

CBOA 22

2022 化學生物作戰分析

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By Chief Warrant Officer Three Macio E. Brown

著者：二級准尉 Macio E. Brown

譯者簡介



譯者周沛瑜中尉，畢業於國防大學理工學院 109 年班(化材系)，化生放核訓練中心軍官正期分科班 109 期，歷任排長，現任化訓中心戰支組教官。

“Technology cannot advance without the vision of a better tomorrow.”

未來沒有更好的願景，科技無法進步

The Chemical Biological Operational Analysis(CBOA)event, developed and executed by the Defense Threat Reduction Agency (DTRA), provides researchers an opportunity to elicit warfighter feedback during the technology development process of emerging chemical, biological, radiological, and nuclear(CBRN)capabilities for use in a realistic operational environment.

化學生物作戰分析(CBOA)年會，是由美國國防威脅降低局(DTRA) 為研究人員所開發和執行的項目。提供一個在開發新興化學、生物、放射和核子(CBRN)技術的過程中，取得作戰人員回饋的機會，以利在現實作戰環境中實際運用。

CBOA 22 was held at Eglin Air Force Base, Florida, in May 2022. In its role as the Joint Science and Technology Office (JSTO) for the Chemical and Biological Defense Program, Chemical and Biological Technologies Department, DTRA is the Department of Defense hub for chemical and biological technical expertise. The JSTO, which leads the defense community in preparing for chemical and biological threats, identifies and provides cutting-edge technology solutions to protect the security of the American people while empowering warfighters to achieve their missions in dangerous environments. The JSTO is responsible not only for protecting against the known threats of today but also for anticipating the major threats of tomorrow.

¹ Major Lothridge is currently attending the Army Command and General Staff College at Fort Leavenworth, Kansas. He holds a bachelor's degree in political science and a master's degree in cyber security from the University of South Florida, Tampa. (Lothridge 少校目前肯薩斯州萊文武堡的陸軍戰爭學院就讀，他本身具備坦帕市南佛羅里達州大學政治科學學士學位以及網路安全碩士學位)。

In addition, JSTO provides science and technology support to the Department of Defense, other government agencies, and the international community.

CBOA 22 在 2022 年 5 月成立於佛羅里達州埃格林空軍基地。美國國防科技安全降低局(DTRA)為化學和生物技術部門中，化學生物威脅防禦計畫聯合科技辦公室(JSTO)，是國防部化學生物的专业技術發展中心。JSTO 領導國防領域應對化學和生物威脅，提供最尖端的技術及解決方案，以保護美國人民的安全，同時賦予作戰人員在危險的環境下完成任務的能力。JSTO 不僅負責人民避免遭受已知威脅的攻擊，亦負責保護人民的安全，並預測未來潛在主要的威脅因子。此外，JSTO 為國防部、其他政府機構和國際社會提供科學和技術支援。

DTRA sponsored more than 300 U.S. government, academia, and industry representatives as participants for CBOA 22, which addressed military capability gaps and high-priority mission deficiencies. During the week-long event, new CBRN-related technologies were assessed by capturing user feedback from all branches of the U.S. armed forces. Technologies were rated at technology readiness levels ranging from 3 to 8, based on four mission areas corresponding to the CBRN core functions: assess, protect, mitigate, and integrate command and control management.

DTRA 贊助了 300 多名美國政府機構、學術界和工業界代表參加 CBOA 22，以解決軍備能力差異和高度優先任務不足的問題。在為期一週的會議中，針對化生放核相關技術進行了評估，並收集來自美國武裝部隊所有單位人員的反饋。根據與化生放核核心功能相對應的四個任務領域，針對技術的準備程度區分 3 至 8 級。化生放核四個核心職責：評估、防護、減緩以及整合指揮和控制管理。

The assessment focused on the following characteristics of the technologies: performance, adaptability, ability to be integrated into the mission command common operating picture, digital security, environmental robustness, training burden, ease of use, task-load requirements for system operations, propensity for system malfunctions, routine maintenance burden, and logistical impacts. The event consisted of three lanes, which contained multiple operational scenarios to demonstrate the effectiveness of the technologies

評估側重於以下幾個特點：性能、適應性、融入聯合作戰指揮部共同操演的能力、數位安全、環境穩定性、訓練責任、實用性、任務所需系統操作及負載要求、系統故障的、後勤之日常維保需求影響。該項目由三個路線所組成，其中包含多變化的場景，以證明技術的有效性。

CBRN Protection 2030 and Beyond 2030 以後的化生防核防護作為

According to Army Doctrine Publication (ADP) 3-37. Protection. Many state and nonstate actors (including terrorists and criminals) possess or have the capability to possess, develop, or proliferate [weapons of mass destruction] WMD. The most likely adversaries during large-scale ground combat have significant WMD capabilities and the doctrine to employ them during conventional operations. The training to conduct operations in a WMD environment is critical to operational success. " In order to achieve freedom of action, increase lethality, and enable movement and maneuver in the execution of large-scale ground combat operations in the complex CBRN environment, the Army must aggressively develop future CBRN defense capabilities to outpace our adversaries.

根据美國陸軍後勤準則 (ADP) 3-37，防護，許多國家和非國家行為者 (包括恐怖分子和犯罪分子) 擁有或有能力擁有、發展或擴散大規模殺傷性武器。在大規模地面作戰中，最有可能的敵人，是擁有強大的大規模殺傷性武器的能力，並有在常規的作戰中使用它們的前例。在大規模殺傷性武器環境中進行作戰訓練對作戰成功至關重要。“為了在複雜的化生放核環境中執行大規模地面作戰行動，達到行動自由，提高殺傷力，並且能順利移動和機動，陸軍必須積極發展更進一步的化生放核防禦能力，以超越我們的敵人。

U.S. Army Futures Command (AFC) Pamphlet (Pam) 71-20-7, Army Futures Command Concept for Protection 2028, builds upon the ideas of the multidomain operations concept and serves as the baseline for required CBRN protection capabilities to enable Army forces in multidomain operations through CBRN reconnaissance and surveillance, integrated early warning, real-time understanding, inherent survivability, and mitigation of CBRN hazards. The key to successful all-domain protection includes improvement of artificial intelligence and machine learning for CBRN detection and mitigation capabilities. CBOA 22 highlighted breakthrough scientific discoveries and technological innovations that support the central idea of the core CBRN competencies (assess, protect, and mitigate) and the integrating activity of hazard awareness and understanding in support of the United States Army Chemical Biological Radiological Nuclear (CBRN) Science & Technology Strategy. By employing capabilities that enable decision making and protect the force, commanders can sense, assess, understand, decide, and act faster and more effectively, thereby gaining an information advantage.

美國陸軍未來司令部 (AFC) 手冊 (Pam) 71-20-7，《2028 年陸軍未來司令部防護準據》，建立在多領域作戰概念的基礎上，作為化生放核防護能力的基

準，使陸軍部隊能夠藉由化生放核監偵及預警，即時判斷固有生存能力和減輕化生放核危害，使陸軍部隊能夠在多域作戰中發揮作用。而成功實現全領域防護的關鍵，包括提高化生放核檢測及減緩傷害相關人工智慧中機器學習的能力。化學生物作戰分析年會 (CBOA 22)強調為化生放核核心能力 (評估、防護和減輕) 的科學發展和技術創新提供支援，以印證美國陸軍化生放核科學技術教則。通過利用支持決策和保護部隊的能力，指揮官可以更快速、更有效地判斷、評估、理解、決策和行動，從而獲得情資。

CBOA Technologies Overview CBOA 技術概論

CBRN assessment capabilities enable commanders to understand the environment as early as possible so that they may make informed, risk-based decisions that protect the force while freedom of action in a CBRN environment. The following assessment technologies were assessed during CBOA 22:

化生放核評估能力使指揮官得以盡早了解戰場環境，以利指揮官評估完整風險並下達明智的的決策，確保防護部隊在自由行動中的安全。在 CBOA 22 年會期間，針對以下幾種技術做出評估：

●Dial-a-Threat Assay 危害分析儀

Hand-held , unpowered, human-readable biological threat identifier.

手持式，無動力，可直接讀取，生物危害辨識裝備。

●Biological Automated Collector/Detector for Expeditionary Reconnaissance (BioACER) 生物自動遠距偵察收集/探測器

A fully automated biological collection and identification device that can be released from an unmanned aerial system (UAS) for remote analysis over a plume. 為一全自動的生物收集識別裝置，可搭載無人載具 (UAS) 於空中進行遠距分析。

●Falcon 4G 化學和生物戰劑遠端偵測器

A 4th-generation laser-based CBRN stand off detector(which was used in a base defense scenario). 四代化生放核雷射偵測器 (應用於演習期間防禦狀況下使用)。

●FentAlert 吩類快篩試劑

An all-environments screening assay for pharmaceutical fentanyl-based

agents. 適用於分析所有環境中吩坦尼類相關藥物的生物工程制劑

● **Forward Advanced Sequencing Technology 未來先進序列技術**

A technology used to identify deoxyribonucleic acid- or ribonucleic acid-based organisms.

用於識別去氧核糖核酸或核糖核酸相關微生物的技術。

● **Hazardous-material small UAS 小型危害物質無人載具**

A UAS that is used to fly optimized patterns through hazardous areas, detecting, identifying, quantifying, and mapping hazardous data in real time, thereby enhancing situational awareness and improving decision quality. 在危害區域利用無人機載具進行空偵測，實施探測、識別、量化和測繪等相關數據，從而加強對現況的認知並提高決策質量。

● **MUSA P3I 顯微手術機器人**

A semiautonomous quadrupedal robot with integrated chemical and radio-logical detection / identification instruments that can also take photographs in the hot zone and conduct most CBRN reconnaissance/sampling missions. 為一半自動式機器人，具有探測/識別化學和放射性物質的儀器，也可以在熱區拍照執行大部分化生放核偵檢/取樣任務。

● **NuGBall 遠距劑量率測量傳感器**

A portable sensor network for real-time CBRN contamination mapping.

用於即時回傳化生放核污染狀況的攜帶式感測器。

● **Pendar X10 攜帶型手持式拉曼光譜儀**

A handheld standoff Raman spectroscopy chemical identification system used to identify unknown materials (liquid, solid, gel) at a distance of 1 to 6 feet within a few seconds (Figure 1). 手持式拉曼光譜化學分析儀，用於在幾秒鐘內鑑定 1 至 6 英尺距離內的未知物質（液體、固體、凝膠）。



Figure 1. Pendar X10

●**Raman spectrometers** 傳統型拉曼光譜儀

a spectrometer used to identify collected particles.

用於收集物質微粒的光譜儀

●**Rigaku** 手持式拉曼光譜儀

A portable handheld ,dual-technology 1064-nanometer for the identification of chemicals and toxic industrial chemicals.

用於識別化學物質和工業毒性化學物質的攜帶型手持式 1064 奈米雷射波長儀器。

CBRN protection capabilities enable inherent survivability (individual and collective) in support of large-scale combat operations ,without degradation or loss of combat effectiveness in a CBRN environment. The following protection technology was assessed during CBOA 22:

化生放核防護作為可提升大規模作行動中的固有生存能力 (個人和集體) , 使部隊的在化生放核環境中不會降低或喪失戰鬥能力。在 CBOA22 年會期間 , 評估了以下防護作為 :

●**Second Skin** 第二層皮膚

A mask cover that is installed on a standard M50 mask to improve the protective garment hood and mask interface.

貼附在標準 M50 防護面具上 , 可用於改善防護衣及防護面具的接縫。

CBRN mitigation contributes to the negation of hazard effects by providing commanders the flexibility to make risk-based decisions about the mitigation of residual CBRN contamination without the reduction of combat power or unnecessary expenditure of time and resources. The following mitigation technology was assessed during CBOA 22:

在不降低戰鬥力或不必要花費的時間和資源的情況下 , 為指揮官提供有助於減輕化生放核危害影響的資訊 , 並對於減輕剩餘的化生防核污染物質做出風險評估及決策。在 CBOA22 年會期間 , 評估以下幾種減輕技術 :

●**Decontaminating skin soap** 皮膚除污肥皂

A soap that is used to rapidly decontaminate sensitive equipment, materials, and skin from chemical warfare agents, biological warfare agents, toxic industrial chemicals, toxic industrial materials, nontraditional agents, pharmaceutical-based agents, and other emerging threats.

用於快速消除皮膚上的化學戰劑、生物戰劑、有毒工業化學物質、有毒工業

材料、非傳統戰劑、藥物製劑和其他新興威脅中靈敏度較高的裝備及材料。

Digital Battlespace Command and Control Management 數位化戰區的指揮與控制管理

Digital battlespace command and control management systems provide CBRN staffs with the information required for commanders to make decisions with enhanced situational awareness and understanding in a timelier manner. Digital battlespace command and control management tools allow CBRN staffs to receive large amounts of CBRN threat information and intelligence, conduct analysis, and develop trends related to enemy CBRN employment. Technology developers presented the following capabilities during CBOA 22:

數位化戰場指揮與控制管理系統提供化生放核參謀們所需情資，以供戰場指揮官使用。使指揮官能即時理解戰場概況並加強其對戰況的認知，從而做出決策。數位化戰場指揮與控制管理系統使參謀們能立即接受大量戰場上化生放核威脅的情資，進而分析並預測敵人使用化生放核武器的可能性。在 CBOA 22 年會期間展示了以下能力：

●CBRN Analysis Software.化生放核分析軟體

A commercial, off-the-shelf knowledge management application.

為一現成的商用知識管理系統

●Multi-intelligence-Enabled Discovery 多元智能應用探索系統

Artificial intelligence, machine-learning algorithms that use Azure Cloud and Azure Cognitive Services to provide near real-time processing of multiple types of raw, unformatted environmental and intelligence data to provide intelligence insight and information to decision makers.

人工智慧，使用 Azure 雲端運算平台和 Azure 認知服務，可立即處理多種類型的數據，提供決策者即時的洞察報告。

Conclusion 結論

CBOA forges the future of CBRN modernization by showcasing experimentation, demonstration, and capability development for the joint force. Commanders need the ability to see the adversary, deny it anonymity, counter specific strengths, achieve positions of advantage, and expand and expand and exploit gained areas.

CBOA 透過展示聯合部隊的軍事力量，開創現代化化生放核的未來新走向。指揮官需要有辨認情勢及判斷未知的敵人的能力，並適時反擊以及掌握優勢進

而擴張並善用所得領土。

Lieutenant General D. Scott McKean, director of the Futures and Concepts Center, Army Futures Command, Fort Eustis, Virginia, prefaced his CBOA 22 speech on AFC Pam a71-20-7 by stating, "Looking forward, the Army must develop capabilities that can support and integrate with our joint, interagency, inter organizational, and multinational partners to expand the protection capability, increase capacity in competition, and operate at scale in armed conflict. "This guidance exemplifies the Army commitment to protecting the force, improving survivability, and reestablishing the readiness of forces through the development of modernized capabilities.

位於維吉尼亞州尤斯蒂斯堡的美國陸軍未來司令部未來概念中心主任 D.史考特-麥肯中將在 CBOA 22 年會發表關於美國陸軍未來司令部(AFC)手冊(Pam) 71-20-7 的演講表示："展望未來，陸軍必須發展能夠支持和整合跨機構、跨組織和多國合作夥伴的能力，以擴大防護能力、提高競爭力，以利在大規模武裝衝突中作戰。"該指導體現了陸軍通過發展現代化作戰能力保護部隊、提高部隊生存能力及重建部隊備戰狀態的承諾。

Endnotes 註釋

1. ADP 3-37 Protection, 31 July 2019. 《美國陸軍後勤準則 (ADP) 3-37：防護》，西元 2019 年 7 月 31 日。
2. CBRN Operations Force Modernization Strategy, U.S. Army CBRN School, Fort Leonard. 《化生放核作戰部隊現代化策略》，美國陸軍化生放核學校，西元 2018 年 7 月。
3. AFC Pam 71-20-7, Army Futures Command Concept for Protection 2028, 7 April 2021. United States Army Chemical Biological Radiological Nuclear (CBRN) Science & Technology Strategy, U.S. Army, 2022 《2028 年陸軍未來司令部防護準據》，美國未來司令部手冊 71-20-7，2021 年 4 月 7 日。