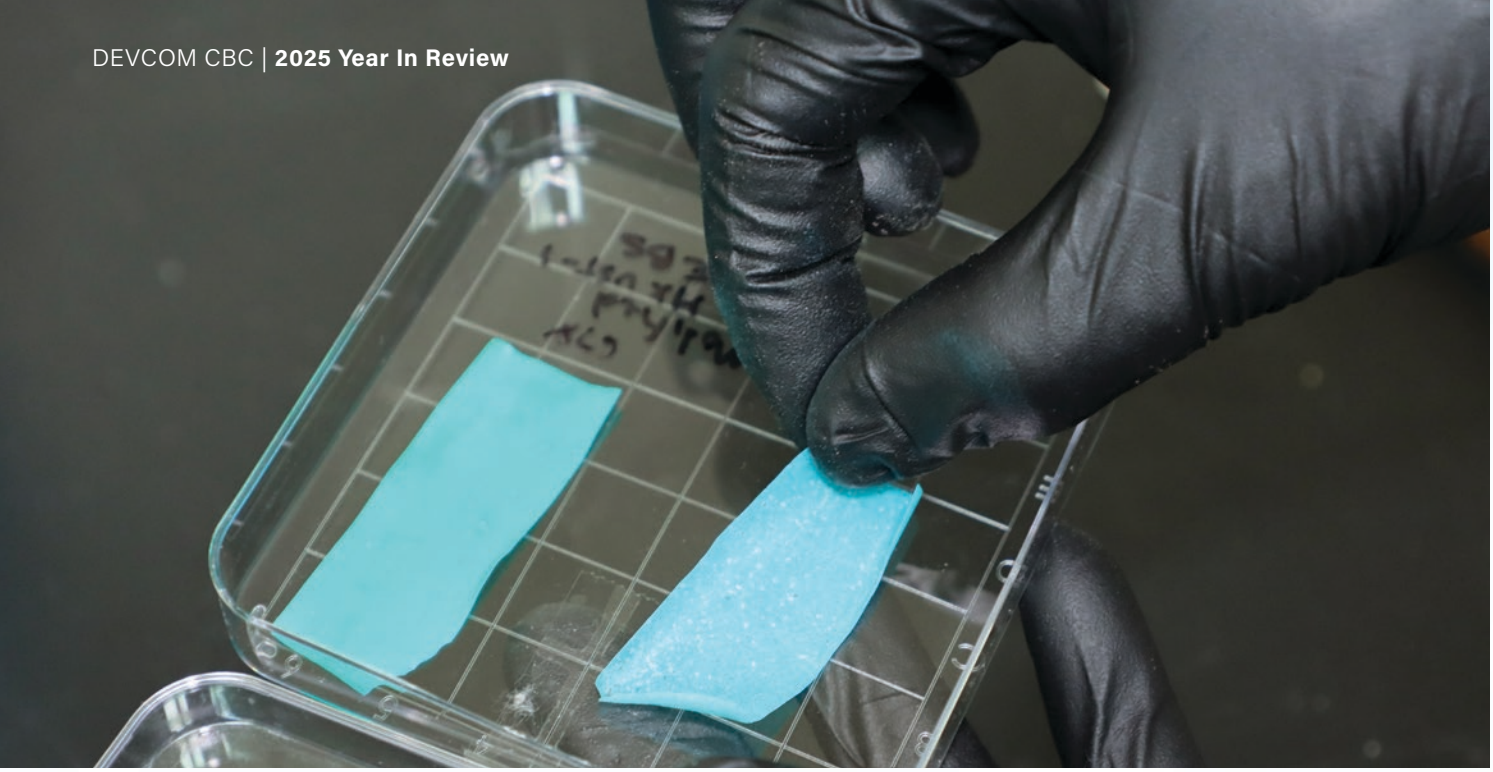
This research has been promising and the team is ready for a seat at the design table for the next generation helmets and uniforms so that their MOF-based nanotechnology solutions can be put to full use.

BREATHABLE FIBERS INSTEAD OF BUTYL RUBBER

Fibers impregnated with MOFs can be used in a scarf for escape purposes, used in decon wipes, and used in curtains to provide collective protection in rooms. MOF-impregnated fibers can even be used in submarines to capture carbon dioxide that accumulates inside submarines on long dives.

MOF fiber spinning has advanced, too. For many years, Peterson and his team were using a method called electrospinning. It uses an electrical charge to turn a liquid polymer solution into many nanofibers that provide an ideal surface to deposit MOFs. They also can be blow-spun using compressed air or melt-spun using heat to melt the polymer. Currently,

| ***Continued on Page 14***



In the form of film, MOFs can be used for everything from masks, gloves and boots.

they are optimizing a technique based on blow-spinning in which they use compressed air instead of a high voltage to turn a liquid polymer solution into nanofibers. They are also working with North Carolina State University's Nonwovens Institute to build a melt spinner that will melt the polymer and then spin into fibers without the use of strong solvents.

FILMS

MOF films are similar to a fiber swatch but rubbery. They are created by dropping a solution of MOF and polymer on a flat surface and flattening the drops out with a blade, much like how a baker covers a cake with frosting. After being flattened, it dries out and can be pulled up for use as a protective material. Uses include anything currently constructed of butyl rubber such as masks, gloves and boots. A valuable feature of MOF film is that, unlike butyl rubber, it is moisture wicking. That relieves the wearer of much of the discomfort that comes with most protective personal protective equipment. Peterson and his team used the SBIR program to have it further developed by small technology companies.

A BRIGHT FUTURE

Still other applications include using MOFs for water harvesting. MOFs pull moisture out of the atmosphere which means that they can be used to create potable water in the desert. MOF-infused material can also be used for agent detection by designing them to change color or fluoresce in the presence of agent. MOFs may even one day be designed to provide drug delivery by having them absorb a medicine then injecting them into the bloodstream for timed release.

Peterson has devoted more than a decade of his professional life to MOF research. Looking back on it, he expressed satisfaction. "It has been very rewarding for me to get MOFs to where they are right now, but there is still work to do," he said. "We have taken these powders that were originally made in milligrams amounts to the ton production scale and put them into various prototypes in filtration, decontamination, and protective suits. We are putting MOFs into new functional forms that could revolutionize how we do chemical biological protection. There are non-military opportunities, too. MOFs are extremely well-suited for water harvesting, water purification and reuse, gas storage, and more."

Lab Gets Nod to Build, Operate Motion Manikin for Chemical Testing

By Parker Martin

Researchers at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) have begun the process of creating a mannikin capable of testing a Soldier's full ensemble against a live agent chemical or biological threat while undergoing physical stress and motion.

The project, known as the Agent Manikin Integrated Ensemble Examination (AMIEE), has received a designation by the Deputy Assistant Secretary of War for Chemical Biological Defense (DASD(CBD)) to be built and housed at DEVCOM CBC at Aberdeen Proving Ground, Maryland. The ability to test the protective ensemble in realistic environments will help ensure protection against chemical and biological threats and supports Soldier lethality.

When complete, the manikin's job will be to test full chemical protective ensembles, including boots, uniform, hood, mask and gloves, against live chemical agents. This approach allows critical insights on vulnerable areas for warfighters in a compromised battlefield, all through the lens of a sensor-laden male manikin. According to Jennifer Hughes, a lab manager at DEVCOM CBC's Engineering Directorate, AMIEE's uniqueness lies in the ability to move rather than be statically tested.

"The test fixture will be comprised of a motorized mannikin that can walk, run, sit and kneel, offering an array of postures or specific activity that could show how a Soldier may be at risk of exposure," said Hughes. "We're looking for how an ensemble performs when interwoven with its individual parts. When running or kneeling in a shooting position, will there be any gaps or weak points that lead to contamination? That's really what we're getting at with AMIEE's testing repeatability and strenuousness."

The project began after more than a decade of collaborative research between DEVCOM CBC and the U.K.'s Defence Science and Technology Laboratory (DSTL). AMIEE comes as an American iteration on DSTL's "Porton Man", the original motion-manikin used for live-agent testing which has demonstrated its benefits by being the first internationally validated chem-bio test capability. U.S. researchers have had long-term assignments in the UK as part of ongoing research with Porton Man and how to transfer its capabilities to an American testing platform.

AMIEE's design is based upon the original UK design alongside lessons learned from previous Porton Man testing, helping to ensure that the capability will meet U.S. warfighter needs. Sharing similar equipment designs offers an opportunity for enhanced collaboration, results comparison, burden sharing and interoperability with allied partners. As the nation's premier laboratory in chemical biological defense, DEVCOM CBC is poised to fully leverage AMIEE's motion-centric style of testing for the next generation of chemical protective equipment for the warfighter.

"Before this, we would have to use simulants to test with volunteers and replicate exercises," said Hughes. "Now, we expect to use live agents in both vapor and liquid forms in order to get more details on protective ensemble integration."

The Center is positioned to add AMIEE's unique capabilities to its already robust suite of testing tools available to its partners in government, industry and academia.

The original UK Porton Man stands ready for testing on its motorized apparatus to evaluate a Soldier's protective ensemble under strenuous activity. The capability, housed at Porton Down, UK, will be matched by its American counterpart "AMIEE" (Agent Manikin Integrated Ensemble Examination) in the coming years.

Researchers Work to Enable Chemical Threat Scanning on the Fly

By Dr. Brian Feeney

U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) researchers are developing a way to scan for chemical biological agent on surfaces on the fly. Literally on the fly as it consists of an AI-enabled spectrometer mounted on an unmanned aerial vehicle (UAV) or unmanned ground vehicle (UGV) sending back vital data in real time. It is called Hyperspectral Threat Anomaly Detection, or HyperThreAD for short.

DEVCOM CBC research chemist Dr. Eric Languirand operates an AI-enabled spectrometer to scan for the presence of chemical threats in powders found on a surface.

A spectrometer is a device that can separate light into individual ranges — much like a prism — and measure them. It does this through band processing, meaning it is calibrated to use a series of distinct wavelengths that bounce off a surface. The returning light is altered in accordance with the ratio of absorption to reflection characteristic of each surface substance it hits. Spectrometers have long been used in mining to locate minerals, in agriculture to identify soil characteristics such as moisture, and even for food safety and infrastructure inspections.

Things change with hyperspectral spectrometry. Rather than a series of distinct wavelengths, hyperspectral sensors cover a wide range of the spectrum with no delineation into categories. The advantage is that you do not have to know what substance you are looking for. Any anomaly encountered will be identified, hence it is called substance agnostic.

For CBRNE applications, that means a hyperspectral spectrometer can find whatever chemical or biological agents, explosives or pharmaceutical based substances that may be present on a surface. This form of presumptive anomaly detection makes it a very useful screening device. If, for example, it is used to scan a suspected clandestine laboratory, it can be used to identify anomalies on tabletops, walls and floors. Only in those areas where anomalies are spotted is it necessary to conduct a further sweep using specialized sensors.

Currently, hyperspectral spectrometers can be mounted on UAVs, UGVs, manned vehicles or are hand-held. However, thus far, the spectrometer has had to be tethered to a laboratory device back on the ground and analyzed in a computer. There, an algorithm uses machine learning and statistical variables form a 3D graph of the scanned area. The graph then functions as a map delineating the most promising areas for further sensing in real time.

A DEVCOM CBC research team plans to greatly enhance real-time hyperspectral anomaly detection by in two ways. First, by condensing the data to be analyzed so results are produced many times faster. Second, by integrating an AI/ML-enabled graphics processing unit (GPU) into the spectrometer. With the supped-up system mounted on a UAV or UGV, it can travel to the interrogation area and perform the computations needed to generate the 3D graph in near real-time. As it is moving it sends data back to command and control – literally creating maps of suspected contamination on the fly.

DEVCOM CBC research chemist Dr. Eric Languirand, who is leading the research effort, explained how his research aims to improve the technology. “For a long time, the disadvantage of hyperspectral spectrometry has been the sheer volume of the data it generates. For example, a sensor may cover 267 wavelengths generating 174,000 pieces of information per sweep.” His research team has developed a method for condensing that data down to 807 pieces of data, or around 1 percent of the original, opening promising new possibilities.

The DEVCOM CBC research team, funded through the Army Explosive Forensic Program, established a Cooperative Research and Development Agreement in 2021 with a Boston-area technology company, Headwall Photonics, that specializes in remote sensing. Together, they plan to further develop the technology and ultimately realize its commercial potential. The goal is to arrive at a system mature enough to place in warfighters hands for field trials.

Army Scientists Use Biotechnology to Identify Toxins in the Field

By Parker Martin / Alexandria Mann

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) has expanded the biological identification capability of one of its handheld biological detectors. Dial-a-Threat (DaT): Antigen provides warfighters in the field the capability to identify various toxins and human health markers on the same device.

DaT: Antigen is an unpowered, credit card-sized device containing materials that, when rehydrated with DNA "instructions," make the components for a toxin identification test onsite. These devices rely on lysates, which are freeze-dried, non-living, but still active components of a cell. These lysates can perform biological processes and are usually pre-embedded in a lateral flow test. With this method, the test can be decided at the point-of-use, which prevents the need to stockpile multiple different tests.

"We take the guts of bacterial cells that perform various biological processes, freeze dry them down and put customized instructions – via DNA – into these assays. The customized instructions then direct the assay to make antibody-like binders, called nanobodies, to identify specific chem-bio threats – in the case of DaT: Antigen, toxins," said Caitlin Sharpes, a senior scientist at the Center.

DaT: Antigen provides the warfighter with customized technology for in-the-field use while decreasing reliance on supply chains and cold-chain storage needed to store these tests. Freeze-drying the components reduces the need for climate-controlled storage and extends shelf life, and warfighters can activate the assay components at any time when encountering a potential threat.

The assay can be reprogrammed by rehydrating the freeze-dried components with a new set of DNA instructions in the field, which means it can test for more than just toxins. A warfighter could use the same "blank" test used to identify a harmful toxin and reprogram it to detect a human health marker, further minimizing supply chain logistics or improving diagnostics in austere settings.

"A critical commercial off-the-shelf (COTS) diagnostic test with a three-week shelf life set by the manufacturer could require continuous resupply if the point-of-need is two weeks away, which could result in waste if the diagnostics aren't used," said Dan Phillips, a CBC research biologist. "By modifying a DaT: Antigen to detect that human health marker, units made at the point-of-need could save the time, cost, and fuel needed to resupply these COTS diagnostics because you could make them at the point-of-need by reprogramming a DaT: Antigen toxin identification device for this purpose."

The team has refined this concept and technology through various operational analysis events and advanced technical demonstrations (ATDs) around the country, which put prototypes into the hands of Soldiers for further direct feedback. ATDs, such as the Defense Threat Reduction Agency's Chemical and Biological Operational Analysis, held at Fort Dix, New Jersey in June, provide DaT: Antigen scientists with the ability to gather direct end-user feedback and incorporate warfighter-centric refinements into prototypes.

Dial-a-Threat (DaT): Antigen is an unpowered, credit card-sized device with a windowpane holding paper tickets called assays that, when encountering a sample, rehydrate and present a reading, operating similarly to a COVID-19 or pregnancy test.

DEVCOM CBC Electrical Engineer, James Severtsen, demonstrates how the modular deployable microsensors (DIMES) are inserted into the carousel attachment on the FLIR Skyraider quad copter. The quad copter can then remotely drop the expendable microsensors to create a larger system of DIMES that work together to alert warfighters of nearby threats.

DEPLOYABLE MICROSENSORS

The Best Chemical Agent Protection is Knowing Where Not to Go

By Dr. Brian Feeney

The best way to keep warfighters safe from chemical agents on the battlefield is to know whether an agent is present before they enter the area. That requires a new kind of sensor, one that can be placed on the battlefield in quantity ahead of time by drones or unmanned ground vehicles to form a meshed network that communicates back to command and control.

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) found a new approach to acquisition to get this entirely novel approach to sensing fielded faster than the traditional acquisition cycle allows. To do this, the technology development team at the Center changed the acquisition paradigm by shaping the requirements to best take advantage of an emerging technology rather than develop technology-agnostic requirements and request bids from vendors.

They were helped by the recent pace of sensor technology advances within academia and in the microelectronics industry. That, coupled with the Army's need for quickly evolving technology capabilities and developments, aided researchers in rapidly prototyping and experimenting with these new sensors. Thus, the Center's Deployable Microsensors System Initiative was launched.

IDENTIFYING THE POSSIBLE

The initial challenge was posed by the Defense Threat Reduction Agency's Joint Science and Technology Office (DTRA JSTO) in 2019: "Was it possible to develop Chemical, Biological, Radiological, and Nuclear (CBRN) sensors that could be smaller and expendable." DEVCOM CBC Senior Research Chemist Dr. Alan Samuels took up the challenge and developed a draft of his Leave In-Place Chemical Sensor (LIPCS) concept. The idea was shared with the chemical biological defense community, including a key member, the Maneuver Support Center of Excellence's Capabilities Development and Integration Directorate (MSCoE CDID) at Fort Leonard Wood, Missouri. They saw the value of the concept for warfighter early warning.

DEVCOM CBC Senior Research Scientist (ST) Dr. Patricia McDaniel arrived at the Center in 2020 from a Navy office that specializes in rapid research and development. She was looking for a technology initiative that would make a real contribution to warfighter protection. She immediately saw the potential of LIPCS but needed a tiger team to take on the challenge of operationalizing the concept.

FINDING RESEARCH PARTNERS

In 2021, using Center investments, McDaniel devised a strategy to begin maturing the concept of an inexpensive, attritable family of sensors operated on battery power and capable of detecting chemical agents before warfighters enter an area. She reached out to DTRA JSTO, the original initiator of LIPCS, and persuaded them to partner with the Center in advancing the effort. She then assembled a research team composed of scientists and engineers from across the Center to tackle the problem using a wide range of technical expertise within a single research center.

The concept needed to be fleshed out before the team could effectively develop prototypes, so the Center assembled an interdisciplinary team of scientists and engineers to conceptualize a minaturized microsensor and identify what was within the "realm of the possible." This interdisciplinary team followed a methodology for innovation the Center created in 2019, called the Warfighter Innovation Leveraging Expertise (WILE-E). In 2022, the WILE-E team began by using the microsensors initiative's problem statements to break the research and development effort into manageable pieces to be addressed over six-month, two-year and 10-year timeframes.

In the fall of 2022, the team turned to another partner, the U.S. Special Operations Command (SOCOM), for help finding technology developers to manufacture the sensor prototype. The Center had worked previously with SOCOM to establish an innovation incubator known as the Accelerator for Innovative Minds (AIM). DEVCOM CBC was able to use AIM as a mechanism for fast-track collaborations with vendors for sensor development.

AIM released a request for technology applications in the form of problem statements to be answered. The problem statements addressed challenge areas in the categories of "Sensor", "Micro" and "Deployable." More than 40 small businesses, laboratories and universities responded to this request. After reviewing the responses in early 2023, the team identified three sensor development companies to work on improving sensor technology and three sensor delivery platform developers to work with the sensor companies to build an integrated delivery vehicle.

An important partner in the WILE-E initiative was Design West Technologies, Inc. (DWT) of Tustin, California. Members of the WILE-E team knew that DWT had developed the novel "DropPuck" system for delivering material and decided that it was a promising platform for experimentation and demonstration with sensors. It can fly over an area and drop hockey puck-shaped sensors onto the ground in a designated pattern. The miniaturized sensors communicate in tandem through a wireless MESH network, enabling the system to communicate in the field by way of their proprietary command and control end user devices. In early 2023, the WILE-E team held a field demonstration at Aberdeen Proving Ground (APG), Maryland, to demonstrate the microsensor concept. The DropPuck system was integrated onto a FLIR Skyraider quadcopter by the Center's Engineering Directorate. Personnel from the U.S. Army Maneuver Support Center of Excellence Capability Development Integration Directorate (MSCoE CDID) attended the event and provided practical feedback from the warfighter's point of view.

In March 2023, DEVCOM CBC, again in partnership with DWT, executed a field experiment at Army Expeditionary Warrior Experiment (AEWE) 2023, an event that the MSCoE CDID hosts annually to test tactical concepts and capabilities in support of multi-domain operations. The event was attended by a broad range of warfighters and yielded valuable end user and expert assessor feedback on the concept's current strengths and on areas in need of further development.

BRINGING THE PIECES TOGETHER

To carry out field expeditionary experiments with Soldiers and rapidly adapt the system to address their feedback, DEVCOM CBC's Engineering Directorate designed and fabricated a modular microsensor demonstration prototype called the Deployable Integrated Microsensor Evaluation System, or DIMES for short. It is a series of playing card sized packages each one housing a commercial volatile organic compound sensing element, communications chip and power source. These sensing elements are a placeholder for future chemical agent-specific sensing

The unmanned ground vehicle (UGV), Spot the Yellow Dog, carries the carousel designed to contain deployable sensors. The carousel attachment is compatible with multiple remotely-operated delivery vehicles.

| *Continued on Page 20*

The modular deployable microsensor (DIMES) has gone through many iterations. The design shifted from being cylindrical (as shown on the right) to rectangular (as shown on the left) to maximize space efficiency and increase the surface area of the printed circuit board.

technologies under development by the joint DEVCOM CBC-JSTO effort. These individual DIMES are then placed inside a circular dispenser called the Carousel, so-called because it resembles an old-fashioned slide carousel. The Engineering Directorate designed the carousel to be integrated with either a quadruped robotic system, called Spot, that the technology developer, Boston Dynamics, designed, or on an aerial platform such as the FLIR Skyraider using a standardized DEVCOM CBC-developed interface.

The Deployable Microsensor Initiative initially focused on the technical advances of chemical sensors. However, before the team could take advantage of the low size, decreased weight, and reduced power (SWaP) needs of a new generation of sensors, they had to solve the problem of inconsistent methodologies for evaluating sensor performance. That meant they had to continuously scan sensor development progress across academic, government, and industry laboratories to find the best candidates to assess for feasibility. It also required them to develop standardized methodology that consistently assessed a variety of sensor technologies as the sensors continued to be improved. The team drew upon expertise within the Center to develop sensor evaluation protocols to assess and then compare sensor results and development progress.

But that was just the first part of what quickly became a multi-tiered effort. The team not only had to find the best way to identify and validate high quality, low-SWaP sensor technologies; once the sensors were distributed and engaged in detection, they had to be able to send the detection data through a battlefield communications network so warfighters on the ground and their commanders would be alerted to threats in near real-time.

The DEVCOM CBC Engineering Directorate had the capability to rapidly construct advanced microsensor demonstrator prototypes and integrate them with a variety of delivery vehicles and communication networks. That way, the team could quickly see the strengths and weaknesses of each using warfighter feedback.

Meanwhile, MSCoE CDID took lessons learned from the demonstrations and experiments to draft an Army Capability Development Document (CDD) that specifies the operational benefit that the technology provides. The CDD progressed from MSCoE CDID through Future Capabilities Command to Army Futures Command, where the validated concept was submitted to the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASAALT). In August 2023, ASAALT sent the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense a letter designating it as the Office of Primary Responsibility for the maturation and acquisition of this technology. This designation moved the Deployable Microsensor System further down the acquisition cycle to becoming a recognized Program of Record.

FIELD PERFORMANCE

By April 2024 the pace of the Microsensors program quickened further. The concept demonstrator was put through its paces in a series of field exercises starting with DTRA JSTO's Rio Robotico, a venue that allows technology developers an opportunity to operate autonomous vehicles outdoors in a variety of scenarios. At this event, prototype sensor systems were distributed in a variety of terrains in the West Texas desert, where sensor range, data throughput and overall communication was assessed.

"We were able to demonstrate a technology that keeps the warfighter

AWAY FROM THE THREAT

altogether using a system that does not further burden them..."

Dr. Alan Samuels
DEVCOM CBC Senior Research Chemist

The next stop was DTRA JSTO's Tenacious Dragon 2 (TD2) experimentation at Joint Base San Antonio-Camp Bullis, Texas, in July 2024. DIMES showcased its integrated early warning capability during the event. Participating warfighters concluded that DIMES proved itself as a leap forward in remote and wide area early warning capability.

TD2 was followed by Beholder's Gaze in fall 2024. This event addresses integrated early warning capability needs in the U.S. Indo-Pacific Command, and the Deployable Microsensors System proved the value of an integrated system of systems for remote monitoring.

The next big test was Project Convergence Capstone 5, the U.S. Army's marquee technology modernization demonstration event, held at the National Training Center at Fort Irwin, California in March 2025. The system demonstrated its applicability to two of that year's major themes: Data-Driven Decision Making and Expanded Maneuver.

CONCLUSION

The conventional Joint Capability Integration Development System approach to defining and validating requirements simply cannot keep pace with the rapidly changing technology landscape and dynamically evolving threats. A better approach is to design experiments to address prioritized capability gaps using the best available technology solution with the warfighters in their operational setting. This drives the refinement of the technical solutions, and the acquisition process adapts through agile development.

Samuels is very pleased with the results of the Microsensors program. "We showed the acquisition community that a new paradigm for getting an advanced technology into the hands of warfighters far faster is possible," he said. "We were able to demonstrate a technology that keeps the warfighter away from the threat altogether using a system that does not further burden them with more stuff to carry or more operational responsibility."

McDaniel agreed. "We proved the advantage of a new paradigm where requirements are informed by the science and technology communities using experimentation prior to finalizing the capability documents," she said. "This has been a cross-government effort involving several organizations, government agencies and private industry, coming together to make rapid development and fielding of a breakthrough concept happen. It was truly a team effort."

Next steps for the team are to identify the best-of-breed sensing elements and decision analytics for the microsensor and quantify its detection confidence. The team will also continue to investigate and improve the wireless MESH networking architecture and refine and improve the deployment system. Finally, they will work on discovering new concepts for how best to employ this technology.

Army Collaborates to Enhance Biomanufacturing Skills in DoW

By Dr. Brian Feeney

When the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) expanded the size and capabilities of its biomanufacturing hub at its Aberdeen Proving Ground, Maryland, research campus, they realized that in order to get the most out of the expanded facility it was necessary to provide opportunities to educate their partners and stakeholders on biomanufacturing techniques and capabilities. A key partner chosen to achieve this was the Advanced Biofuels and Bioproducts Process Development Unit (ABPDU) based at Lawrence Berkeley National Laboratory.

The ABPDU's mission is to speed up the commercialization of advanced, next-generation biofuels, biochemicals and other bioproducts. Together, ABPDU and the Center developed a training program to share its knowledge of biomanufacturing with researchers across the Department of War (DoW).

This upskilling, collaboration-building process is aimed at ultimately benefiting the warfighters by securing the supply chain they depend on. "The products we're targeting through biomanufacturing ultimately help to secure the domestic supply chain and thus ensure we're able to support warfighter readiness. DoW's biomanufacturing priorities have been identified with warfighter's needs in mind, both domestically and abroad," said Dr. Jessica Tague, one of two DEVCOM CBC research biologists spearheading the program.

In October 2023, Tague and DEVCOM CBC research biologist Dr. Nathan McDonald, traveled to the ABPDU in Emeryville, California, to help shape a curriculum of both virtual and in-person classroom components covering such biomanufacturing topics as technology transfer, technoeconomic analysis, downstream processing, bioprocess optimization, and fermentation scale-up. Perhaps the most important part of the curriculum, according to Tague and McDonald, was developing a common language for biomanufacturing that could be used across the Army, Navy and Air Force to effectively communicate in this highly specialized field.

"Each of the DoW services has its own skill set. We developed the course to make sure that scientists and engineers across the tri-services have the same understanding of biomanufacturing equipment capabilities," said McDonald. "We also wanted to teach participants how to transition from microbes produced in very small quantities at the research level to 1,000+ liter biomass batches for industry to use at commercial scale." The biomanufacturing course that resulted from Tague and McDonald's effort was, in essence, a full semester course on bioprocessing, currently taught at the University of California at Berkeley, condensed to two weeks and tailored to support the DoW's needs.

The ultimate goal of this collaborative effort is to create a community of biomanufacturing researchers across the tri-services that encourages active research collaboration and sharing of lessons learned. As Tague put it, "If you take this course, you will understand how to effectively communicate with customers and collaborators about biomanufacturing and appreciate the importance of optimizing bioprocesses."

DEVCOM CBC research biologists Dr. Nathan McDonald and Dr. Jessica Tague used their biomanufacturing expertise developed in the DEVCOM CBC Biomanufacturing Pilot Facility at Aberdeen Proving Ground, Maryland, to enrich a course for scientists engaged in biomanufacturing across the entire DoW.

Creating this course was unlike anything Tague and McDonald had ever done before. "Designing this course has much more impact than producing a report or written deliverable for a customer," said McDonald. "This program will improve biomanufacturing across the tri-services. In fact, attendees who took the virtual course kept saying, 'I never knew much about the topics we're covering, now I really want to take the in-person part of this program.'" The first training was completed in fall 2024 with more than 60 DoW participants. In 2025, the Bioprocess Upskilling Program offered an additional round of virtual and in-person training opportunities. With each new round of courses, comes an expansion in the number of DoW scientists and engineers with a high-level knowledge of biomanufacturing and bioprocess optimization.

Tuan Nguyen, DEVCOM CBC Electrical Engineer, provides hands on familiarization on the M26 Joint Service Transportable Decontaminating System, Small Scale, with Soldiers during an EAU assessment.

Equipment Assessment Unit Boosts Soldier Readiness

By James W. Campbell

A team of experts from the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) are working to ensure that Soldiers are prepared to defend against chemical and biological threats. They are doing this by supporting the fielded equipment used for detection, protection, and decontamination in contested environments.

"We essentially assist Army units in improving overall readiness of Chemical, Biological, Radiological, and Nuclear (CBRN) defense equipment," said Kyle Phillips, team lead of the Equipment Assessment Unit. "Our main goal is to ensure serviceability and maintainability throughout long-term storage or field use."

The services provided by the Equipment Assessment Unit include hands-on familiarization for preventive maintenance checks and services, as well as field-level maintenance. The team also conducts current condition analysis of on-hand equipment and provides units with updated contact information for equipment-related issues and recommendations.

> *"Every opportunity for interaction provides*
> **CRUCIAL INSIGHT"**
>
> **Dr. James Watson**
> *Director of Engineering*

"Our team of engineers and technicians at the Chemical Biological Center prioritize soldier touchpoints – every opportunity for interaction provides crucial insight," said Director of Engineering Dr. James Watson. "The Equipment Assessment Unit team is dedicated to adapting its support to each unit's specific requirements, ensuring Soldiers are proficient with CBRN equipment, and channeling valuable feedback directly to our developers for continuous improvement."

Although encountering CBRN threats during a deployment isn't common, Phillips noted that Soldiers prioritize their CBRN equipment readiness just as they do for their weapon systems and other vital equipment.

"The goal of our program is to enhance Soldiers' knowledge of the specialized equipment they depend on to accomplish the mission," Phillips said. "We add context and our experience to what's in their manuals. We prioritize answering their questions and going through maintenance tasks with them."

The long list of equipment the team's experts can assist with ranges from the M26 Joint Service Transportable Decontamination System to the M20A1 Simplified Collection Protection Equipment and reaches all the way down to the individual Soldier's Field Protective Masks.

"The best thing about this work is directly helping the units increase confidence in their equipment," Phillips said. "We prioritize equipment readiness, and that gives us a strong sense of responsibility."

ExLab Provides Forward Deployed Prototyping Capability

By Parker Martin

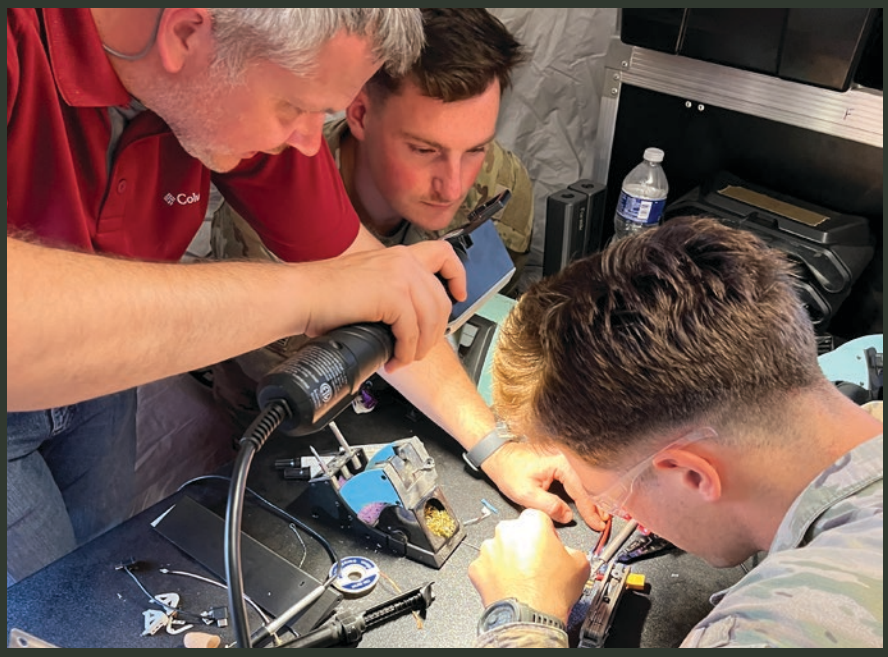
Austere, remote operational environments call for adaptability and agility from Soldiers and their equipment alike. When conditions worsen or circumstances flip the script of their mission, warfighters must remain ready and lethal—a requirement that often depends upon their kit and supply lines. To help maintain Soldier readiness, the U.S. Army Combat Capabilities Development Command is spearheading an effort to expand and enhance the Army and Joint Services' advanced manufacturing capabilities in the Indo-Pacific region by utilizing their fleet of Prototyping Integration Facilities (PIFs).

DEVCOM's Chemical Biological Center's (CBC) mobile engineering and advanced manufacturing platform, the Expeditionary Lab (ExLab), is essentially a Swiss Army knife when it comes to repair, modification and innovation while in the vicinity of battle.

The transportable 20-foot climate-controlled, standard CONEX (shipping) container houses a fully-fledged machine shop containing everything a Soldier might need for the future fight: computer aided design and manufacturing software, a computer numerical control mill, a polymer 3D printer, an air compressor, a handheld 3D scanner, welding equipment, a plasma cutter, a slew of hand and power tools, a sewing machine for soft goods and textiles as well as electronics equipment to enable warfighters to conduct equipment troubleshooting, build cables and conduct basic soldering. According to DEVCOM CBC Mechanical Engineer Kevin Wallace, the ambidextrousness of ExLab allows it to be utilized by any Soldier for any need.

"It has everything," said Wallace. "Just as critical as the equipment, the ExLab is currently supported by DEVCOM's engineers and technicians, overlaying their subject matter expertise with the warfighters' tactical knowledge and skill sets."

ExLab enables warfighters to invent and iterate on what they need. This capability's adaptability shows just how flexible Soldiers can be when it comes to resupply and sustained presence on the battlefield while remaining timely and robust through this streamlined system.



A C5ISR engineer instructs Soldier from the 25th Infantry Division Lightning Labs how to solder components on an unmanned aerial vehicle at a JPMRC exercise in Hawaii.

ExLab's tool carts roll out from the main 20-foot container to expand as an outdoor design and build space, allowing personnel to operate at night and in humid climates.

The ExLabs were deployed to Afghanistan from 2012 through 2020 in support of Operation Enduring Freedom and Operation Freedom's Sentinel under the U.S. Army's Rapid Equipping Force (REF). DEVCOM CBC managed the ExLabs with REF for six years. After the REF was discontinued, the ExLab effort transitioned to DEVCOM CBC's oversight. Today, alongside DEVCOM Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance

ExLab deploys its outdoor space to support the 25th Infantry Division during the Joint Pacific Multinational Readiness Center's training exercise in Hawaii in October 2024. ExLab's tool carts allow operators to expand to an outdoor design and build space.

and Reconnaissance (C5ISR), the Center presides over the PIF Council where a handful of other DEVCOM centers participate with PIFs of their own to utilize for their own specific problem sets that, ultimately, better equip and prepare our warfighters.

To add to the already inter-agency nature of ExLab, PIFs are customer-reimbursable R&D entities designed to collaborate with other organizations, benefiting customers without prototyping expertise to either provide urgent solutions or general experimentation.

"[DEVCOM CBC] recently deployed the only remaining functional ExLab to support the 25th Infantry Division in Hawaii," said Angel Cruz, lead mechanical engineer at DEVCOM CBC and former ExLab project manager. "While ExLab support was previously only available to the U.S. Army, we have gotten away from that restriction. The ExLab capability is now available for Joint Force partners to accelerate schedules and technologies– one team, one fight."

Fitting this into an operational context, the teams at DEVCOM CBC and DEVCOM C5ISR have been improving their own logistics flow with a new methodology called the "Hub & Spoke" method. By operating in logistically complex environments such as the Indo-Pacific, operators are able to conduct remote missions away from the mainland (hub) by relying on their nearby PIF (spoke) for steady resupply and redundancy.

"It's designed to put equipment in the right places while shortening response time and transit," said Tom Brutofsky, chief of DEVCOM C5ISR's Ground Integration & Engineering Division. "By placing our far-forward PIFs in more distant locations, our 'hubs' continue to act as just that, a hub for resupply that provides reachback support for our forward 'spokes.' For areas such as Hawaii and the rest of INDOPACOM, this greatly reduces infrastructure requirements and shipping costs."

DEVCOM CBC has been ensuring proper practice and testing for ExLab's performance within the INDOPACOM arena. The climate and remote operability make Hawaii one of the more critical places to determine if the ExLab can perform when called upon. With exercises like October's Beholder's Gaze held at Marine Corps Training Area Bellows, Oahu, Hawaii, researchers were able to identify just how effective it is to springboard ExLab into an operational location.

With more upcoming Advanced Technology Demonstrations (ATDs) on the horizon, DEVCOM's PIFs are working on more ways to improve and iterate on themselves. Taking Soldier feedback into consideration, researchers are ensuring that ExLab's future coincides to warfighters' criteria. By bolstering more software capabilities, ExLab has the chance to make itself a one-stop-shop for more than just tactile materiel.

"We talk a lot about repairing and building physical widgets but the world, our equipment, and the fight has also moved to electronics and software," said Cruz. "The ExLab should have a software component as well, giving Soldiers the ability to code."

"We're making efforts for cloud-based repositories of data that can be interwoven between all members of the Joint Force," added Wallace.

Looking ahead, the team plans on continuing their iteration process to help determine what the near future ExLab "spoke" configuration should be as a system. History and present times have shown the need for this capability and ever-evolving method of ensuring Soldiers stay equipped and lethal in the future fight.

The Compact Rapid Chemical Agent Neutralization System (CRaCANS) is a highly portable chemical agent destruction system designed by the U.S. Army Combat Capabilities Development Command Chemical Biological Center to fit inside military aircraft, on a small flatbed truck or suspended from a helicopter.

Miniature but Mighty

By Dr. Brian Feeney

When chemical agents are found in the field, either as legacy waste from prior conflicts or recently produced by bad actors, there are advantages to destroying them at or near the place of discovery rather than packing them up and transporting them to a brick-and-mortar destruction facility. The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) has been steadily miniaturizing destruction technology to make that increasingly possible.

According to DEVCOM CBC's Field Response Team Operations Director, Timothy Blades, chemical agents found in the field present unique challenges to warfighters and commanders. "Because of the risk of transport and mission timelines, it's almost always better to destroy these items on site," Blades said. "Part of our mission at DEVCOM CBC is to identify and develop technologies that make that possible."

A BIG START IN MINIATURIZATION MAKES HISTORY

DEVCOM CBC's effort began in 2012 when the U.S. Defense Threat Reduction Agency (DTRA) and National Security Staff approached DEVCOM CBC's field response team, the Chemical Biological Application and Risk Reduction (CBARR) business unit, with an urgent need to destroy Syria's chemical warfare agent stockpile. The national team was considering incineration of the stockpile in or near Syria as a possible solution. Based on decades of experience, Blades told them that destruction using hot water, a method known as neutralization, would be a much better solution. An incinerator would take too long to build, require too many people to operate and involve too large a logistics train.

Until then, neutralization had only been used to destroy the U.S. chemical agent stockpile in the early 2000s in large factory buildings covering acres of land. Blades and his team got to work and came up with a modularized system called the field deployable hydrolysis system (FDHS) that could be disassembled and fitted into standard shipping containers. It was designed for ease of maintenance and came with a portable laboratory for testing batches to ensure complete agent destruction. The rest is history. The FDHS was placed inside a Maritime Administration Ready Reserve Fleet roll-on/roll-off ship and was used to destroy 600 metric tons of mustard agent and 130 metric tons of sarin precursor chemicals in the international waters of the Mediterranean Sea in just 42 days.

MAKING IT SMALLER IS BETTER

While that was a great triumph receiving world recognition, it was only a start. The scientists and engineers at DEVCOM CBC were intent on further miniaturizing chemical agent destruction technology so that it could be used by CBARR operators and warfighters alike to destroy caches of agent encountered in austere environments around the globe. They began this effort by shrinking the FDHS, which filled several 8-by-20-foot shipping containers for transport and took up over a 20,000 square foot area once assembled.

DEVCOM CBC further miniaturized the FDHS with a system called the Compact Rapid Chemical Agent Neutralization System, or CRaCANS, for short. Its dimensions are 88 inches by 108 inches by 80 inches and it fits on a standard NATO military aircraft shipping pallet. It can also be placed on a small flatbed truck or suspended from a helicopter. It can destroy two tons of bulk agent or agent from more than 48 projectiles and mortars in 24 hours when paired with an access system. It contains its own generator, compressor, heaters and waste storage. As a result, the CRaCANS only requires reagent plus diesel fuel to run.

A transportable laboratory that accompanies it confirms greater than 99.9% destruction as required by the Organisation for the Prohibition of Chemical Weapons (OPCW) and greater than 99.99% destruction required by the U.S. Environmental Protection Agency for each batch of agent. The process renders the agent a conventional industrial waste that

A DEVCOM CBC operator attaches the Viper to the side of a munition in order to remotely drill and drain the container.

is stored in bulk containers for disposal at a commercial hazardous waste disposal facility.

CRaCANS development is funded by DTRA and DEVCOM CBC and has already proven its effectiveness with agent simulant testing. It is currently undergoing live agent testing and DEVCOM CBC plans to field it for CBARR, making it available to operate in austere environments in 2025. It could be available to warfighters as early as 2026.

CRaCANS opens entirely new field response capabilities according to Michael Marinelli, DEVCOM CBC environmental scientist and CBARR project manager. "Once the CRaCANS is ready to deploy with us in the field, we will be able to quickly go to locations around the world where chemical agents are found, arrive with all the equipment we need, set it up within hours, and within days have the threat eliminated and be gone."

STILL GOING SMALLER

All too regularly, a chemical munition will be unearthed during construction at a current or former military site, or warfighters will encounter one while forward deployed. There needs to be a simpler, less expensive way to deal with these situations than having to ship and set up the CRaCANS in a location that may be on the other side of the country or the other side of the world. That capability, now under development, is called Blackdog. It has two components. The first is a mechanism called Viper, which drills into the munition and drains out the chemical agent for neutralization. The second is the Polycat system, which neutralizes the drained agent in a bag. Each system can fit inside a single backpack and can be man-carried to the discovered munition.

The Viper consists of a mechanical drill with a vacuum-attached self-sealing probe that punctures the munition and enters the chamber containing the agent. The drill is controlled by a sophisticated mechanical control unit (MCU) which is wirelessly attached to a display tablet and a camera to allow for the process to be conducted by field operators at a safe distance. The MCU monitors the depth of the drill and operates the drill through a cable link. Once inside the munition it draws a sample of the liquid for testing through a small pipe attached to the probe. If the sample tests positive as a chemical agent, it is time to pull the Polycat system out of its backpack.

While still under development, Polycat will be combined with the Viper, which is already used in the field, to form the combined Blackdog chemical agent destruction system. The hose used for sampling the munition will be attached to a 15 kilogram "kill bag" containing an absorbent powder that neutralizes the agent. The bag can neutralize up to six kilograms of agent. Alternatively, responders can use a 14.5 kilogram "kill drum" that also neutralizes up to six kilograms of agent. Complete neutralization takes seven days, although most of the agent is neutralized in the first hour, making it safe for warfighters or a field response team to place the container in the back of a truck.

Working in tandem, Viper and Polycat give warfighters and field response teams the ability to carry the system to a remote location in the back of a vehicle or on their backs, set it up in minutes, sample the contents of the munition and, if positive, have the agent in a bag or barrel being neutralized in an hour, then move on.

Blackdog is the result of a joint industry call from the U.K. Ministry of Defence and the U.S. Department of War in 2018. With most of the world's stockpiles of chemical agents eliminated under the Chemical Weapons Convention, they focused on the need to respond to small caches of chemical agent found in munitions or in illicit laboratories and production facilities. The U.K. companies, Polycat, Ltd. and Valent

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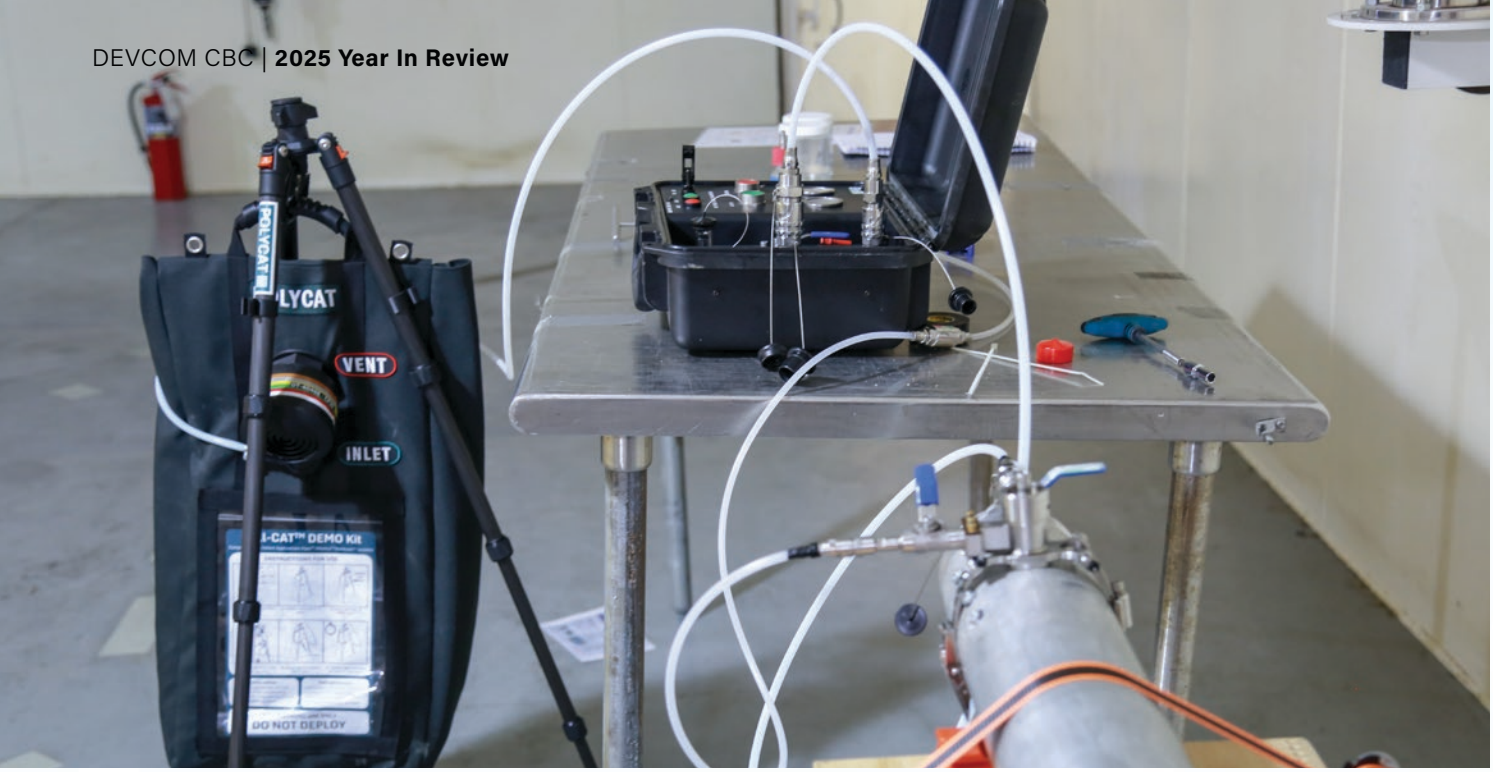


The Viper, when connected to the Polycat system, functions as the Blackdog chemcial agent destruction system, allowing DEVCOM CBC operators to remotely drill into the side of a munition with the Viper and drain its contents into the Polycat bag for neutralization.

Applications Ltd., were selected to collaborate on a solution. They teamed up with DEVCOM CBC to take advantage of the center's 100+ years of chemical agent experience and live agent testing facilities.

In July, DEVCOM CBC scientists concluded a successful initial round of bench scale testing with live agent at the milligram level. Polycat, Ltd. and DEVCOM CBC plan to soon scale up to testing in three-liter quantities to further prove the concept.

For DEVCOM CBC lead project manager Laura Graham, this is an exciting development project. "Nothing in this niche exists and it will be a valuable new tool for our field response teams," she said. "The spirit of collaboration with the Polycat and Valent teams has been terrific, and we are all very excited about it."

HOW NEUTRALIZATION WORKS

Neutralization is a method of chemical agent destruction that uses water to break apart the chemical agent molecules. Agitating a mix of water and agent alone is often enough to destroy the agent because of the kinetic energy generated by the baffles in the system. The destruction byproduct the process produces is highly acidic. Typically, a second reagent is added, commonly sodium hydroxide, to reduce the acidity. That makes the byproduct less corrosive to the pipes and valves in the destruction system and makes it more suitable for disposal as a conventional hazardous waste.

The tricky part is coming up with the right quantities of water, agent and second reagent in the recipe. DEVCOM CBC has more than 100 years of experience with chemical agents and is a recognized world authority on how to achieve optimum destruction.

Marinelli compares it to finding the best recipe for baking a cake. "You have to look at the batch size you want, the temperature and the amount of agitation you want to maintain in the reaction vessel, plus the optimum time to agitate each batch. On top of that, you have to consider the ratio of agent and reagents for each batch."

The recipe varies by chemical agent. For example, the VX nerve agent destroyed at the U.S. Army Chemical Materials Agency's Newport, Indiana, stockpile site in the early 2000s used 20% sodium hydroxide at 90 degrees and a two-hour period of agitation to achieve destruction. Other U.S. stockpile destruction facilities made minor variations to best meet the characteristics of the chemical agents in each stockpile.

AND SMALLER YET

Still smaller is the thermite bag system. It can fit into a single pelican case and weighs 85 pounds. The concept behind it is simple; place a chemical munition found in the field inside a double bag with thermite grenades, fire them and the thermal reaction destroys the agent in the munition. DEVCOM CBC is performing advanced development and testing on the prototype originally developed by Southwest Research Institute, a non-profit research and development organization in San Antonio, Texas.

The double bag arrangement safely contains the temperature and expanding gases because the outer bag is reinforced with aluminum sheeting similar to a fire suit. The heat and pressure of the detonation decomposes the molecular structure of the agent leaving inert remains that can be disposed of at a commercial disposal facility.

DEVCOM CBC operators use the thermite bag to access and thermally destroy chemical agents.

Once fielded, the thermite bag system will provide commanders in the field with a simple and effective option for field destruction of individual chemical munitions and small chemical agent caches with a minimal logistics burden. After destruction, the intact bags can be placed in a container and then into the back of a vehicle for disposal. The threat is disabled and the unit can keep moving.

DEVCOM CBC began advanced development in 2023, and it is currently at the testing stage. The development team is ensuring that the thermite bag can fully contain the thermal reaction. The next steps are to test the effectiveness of agent destruction starting with simulants and ultimately live agent in a specially designed DEVCOM CBC testing chamber. The development team hopes to see it available for use by warfighters in 2026. The project is being funded by the Office of the Deputy Assistant Secretary of War for Threat Reduction and Arms Control.

DEVCOM CBC's program manager for the system, Janson Stoltzfus, sees this as a big benefit to the warfighter. "A thermite bag reduces the logistical burden on Soldiers when compared with current destruction methods. It is much lighter, more compact and easier to deploy. It will be a powerful tool in the commander's suite of chemical agent defeat capabilities."

CONCLUSION

The greatest success of the Chemical Weapons Convention (CWC) of 1993, signed by 193 nations, is that it led to the destruction of the world's large stockpiles by those signatory nations. They were destroyed under the direction of the OPCW, which was created by the CWC. It performed regular inspections during destruction and confirmed final destruction. What the world faces now is the illicit production of chemical agent by rogue nations and non-state actors.

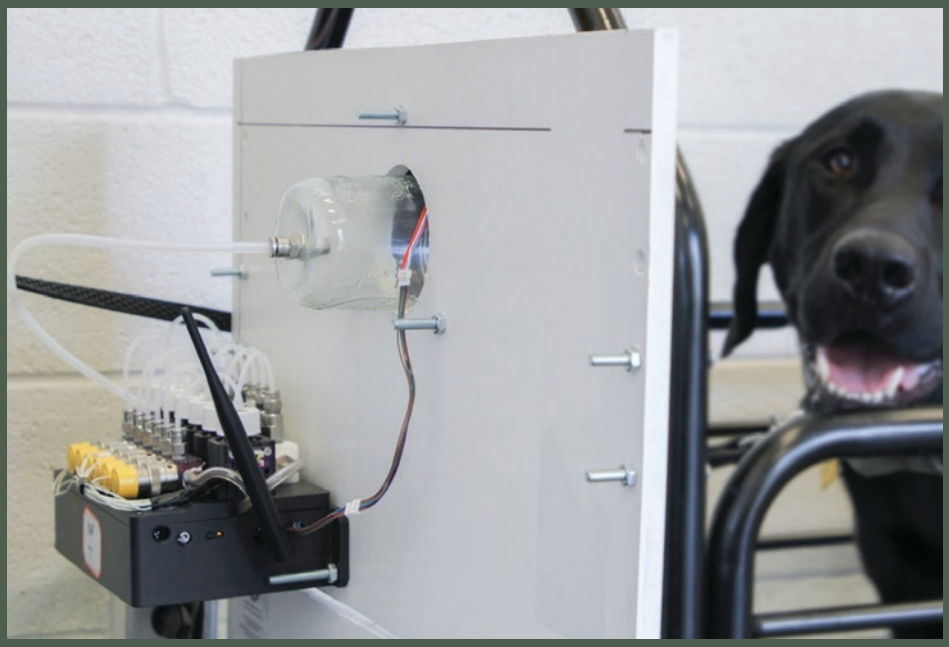
DEVCOM CBC is addressing the new threat by making agent destruction technology smaller and thereby easier to transport, set up, operate and remove. By replacing the large brick and mortar destruction facilities of the 1990s and early 2000s with highly portable destruction systems, field response teams such as CBARR can, in effect, make house calls. Some of those house calls are to harsh and barren locations where providing the logistics for a larger system would be impossible.

The scientists and engineers of DEVCOM CBC who are advancing and operating this technology are proud of the contribution they are making to the world. DEVCOM CBC Director Michael Bailey shares in that pride. "The men and women who design, construct and operate these miniature agent destruction systems are making the world a safer place and demonstrating that the United States is a force for good in the world."

Understanding the Science Behind a Canine's Sense of Smell

By Parker Martin

A dog's sense of smell could be considered one of nature's superpowers. This superpower, known to scientists as "canine olfaction," has long been relied upon by the military and law enforcement for detection of hazardous materials, such as explosives and narcotics. However, canine olfaction is an under-explored area of research – one that scientists at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) hope to gain a better understanding through a project called IronDog.



The olfactometer delivers precise amounts of odor at specific times to measure Ember's detection accuracy while she exercises on the treadmill.

Initiated in 2023, IronDog provides new methods for researching and understanding the science behind this superpower – specifically how physical activity may impact a dog's ability to detect odors. For example, vehicle searches at entry-control points are physically demanding for military working dogs, requiring them to simultaneously run, search, sniff and pant. Eventually, the dog will get tired and its ability to detect a threat will decrease, leaving its handler with a sensor (the dog) that appears to be fully functioning when, in reality, it's not.

To better understand the impact of physical activity on a dog's sense of smell, IronDog leverages a computer-controlled odor delivery device called an olfactometer attached to a treadmill to test a dog's olfactory performance while walking or trotting. Developed by project partner Texas Tech University, the olfactometer delivers precise amounts of odor at specific times to measure the dog's detection accuracy while it exercises on the treadmill. This allows DEVCOM CBC researchers to control the level of exertion while simultaneously testing a dog's ability to detect a specific odor.

Other project partners include the U.S. Army Veterinary Corps, University at Albany, Southern Illinois University, Texas A&M University and Tier Wohl Team, an independent international partner with expertise in artificial intelligence. All offer technology, expertise or insight to perform the research or apply lessons learned from related projects.

According to Dr. Aleksandr Miklos, chief of DEVCOM CBC's Applied Synthetic Biology and Olfaction Branch, the IronDog project is an extensive effort that brings together the best teams, minds and technologies in canine olfaction research.

"We have an array of technologies from multiple partners that we believe are the best for the job," says Miklos. "This project demonstrates our collaborative capabilities and expertise in solving a unique problem. Our collaborators have been instrumental in enabling this research to be performed now. Ten years ago, these capabilities didn't exist. It's come a long way."

Thanks to IronDog, the Army now has a testing method for assessing a military working dog's effectiveness under exertion. Having this information could be critical for handlers to recognize when their dogs should rest or how to best use them in operational environments.

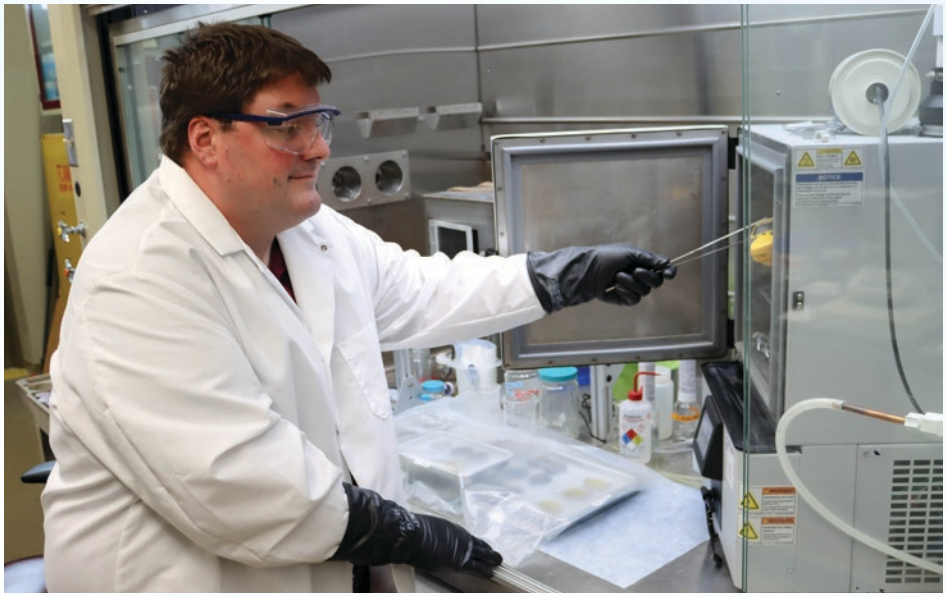
"We can now use this as a platform for testing a myriad of other things," says scientist Dr. Michele Maughan. "We can test effects of canine equipment like harnesses and helmets on the dog's body temperature and detection performance. Using computer-assisted vision, we can classify a dog's gait and identify imperceptible abnormalities before they become an injury."

IronDog is funded through the U.S. Army Chemical Biological Advanced Materials and Manufacturing Science (CBAMMS) program, established by the Department of the Army to promote basic research related to the priorities and challenges of the service's modernization strategy.

With one more year of funding, members of the IronDog team hope to continue advancing the research and awareness of the project. One way they plan to do this is through participating in technology demonstrations, providing industry, academia and government the opportunity to observe the work being done as well as potentially spur further collaboration.

More data combined with technology demonstrations will continue to improve the project's foundation, all while exploring possibilities for more use cases and expanding the capability.

"The more dogs that participate, the better our predictive analytics become," says Maughan. "This data and information will help our military working dogs and their handlers maintain mission readiness to increase Soldier survivability."



Joe Myers, a supervisory chemist and acting branch chief for decontamination sciences, removes a hand radio from a Chemical Hot Air Decontamination (CHAD) unit. Using CHAD instead of more traditional decontamination methods allows sensitive equipment to be decontaminated without altering the device.

Heat-Based Decontamination Project Transitions to Program of Record

By Alexandria Mann

Researchers at the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) have successfully transitioned a heat-based decontamination project to a Program of Record, marking the next step in getting contaminated sensitive equipment back into warfighter hands faster.

The Chemical Hot Air Decontamination (CHAD) project has transitioned to a Program of Record with the Joint Project Manager for Protection within the Capability Program Executive Chemical, Biological, Radiological, and Nuclear Defense (CPE CBRND), who will move it through the acquisition process.

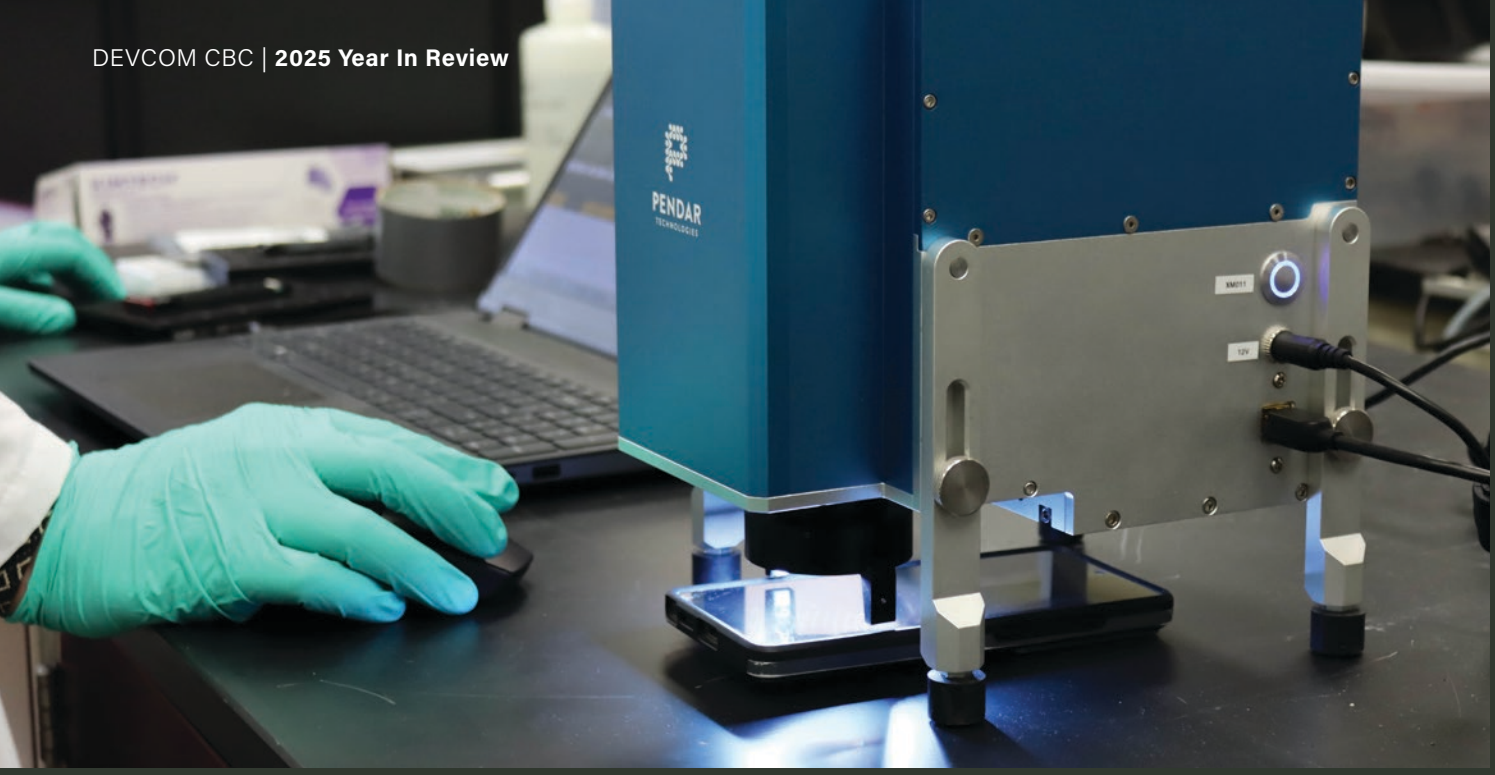
Decontamination is an essential capability if Soldiers and their equipment are exposed to a chemical agent in the field. Traditionally, soap and water, bleach, or sodium hydroxide would be used for equipment decontamination. While this process works, it is not suitable for sensitive equipment, like computers and sensors. The other issue traditional decontamination methods pose is that they can alter the materials being decontaminated. CHAD presents an alternative method for decontamination that is suitable for sensitive equipment materials and can quickly decontaminate items, getting equipment back into warfighter's hands faster.

"The idea is to use heat, airflow, and high levels of relative humidity as a treatment process. By elevating the temperature and humidity, we can remove the agent without performing too harsh of a treatment. This is what makes CHAD suitable for sensitive equipment," explained Joe Myers, a supervisory chemist and acting branch chief for decontamination sciences at DEVCOM CBC. "Basically, is an enclosure that equipment can be placed into, you push a button, and the decontamination process runs."

Two of the biggest benefits to CHAD are that multiple pieces of equipment can be decontaminated at once and equipment can be returned to the warfighter, which does not usually happen. For example, items like gas masks and rifles can be placed on a rack with CHAD and reach non-detection with a treatment time as short as two hours. The process used by CHAD has the potential to save the Army from replacing equipment after being exposed to a chemical agent.

The CHAD project has evolved over the years as Myers and team adjusted the parameters of the treatment process and broadened the application for the warfighter. "Ultimately what started as a way to decontaminate personal effects and return them to the warfighter or their family, has really grown into a low-burden, scalable decontamination capability that can decontaminate objects that have historically presented a challenge."

Now that CHAD has transitioned to a Program of Record, the JPM Protection team will take over the project. Before CHAD is fielded, it will go through a series of tests and demonstrations as part of the acquisition cycle. The DEVCOM CBC team will continue to provide technical expertise to transition partners as the technology continues to mature.



The Portable Microscopy Chemical Detection System can find trace amounts of chemical particles on common surfaces such as cell phone screens.

Army Researchers Develop New Sensors Technology for Trace Detection

By Alexandria Mann

U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) researchers have developed a portable system to detect trace amounts of various substances, a long-standing goal in the detection community. The Portable Microscopy Chemical Detection System (PMCDS) is a small, 10-pound device that Soldiers can easily transport in the field, helping them detect minimal amounts of chemical threat particles, such as fentanyl and other narcotics, that may be present on commonly found surfaces.

The PMCDS works by using Raman spectroscopy, a non-destructive chemical analysis technique. In combination with optical microscopy, the PMCDS provides initial detection information to operators and users of potentially hazardous materials. This technique involves two steps. First, the optical microscope component automatically locates possible chemical threat particles. Next, a laser is focused on the particles, and the Raman spectrum of the particle is obtained. Raman spectra provide a distinct chemical "fingerprint" that is compared to an extensive library of chemicals, allowing for rapid identification.

"Current Raman systems are for bulk detection, meaning if you can see the material, and there's a lot of it, that's what Raman is good at," said Dr. Jason Guicheteau, DEVCOM CBC research chemist. "The challenge is when it becomes invisible to the human eye, or it's a residue. Traditional portable Raman systems in use could not detect low levels of materials, and that's the challenge we aimed to solve. We went from bulk detection to trace detection."

The PMCDS is the first fully automated and portable system capable of detecting trace amounts of a substance on a variety of surfaces, including bomb fragments, shrapnel, and equipment that has undergone initial cleaning. Another benefit of using this system is that the sample being analyzed is not damaged during the process, allowing it to be sent for further analysis and testing.

One of the primary use cases for this technology is its potential application at the southern border between the U.S. and Mexico. Several organizations have been able to procure a PMCDS to help identify narcotics before they can be transported across the border. Specifically, the system has recently been used for trace fentanyl detection. The PMCDS would be able to help agents identify fentanyl and detain potential suspects to conduct a larger investigation where accuracy is confirmed. Through constant innovation, the team at DEVCOM CBC has been able to detect down to 1% fentanyl, helping various teams stop harmful narcotics from entering the U.S.

Dr. Jason Guicheteau, a DEVCOM CBC research chemist, and Dr. Ashish Tripathi, a DEVCOM CBC research physical scientist, use the Portable Microscopy Chemical Detection System to test samples containing trace amounts of particles and identify the substance.

"They can take that pill, put it under the scanner, AND INSTANTLY KNOW..."

Dr. Jason Guicheteau
DEVCOM CBC Research Chemist

"With the PMCDS, we can take an oxycodone pill that Customs and Border Protection has seized, where the pill looks exactly like it should, but it's not what it's supposed to be. They can take that pill, put it under the scanner, and instantly know that it's a fake pill that is potentially laced with fentanyl," said Guicheteau.

The process of reaching the point where devices are used in the field and across partner organizations has been a joint effort. The spectroscopy team at DEVCOM CBC played a crucial role in preparing the device for use. Additionally, several teams at the Center and multiple external collaborators have contributed to the effort.

"We have worked with several other teams to build our library of samples and determine where the device was failing. We knew from talking to these teams that we needed to be able to detect particles on a variety of surfaces hours or even days after initial contamination," said Dr. Ashish Tripathi, DEVCOM CBC research physical scientist. "Through engagement across the Center, external collaborations, and multiple field trials, we were able to successfully incorporate information on enhanced performance needed to create the second generation of the device."

Users who have been early adopters of the PMCDS joined Guicheteau and Tripathi in the fall to discuss what future devices will need. The primary goal for the next generation of the device is to transform the PMCDS into a chemical biological sensor that can detect droplets in addition to solid particles. Funding has already been secured to move forward with this phase, and the device will undergo extensive redesign to reach the point where this capability is possible.

DEVCOM CBC Assists in Showcasing Autonomous Decontamination at MSPIX 2025

By Parker Martin

The U.S. Army Combat Capabilities Command Chemical Biological Center (DEVCOM CBC) attended 2025's Maneuver Support & Protection Integration eXperiments (MSPIX) to showcase its newest autonomous decontamination capabilities.

Held in Ft. Leonard Wood, Missouri, MSPIX provides the opportunity and space for emerging technologies and capabilities to be evaluated in a simulated battle environment with an emphasis on hands-on Soldier interaction, allowing direct feedback on future technology to improve the tools warfighters can use to stay ready and lethal. MSPIX is just one example of the various advanced technology demonstrations that scientists and Soldiers alike attend to become familiarized with and further refine upcoming prototypes.

During the event, which took place May 5-16, 2025, DEVCOM CBC demonstrated its Autonomous Biological Critical Area Disinfection (ABCAD) system, which enables Soldiers and other end-users to remotely control an ATV-sized, 8-wheel vehicle equipped with applicators and tanks housing various liquid decontamination formulas. Matt Reber, a mechanical engineer from the Center's Product Design and Development division, marked his second year attending MSPIX by training participating Soldiers and facilitating their further feedback into the next iteration of the system.

"We anticipate the use of this technology to be at places like airstrips, shipyards – any large area with a high volume of ground to cover for decon," said Reber. "Our goal at this event was to train Soldiers before letting them loose with the equipment. The aim was to be mostly hands-off so that they can use the system armed only with some basic instructions to test how streamlined and user-friendly the system is."

Soldiers were able to drive around the simulated battlefield, spraying water as a substitute for the decontamination formula to illustrate the large area capable. According to Reber, the main goal is not just to put this in their hands but to leverage the feedback they receive from the Soldiers during post-experiment Q&A sessions and questionnaires further to refine the end product into a mission-oriented capability.

"Knowing what Soldiers liked and didn't like gives us the correct jumping-off point for when we return to the lab," said Reber. "Their recommendations help us get closer to making this as autonomous as possible. Our end goal is to get Soldiers out of the field. Decon work can be hot, dirty and just an overall dangerous work environment."

The Autonomous Biological Critical Area Disinfection system enables Soldiers and other end-users to remotely control an ATV-sized, 8-wheel vehicle equipped with applicators and tanks housing various liquid decontamination formulas. The system is designed and run through a partnership between DEVCOM CBC and DEVCOM Ground Vehicle Systems Center

The ABCAD is designed and run in partnership with DEVCOM's Ground Vehicle Systems Center (GVSC). While CBC dials in the autonomous applicator, GVSC further refines its 8-wheeled transport, as well as the respective software and hardware. As the project begins to attend more scheduled ATDs, GVSC and CBC collaborate every two to three months for weeklong tests that make additional tweaks to the system.

This year's MSPIX is the first that the ABCAD system has attended, marking an important steppingstone for the technology. It provides the ever-crucial Soldier feedback that will hone this technology into a more warfighter-focused prototype.

"We don't get a lot of time to interface with Soldiers," said Reber. "Sometimes, I'll work on a project from start to finish without interacting with the end-user at all. But, if what we're making is going to end up in the Soldier's hand at some point in time, then it only makes sense for us to test, train and learn from these guys. In the end, they're the ones that know what is needed to win the fight."

An M75 Screening Obscuration Module mounted on an unmanned vehicle releases smoke to obscure Soldiers traveling across a simulated wet gap.

DEVCOM CBC Supports CBRN Technology Capstone Event

By Alexandria Mann

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) assisted the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) with an event focused on advancing Army CBRN capabilities.

The Integrated Test and Evaluation and CBRN Integrated Layered Defense capstone event featured various technology demonstrations and highlighted ways to integrate technology and prepare and protect the warfighter.

The event showcased Soldiers applying CBRN capabilities to a variety of scenarios, including a simulated wet gap crossing. In this scenario, the team outlined a portion of the field that would simulate the water obstacle and Soldiers demonstrated how they would move from one side of the field to another while using a smoke generator to obscure the unit's movement. The Center's team of obscuration experts demonstrated the M75 Screening Obscuration Module, a mountable and portable smoke generator. It was deployed on an unmanned ground vehicle, which deployed the smoke obscurant used to conceal the Soldiers as they crossed the simulated wet gap.

Data analysis and communication were at the forefront of the event, which included various technologies working together. These exercises demonstrated how existing technologies can be integrated to expand capabilities in the field and equip the warfighter with the appropriate data to make real-time decisions on the ground.

The teams from DEVCOM CBC and JPEO-CBRND gathered with several other partners at the Center's campus at Aberdeen Proving Ground to execute the event. The facilities and ranges operated by DEVCOM CBC offer unique opportunities to enhance Soldier readiness.

"Out here we have obstacles like hills and valleys that can help determine if technologies might have certain pitfalls in different environments," said Sheri Blackiston, a lab manager at the Center. "At other facilities, you usually have a flat field, and that might not provide the ability to see if different terrain will impact whatever technology is being tested."

The other major draw to partnering with DEVCOM CBC is the people. The Center features world-class scientists and researchers ready to work towards the common goal of improving readiness across the force. When working with a diverse range of stakeholders and partner organizations, it is important to have a team that can come together and deliver results.

"I have an incredible team of scientists and engineers who are experts in obscuration. We've had representatives from the Chemical School and from the requirements community coming to us directly to ask their questions and looking for our guidance," said Dr. Danielle Kuhn, the Center's Branch Chief for Smoke and Target Defeat. "They recognize that we're the experts and they're asking us how to plan for the future and make sure the warfighter has the upper hand. And it's been great to see my team switch from the scientific perspective to understanding the bigger vision."

The event has significant implications for Kuhn's team, which receives a predominant amount of its funding directly from the Army. The team used this event as a jumping-off point to engage with customers and stakeholders and ultimately advocate for the project's next steps. The team is currently working on a new generation of the M75 Screening Obscuration Module. The next phase of this initiative will focus on expanding infrared and radar obscurant capabilities, further modernizing obscurant technologies.

"By working together, DEVCOM CBC, JPEO-CBRND and other partners were able to demonstrate capabilities that had never been integrated, seeking real-time feedback from Soldiers and stakeholders. These partnerships have helped teams cross the Valley of Death, the phase in acquisition where technologies sometimes stall out, and get into the hands of the warfighter," said Kuhn.

Dr. James Watson, DEVCOM CBC's Director of Engineering, added, "Collaborative exercises and demonstrations like these are a critical part of the Army's continuous transformation and its ability to deliver concept-required capabilities, both for today's battlefield and the future."

PARTNERSHIPS

Technology Transfer at DEVCOM CBC

DEVCOM CBC is built on a foundation of deep collaborative research. Our Technology Transfer (T2) program is designed to move cutting-edge intellectual property from our government laboratories to non-government organizations for rapid commercialization. These strategic T2 agreements accelerate the development and deployment of critical emerging technologies by actively connecting government expertise with industry innovation. Our partners benefit from leveraging the Center's robust technical capabilities, world-class Research, Development, Testing, and Evaluation (RDT&E) facilities, and extensive data archives. Our singular, driving mission remains clear: to enhance warfighter operational readiness and effectiveness. Through strong partnerships and interoperability with allies and coalition forces, T2 ensures the U.S. Army is continuously equipped with the most advanced technologies on the modern battlefield.

Strategic Partnerships

The Center's Technology Transfer Office facilitates collaborations and works to reach mutually agreeable terms and conditions and appropriate legal mechanisms for other CBRNE organizations to expand upon our work or find private sector applications for it.

Our government laboratories have extensive technical capabilities, research, development, test, and evaluation facilities, and data that add tremendous value to our collaboration partners.

Through our technology transfer collaborations we're able to:

Enable accomplishment of technology transition objectives while benefiting U.S. industry

Enable industry, academia and other organizations to leverage the Center's unique assets including:

- **The Center's intellectual property portfolio**
- **Its science and engineering expertise**
- **Its unique infrastructure and rapid prototyping**

111
Active Interagency Agreements

127
Active Cooperative Research and Development Agreements (CRADAs)

60
Active Memoranda Of Understanding (MOUs)/Memoranda Of Agreement (MOAs)

71
Active Technology Support Agreements (TSAs)

69
Active University Agreements

30
International Agreements/Annexes

FY25 Patents

Detoxifying Light Emitting Device and Use Thereof
Patent # 12,337,069 | June 24, 2025 | Christopher J. Karwacki, John M. Landers, Hui Wang

Horizontal Whole-Body Exposure Apparatus
Patent # 12,324,773 | June 10, 2025 | Michael S. Horsmon, Dennis B. Miller

Nose-Only Inhalation Exposure Plethysmograph for Rabbits
Patent # 12,324,723 | June 10, 2025 | Michael S. Horsmon, Dennis B. Miller

MOF-Clay-Polymer Composite Membrane with Dispersed Filler Constituents and Anisotropically-Oriented Clay Platelets
Patent # 12,311,322 | May 27, 2025 | Alex Balboa, Matthew A. Browe, Wesley O. Gordon, John M. Landers

Apparatus and Method for Plasma Coating Solid Fuels and Coated Solid Fuels Produced Using Same
Patent # 12,264,289 | April 1, 2025 | Shaun M. Debow, Mikhail Y. Efremov, Patrick J. Heaney, Zachary B. Zander, Aiping Zeng

Protective Headwear, Garment Assembly and Method of Donning
Patent # 12,263,360 | April 1, 2025 | Lynn Anderson, Stephanie Broce, Lauretta Welch

Portable Test System for Uniform Chemical Concentration Testing of Personal Protection Products and Method of Use
Patent # 12,203,841 | Jan. 21, 2025 | Steven A. Yurechko

Respirator Mask Filter Adapter
Patent # 12,133,997 | Nov. 5, 2024 | Douglas E. Wilke

Catalysts for Oxygen Evolution Reactions
Patent # 12,132,210 | Oct. 29, 2024 | Shaun M. Debow, Brendan G. Delacy, Yi Rao

Portable Impedance Based Chemical Sensor
Patent # 12,111,278 | Oct. 8, 2024 | Adam Hauser, Smriti Ranjit, Jennifer Rose Soliz

Vehicle Trailer or Shipping Container and Evacuation Assembly
Patent # 12,103,765 | Oct. 1, 2024 | Brian J. O'Donnell, Jr., Jeffrey M. Kiley, Amy L. Dean, Michael C. Glorioso, Michael Richter, Donnie Lester

In-house Laboratory Independent Research / Chemical Biological Advanced Materials and Manufacturing Science Programs Active Collaborations

United States Naval Research Laboratory
Department of War Distributed Bioindustrial Manufacturing Program
United States Marine Corps
Department of War Military Working Dog Veterinary Service
United States Special Operations Command
Department of Homeland Security
Defense Science and Technology Laboratory
United States Army Veterinary Corps
National Security Agency
Advanced Research Projects Agency - Energy
United States Army Corps of Engineers, Engineer Research and Development Center Cold Regions Research and Engineering Lab
DEVCOM Army Research Laboratory
DEVCOM Soldier Center
Tri-Service Biotechnology for a Resilient Supply Chain
Defense Threat Reduction Agency

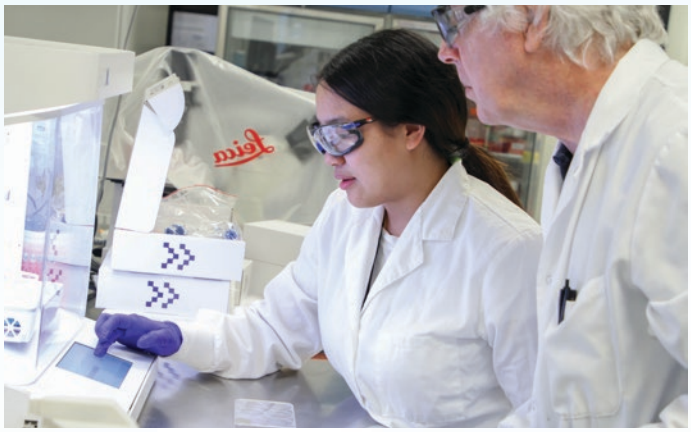
Heathcoat Fabrics
Biowraptor
Superbrewed Foods
United States Military Academy
University of Hawaii
University of Wisconsin - Madison
University of North Texas
The University of Texas at Austin
Stanford University
Northwestern University
Johns Hopkins University
Southern Illinois University
City University of New York
California Institute of Technology

DEVCOM CBC Partners with the University of Hawaii to Enhance Bioprinting and Advanced Manufacturing

By Lauralyn Taylor & Parker Martin

DEVCOM CBC and the University of Hawaii (UH) System have used a cooperative research and development agreement (CRADA) and two joint work statements (JWS) to partner on two initiatives to leverage biomaterials and advanced manufacturing to enhance warfighter survivability and effectiveness.

These agreements enable collaboration on initiatives ranging from organ-on-a-chip scientific tools to broader advanced manufacturing and repair capabilities supporting the United States Indo-Pacific Command (USINDOPACOM). The first JWS, executed on March 14, 2025, partners Dr. Jason Barnhill, an associate research professor at UH Mānoa, and Priscilla Lee, a DEVCOM CBC bioengineering researcher, to develop organ models for assessing DoW compounds.



DEVCOM CBC Bioengineering Researcher Priscilla Lee and DEVCOM CBC Senior Biologist Ted Moran use a bioprinter capable of creating synthetic skin at a DEVCOM CBC laboratory at Aberdeen Proving Ground, Maryland.

Advances under this new CRADA enhance existing in vitro organ models using bioprinting to improve protection and treatments for burns, poisonous gases, antibiotic-resistant bacteria and other chem-bio threats. The second JWS leverages the UH System's presence and advanced manufacturing R&D capabilities in the USINDOPACOM region. This enables both parties to develop advanced manufacturing capabilities for more extensive regional network. This new network could increase supply chain resilience, promote defense innovation, and improve information sharing and collaboration.

DEVCOM CBC Director Signs Collaborative Agreement with University of Delaware

By Dr. Brian Feeney

DEVCOM CBC Director Michael Bailey and University of Delaware (UD) Vice President for Research Dr. Miguel Garcia-Diaz signed an Educational Partnership Agreement at UD's campus on April 17.

The agreement facilitates joint laboratory research, offers academic credit to UD students for Center research, allows Center scientists to teach university courses, and enables the loan or donation of equipment. The agreement formalizes a long history of collaboration in areas like biomanufacturing, new materials development, liquid crystals research, and experiments on an autonomous inhalation robot.

The arrangement was inspired by the success of DEVCOM headquarters' master CRADA with UD, as noted by DEVCOM CBC Technology Transfer Specialist Matt Jones. He saw an opportunity to add another prestigious research university to the Center's list of partners.

Dr. Greg Peterson, Chief Scientist for DEVCOM CBC's Protection Division and UD alumnus, immediately saw the value, adding "by combining our expertise and theirs, this is an opportunity to achieve research breakthroughs that neither of us might achieve on our own."

Bailey anticipates "a lot of promising research projects" and that the agreement will help UD students consider the Center for their careers. Garcia-Diaz emphasized the shared commitment to innovation and collaboration, looking forward to advancing critical initiatives in support of America's defense.

University of Delaware Vice President for Research, Scholarship and Innovation Miguel Garcia-Diaz, Ph.D. and DEVCOM CBC Director Michael Bailey, signed an Educational Partnership Agreement on April 17, 2025. The agreement will allow for the exchange of innovative ideas, groundbreaking research, and state-of-the-art equipment between the two institutions.

Inventors of DEVCOM CBC's TACBIO 2 were on hand to witness the signing of an agreement that will enable the technology to get into the hands of users such as homeland security, law enforcement, and many others. Pictured from left to right back row: Jerry Cabalo, Richard Kreis, Anna Wong, Fiona Wiggins, Gary Kilper, Aime Goad, Lester Strauch III, David Sickenberger, and Harold Wylie. Sitting from left to right: DEVCOM CBC Director Michael Bailey and CSES Director of Business Development Shaun Ripani.

DEVCOM CBC, Chemring Sign Patent Agreement for Biosensor

By Parker Martin

The U.S. Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) formally signed a non-exclusive license agreement with Chemring Sensors and Electronic Systems (CSES) Inc., on May 7th at Aberdeen Proving Ground, Maryland. The patent license agreement allows CSES the ability to license the manufacturing of the Tactical Biological Generation 2 (TACBIO® 2) sensor.

TACBIO® 2 is an advanced biological agent sensor designed to detect aerosolized biological threats. Improvements include a reduction in false alarms, the use of deep UV LED sensors, and a greater focus on affordability and reliability. The sensor continuously monitors air by sampling it at one liter per minute, illuminating aerosol particles with a UV-LED light source. It then measures particle fluorescence to determine the presence of biological particles, which can be further analyzed to identify specific threats.

The ceremony featured remarks from DEVCOM CBC Director Michael Bailey and CSES Director of Business Development Shaun Ripani. Both leaders then signed the agreement to formalize their collaborative achievement.

"TACBIO® 2 has been a concerted effort by our researchers at the Center," said Bailey. "We are here to celebrate a job well done in the fact that our experts have developed a product capable of landing in the hands of our end-users, the warfighter. We're sure that this can help save Soldiers' lives."

The DEVCOM CBC researchers responsible for the development of the TACBIO® 2 were also present for the signing. "We're happy to package something that could be instrumental in providing the warfighter more protection," said Aime Goad, chief of DEVCOM CBC's Intelligent Sensing for Detection Branch. DEVCOM CBC Senior Scientist Gary Kilper, PhD., echoed the sentiment and the impact this accomplishment brings. "It has been very gratifying for us to develop this technology in our labs and machine shop, build dozens of prototypes, integrate into the JBTDS Program of Record and now license it for broader use."

This signing represents a significant step toward fulfilling a program requested by the Defense Threat Reduction Agency (DTRA) for the Joint Biological Tactical Detection System (JBTDS).

"We're excited to partner with [DEVCOM CBC] as they're the experts in their field," said Ripani after the ceremony. "Having the sensors finally make it to its second-generation makes for a superior product that we can continue to supply to the Soldiers who need it most."

In addition to this patent license agreement, the Center and CSES have partnered in the past, including an active Cooperative Research and Development Agreement (CRADA) to include testing support from the Center to CSES, ensuring that their finalized product offers soldiers the best possible version of the sensor.

EDUCATIONAL OUTREACH

STEM Internships at DEVCOM CBC

DEVCOM CBC is committed to empowering the future workforce by demonstrating how students can pursue an education and career in STEM. One of the ways the Center does this is through the utilization of various internship programs that allow students to gain experience in lab and research environments.

This year, the Center mainly hosted interns through the Army Educational Outreach Program (AEOP), the HBCU-MI Program, and the SPARK Program. Most of the students are in the process of obtaining their undergraduate degrees, while the Center's AEOP fellows had either already completed their undergraduate program or were pursuing postgraduate studies. The goal for these internship and fellowship programs is to expose the students to civilian careers while molding candidates for the future workforce.

While the students are at CBC, they are allowed to focus on niche career areas that they might not be exposed to elsewhere. Students are encouraged to collaborate with their CBC mentors and build connections over the course of their time with the Center. This experience can help students finetune the remainder of their education and ease the transition from education to career. For CBC employees, this provides a unique experience to mentor students interested in their field of work. By mentoring students, colleagues across the Center are engaging in the opportunity to further develop their skillset while fostering collaboration.

25
Different Universities

24
Different Majors

STEM and Education at DEVCOM CBC

In addition to partnering with college students and beyond, the Center also engages students at the kindergarten through fifth-grade level. CBC has a longstanding partnership with Cecil and Harford counties, exposing elementary school students to STEM subjects earlier than they would normally be. The idea is to demonstrate real-life STEM applications, while focusing on research and development within the Department of War and at Aberdeen Proving Ground. By connecting with these students, the Center can invigorate STEM education in their local communities and beyond.

32
AEOP Undergraduate Interns

14
AEOP Fellows

11
HBCU-MI Program & SPARK Program Interns

31
Elementary Schools Visited

6K
1st - 5th Grade Students Instructed

Cecil College Intern Innovates at DEVCOM CBC

By Alexandria Mann

The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) is an avid supporter of future Army innovators through a variety of internship programs, such as the Army Education Outreach Program (AEOP). One of CBC's summer 2025 AEOP interns is Logan Szewczyk, a May 2024 graduate from Cecil College and the college's first student to graduate with a biotechnology degree with a focus in bioproduction.

Logan Szewczyk, an AEOP intern at DEVCOM CBC, works with his mentor, Dr. Jessica Tague, to produce bacterial cellulose, a sturdy material with several use cases.

Szewczyk found his passion for bioproduction after his first microbiology course at Cecil College and pursued an internship as part of his degree requirements. He began his initial internship at DEVCOM CBC in March 2024 where he would come in a few days a week to intern and learn more about the biomanufacturing initiative at CBC. Szewczyk quickly realized his passion for this field and opted to apply to continue his internship with CBC through AEOP over the summer. Through AEOP, Szewczyk has continued to extend his internship and garner new skills.

One of the main highlights of Szewczyk's internship is the hands-on experience he has been receiving in the lab. In his role, he helps with the production of bacterial cellulose, a sturdy material made from specific types of bacteria that form fine, intertwined fibers. Bacterial cellulose can be used for biomedical applications, wound treatment therapy, and various military applications.

One of the other crucial components to the internship that Szewczyk has enjoyed is the networking and mentorship opportunities. "Working with this team and getting the chance to work in a professional lab space has been an incredibly beneficial experience," Szewczyk said. "I've picked up so many additional skills while I've been here and this internship has helped me build lasting connections that will further me in my future career. I can't thank the Center enough for how they partner with local colleges."

Over the course of his time at CBC, Szewczyk has established himself as an integral part of the team that comprises the Biomanufacturing Branch. He has been working closely with his mentor, Dr. Jessia Tague, a research biologist at CBC.

"Logan is driven by determination and fueled by innovation, as he consistently demonstrates a results-oriented mindset," said Tague. "Since joining the Biomanufacturing Branch, Logan has tackled challenges with creativity and commitment to progress. His hard work and dedication make him an invaluable asset to the cellulose production team, and as a result of the team's work this summer, the project has secured additional funding."

Szewczyk has also had several unique opportunities while interning with CBC. While producing bacterial cellulose and working with the larger team, he has been able to partner with the U.S. Army Combat Capabilities Development Command Army Research Lab (DEVCOM ARL). This partnership helped Szewczyk get credited on several technical reports, and he had the opportunity to write a report on the project for CBC.

When asked about providing his best piece of advice, he urged future interns to get connected. "Make connections early. Talk to everyone that you can to make the most of your experience and really lean on your mentor to help you work through your project and any challenges your might face," said Szewczyk.

Looking beyond his internship, Szewczyk sees more education in his future. His goal is to attend the University of Maryland to get a bachelor's degree in biochemistry or molecular biology, with a focus in biotechnology. Szewczyk is eager to continue his internship with CBC for another rotation to continue gaining valuable lab experience while furthering the production of bacterial cellulose.

OUR WORKFORCE

DEVCOM CBC Employees Honored for Defense Innovation

By Alexandria Mann

Two researchers from the U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) were recognized for their contributions to defense innovation. Priscilla Lee and Dr. Tyler Goralski were recognized in this year's Department of War Science, Mathematics, and Research for Transformation (SMART) Scholarship Program's Scholar and Mentor of the Year awards.

Lee and Goralski were selected for their innovative research on transforming in-vitro platforms and capabilities for emerging chemical and biological threats. Recently they have been expanding to three-dimensional models, such as Organ-on-a-Chip and 3D bioprinting. Their research aims to provide an alternative to animal models and inform the warfighter on the toxicity of both chemical and biological threats.

The awards highlight outstanding technical achievements from SMART scholars and their DoW mentors at a SMART sponsoring facility. The goal of the program and awards is to acknowledge mission-critical work being done to advance science and technology for national security. One key aspect to these awards is celebrating the contributions of both the scholar and the mentor.

"Having a good mentor is invaluable and I got lucky with Tyler because he also went through the SMART Program and could demonstrate the functionality of it by being someone now leading their own projects," said Lee. "The bar was set high, and he was a great example of what a SMART Scholar could do."

Lee and Goralski have spent the last six years working together, first teaming up when Lee was an undergraduate summer intern at CBC. Being able to continue developing a partnership over the years and staying in touch with various projects has led to a successful and unique mentoring opportunity. Goralski describes the process of moving from mentee to mentor as "seamless."

"I can put myself in Priscilla's shoes and I knew what it was like to come back summer after summer. The mission tweaks slightly but we took our first leap into developing these cell-based capabilities during Priscilla's first summer," said Goralski.

Pursuing an education while being able to simultaneously work on a project is one of the primary benefits to participating in the SMART Program. The program allows individuals to continue furthering their education in exchange for civilian service. In the case of Lee, she has been able to continue forming close connections at CBC as a bioengineering researcher, while working on her Doctor of Engineering, with a focus on biomedical engineering, at Johns Hopkins University. Overall, the SMART Program serves as a jumping off point for students looking to get involved in a career with the government.

DEVCOM CBC Bioengineering Researcher, Priscilla Lee, and Branch Chief of Molecular Toxicology, Tyler Goralski, received their SMART Scholar and Mentor of the Year Awards from DEVCOM CBC Director, Michael Bailey.

"I've told other interns and students this is an exciting way to hit the ground running in the chem bio realm. We're always in the lab, always running different projects, and I'm so grateful for this award," Lee said. "There really is no other program like this one and I appreciate CBC picking me up when I applied for this scholarship."

Lee is looking forward to finishing her doctorate next spring and continuing her research in 3D bioprinting, which ties directly into her dissertation. Through the vast experience she has gained as an intern and as a SMART Scholar, Goralski believes that she will continue to emerge as a leader and subject matter expert on this new capability which will benefit the warfighter in the future.

Awards

The Department of the Army presents honorary awards to civilians in recognition of individual achievements. In 2025, 144 DEVCOM CBC employees received honorary awards.

CERTIFICATE OF ACHIEVEMENT

Cemre Sahinci
Charles Harris
Mark Gostomski
Frank Sanchez
Simeon Sykes
Jason Wettig

CERTIFICATE OF APPRECIATION

Sarah Abastillas
Marlene Benicewicz
Melanie Bon
Lowry Brooks Jr.
Lisa Brown
Juan Cajigas
Richard Caudill Jr.
Robert Collins II
William Conlon
Daniel Davis
Kenneth Eng
Luis Faure
Sarah Graham
Steven Harvey
Lee Haviland
Bryan Hild
Jeffrey Kiley
Bernard King Jr.
Barbara Kruse
Michael Laws
Tammy Lopez
Patricia Low
Nathan Marple
Jennie McDonnell
David McGarvey
Timothy Pedrick
Robert Plank Jr.
Nancy Pusey
Binh Quang
Lisa Robinson
Jonathan Sabol
John Stortstrom
James Swank
Cynthia Swim
Tai Terrell
Jay Watson
William Wilson
Daniel Barker
Karen Blades
Courtney Blue
Matthew Brown
Christopher Byers
David Caretti
Julia Cavallo
Walter Chase III
Alexis Cole
Eric Copeland
Katherine Deweese
Janlyn Eikenberg
Andrea Engler
Linda Faison
Katelyn Fitzsimmons
Warren Gardner
James Glaw
Wayne Goode
Norman Haibach III
Dallas Hanson
Barbara Hawk
Jeffrey Hogan
Stanley Hulet
Troy Johnson
Steven Lagan
Barbara Koski
James Lenth
Leon Lewis Jr.
Courtney Love
David Love
Matthew Lux
Robert Merritt
Dat Nguyen
Kelly Nobles
Mathew Pint
Dominic Pompa Sr.
Jeffrey Poor
Genna Rowe
Henry Stpierre
David Szymanik
Christopher Tarsi
Kevin Wallace
Heather Welsh
Glenn Wetherell Jr.
Brendan Yetter
Erika Dovi
Melanie Pender

CIVILIAN SERVICE ACHIEVEMENT MEDAL

Jason Adamek
Daniel O'Neill
Julie Renner
Daniel Davis
Paul Sneeringer Jr.
Elizabeth Durand
Nathan Marple
Dallas Hanson
Andrea Engler
Michael Krouse
Shawn Davies
Roman Kuperman
Russell Dorsey

CIVILIAN SERVICE COMMENDATION MEDAL

Anna Crumbley
Frank Kragl III
Henry Gibbons
Melody Zacharko
Bryan Rivers
Theodore Moran
Scott Kramer
Janelle Keberle
Russell Taylor
Leslie Bomar Jr.
Michael Herman
Lisa Brown
Wayne Goode
Aaron Thomas
Eric Copeland
Leon Lewis Jr.
Phyllis Brown
Candace Montville
Karen Blades
Kevin Morrissey
Shannon Efird
Dawn Baker
Jeffrey McGuire

DISTINGUISHED CIVILIAN SERVICE MEDAL

James Swank

MERITORIOUS CIVILIAN SERVICE MEDAL

Christine Pan
John Strawbridge II
Stephen Richard
Suzanne Schafer
Bryan Hild
Samuel Sharps Jr.
Robert Malone
Jeffrey Hogan
Daniel Barker
David Caretti
Alan Cushen
Deborah Absher

2025 Peer-Reviewed Publications

- Kang, N. R., Im, J., Biondo, J. R., Sharpes, C. E., Rhea, K. A., Garden, P. M., Montezco, J. J. J., Ringaci, A., Grinstaff, M. W., Phillips, D. A., Miklos, A. E., & Green, A. A. (2025). " A Rapid and Modular Nanobody Assay for Plug-and-Play Antigen Detection". *ACS Synthetic Biology, Vol. 14* (9), 3423-3433. DOI: 10.1021/acssynbio.5c00182.
- Hansen, K., García-Hernández, D. A., Campbell, E. E. B., Erbahar, D., Domaracka, A., Jäger, C., Ewels, C., Umek, P., Kwok, S., Peeters, E., Cami, J., Sloan, G. C., Ehrenfreund, P., Linnartz, H., Manchado, A., Cox, N. L. J., Bernard-Salas, J., Campbell, E. K., Monreal-Ibero, A., Foing, B. H., Smoker, J., Elyajouri, M., Ebenbichler, A., van Loon, J. T., Bouwman, J., Farhang, A., Salama, F., Joblin, C., Mulas, G., Jacovella, U., Gómez-Muñoz, M. A., Barzaga, R., Huertas-Roldán, T., Mohan, H., Bartkowski, M., Giordani, S., Hou, G. L., Díaz-Luis, J. J., Alcolea, J., Tafoya, D., Bujarrabal, V., Doslic, N., Doslic, T., Catalano, E., Yesiltas, M., Ferrari, P., Bruenken, S., Berden, G., Bakker, J. M., Oomens, J., Redlich, B., Pitanti, A., Bertoni, B., Vicarelli, L., Lamberti, P., Cojocari, M., Fedorov, G., Svirko, Y., Kuzhir, P., Hochlaf, M., Al Mogren, M. M., Potapov, A., Gezer, E., Zettergren, H., Schmidt, H. T., Stockett, M. H., Ashworth, E. K., Bull, J. N., Farnik, M., Wakabayashi, T., Ganner, L., Kappe, M., Gruber, E., Pardanaud, C., Dezalay, J., Noble, J. A., Tokési, K., Li, Z., Zhou, X. H., Gong, J. M., Zeng, R. G., Ding, Z. J., Yang, C. S. C., Jin, F., Trivedi, S., Hommerich, U., Nemes, L., Samuels, A. C., Shmavonyan, G., Misakyan, L., Shmavonyan, A., Sciriha, I., Suriyaprasanth, S., Gupta, D., Kalchevski, D. A., Trifonov, D., Kolev, S., Milenov, T., Caro, M. A., Sadjadi, S., Parker, Q. A., Lombardi, A., Mccoustra, M., Koch, F., Schubert, I., Trautmann, C., Toimil-Molares, M. E., Kerkeni, B., Talbi, D., Hsu, C. P., Ouerfelli, G., Chuang, H. H., Chuang, K. J., Chen, Y. J., Villaver, E., & Manteiga, M. (2025). " Roadmap on Carbon Molecular Nanostructures in Space". *European Physical Journal D Vol. 79* (8), 94. DOI: 10.1140/epjd/s10053-025-00984-1.
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