Countering WMD Journal

In This Edition:

- The CWMD "Operational Void"
- The Army's Contribution to Integrated Deterrence via CWMD Readiness
- Avoiding Strategic Miscalculation

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MAILING ADDRESS:
Director, USANCA,
5915 16th Street Building 238
Fort Belvoir, VA 22060-5514

TELEPHONE:
703-545-9812

ELECTRONIC MAIL:
cwmdjournal@army.mil

MISSION STATEMENT

The Countering WMD Journal is published semi-annually by the U.S. Army Nuclear and Countering WMD Agency. It furthers the education and professional development of military and civilian leaders and members of government and academia concerned with the nuclear and countering WMD matters.

ARTICLE SUBMISSION

We welcome articles from all U.S. Government agencies and academia involved with Countering WMD matters. Articles are reviewed and must be approved by the Countering WMD Journal Editorial Board prior to publication. Submit articles in Microsoft Word without automatic features; include photographs, graphs, tables, etc. as separate files. Please email us for complete details. The editor retains the right to edit and select which submissions to print. For more information, see the inside back-cover section (Submit an Article to Countering WMD Journal) or visit our website at www.usanca.army.mil/.

ABOUT THE COVER

U.S. Marines assigned to the Chemical Biological Incident Response Force (CBIRF), and U.S. Army Soldiers assigned to the 172nd Chemical, Biological, Radiological, Nuclear Company, prepare a simulated casualty for decontamination during Exercise Sudden Response at Fort Hood, Texas, Dec. 11, 2022. CBIRF, along with teams from Task Force (TF) Aviation, TF Logistics, TF Medical, and TF Operations, rehearsed force and equipment employment, life-saving operations and web-based collaborative tools to ensure their ability to execute the Defense Support of Civil Authority (DSCA) mission. These units make up the Defense CBRN Response Force, which comprises up to 5,200 personnel from military units located throughout the nation who come together to help fellow Americans in the event of a catastrophic crisis response. (U.S. Marine Corps photo by Staff Sgt. Jacqueline A. Clifford)

Read further in "The Rugged Brigade's Impact on the Defense CBRN Response Force: Ready to Respond to CONUS CBRN Disasters (P.44)

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COL. TINA M. SCHOENBERGER

Welcome to Issue #27 of the CWMD Journal.

I am Col. Tina M. Schoenberger, and I have been serving as the USANCA Director since July 2023.

I would like to thank my predecessor, Col. Colin, P. (Pat) Nikkila for his outstanding leadership and significant contributions to nuclear and CWMD readiness throughout the Army and the across the Department of Defense. Under his leadership, the Army implemented progressive and sequential Conventional Nuclear Integration (CNI) curriculum across all levels and cohorts of Army Professional Military Education while also supporting CWMD readiness initiatives in priority theaters and across the institutional Army. His efforts to reform the management and education of FA52, Nuclear and Countering Weapons of Mass Destruction Officers will pay dividends for the entire DoD CWMD community and beyond. As you read on in this edition of the CWMD Journal, you'll see these efforts reflected in many of the key articles.

Prior to my arrival at USANCA, my most recent assignment was the Plans, Integration and Assessments Division Chief for U.S. Special Operations Command (USSOCOM) J10-Countering Weapons of Mass Destruction Directorate. In that capacity, I led efforts executing the Coordinating Authority for CWMD for the Commander of USSOCOM as well as CWMD planning support for the Office of the Secretary of Defense, Geographical and Functional Combatant Commands for campaign, contingency and crisis action planning to include the SECDEF's Functional Campaign Plan for CWMD. I know full well how large and diverse this community is, and how much potential it holds.

I want to begin by expressing how absolutely honored I am to be leading this organization at such a strategic inflection point for our community. USANCA is part of a tremendous Army-wide effort to posture the Army of 2030 for a strategic environment in which WMD considerations will be at the forefront. For the first time in my memory, all our strategic guidance—to include the recently published DoD CWMD Strategy and Biodefense Posture Review—are completely aligned and focused on deterring malign activity from WMD-armed adversaries. Our leaders have made our path forward very clear.

During my 90-day assessment I was happy to find that USANCA is fully integrated within the larger DoD-wide CWMD campaign that I participated in while at USSOCOM J10. As with all of your organizations, USANCA's strength is our people: our FA52 Officers stationed world-wide, and our connection to the CWMD enterprise. We are a unique organization and community filled with scientific and technical experts with unique skill sets and years of tactical, operational, and strategic experience. Yet we are only one of a wide network of similarly organizations rowing along as part of a Department-wide campaign. It will take unified efforts from across this entire diverse enterprise to achieve the objectives our leaders have placed in front of us.

A world in competition and conflict continues to illustrate the critical nature of our community's mission and efforts. In my short time as Director, I have already been amazed by the dedication of stakeholders across the entirety of the nuclear and CWMD enterprise as they work to provide our leaders strategic deterrence options and actionable CWMD solutions. Everything we do here at USANCA—to include publishing this Journal—is focused on supporting, integrating, and underwriting your efforts.

Within Issue 27 and in all of our publications, we hope to expand conversation and dialog on subjects including integrated deterrence, active campaigning under a nuclear shadow, and innovations in nuclear and CWMD training strategies. I challenge all members of CWMD enterprise to consider how your work and efforts are contributing to these and other critical areas. Take the time to capture these thoughts and submit them for publication in the CWMD Journal. Insights that aren't captured or shared can never lead to lasting change.

I appreciate your hard work, dedication, and resolve. Your contributions to the collective conversation on nuclear, CWMD, and biodefense issues facing our nation are critical to inform meaningful change. Our leaders will need the collective wisdom of our entire community to meet the challenges of 2030 and beyond. ■

Below: U.S. Soldiers attached to the 1st Brigade, 101st Airborne Division, react to a simulated chemical attack during Combined Resolve 24-01 at the Joint Multinational Readiness Center near Hohenfels, Germany Oct. 30, 2023. Combined Resolve 24-01 is a reoccurring U.S. Army Europe and Africa training exercise, designed to prepare U.S. brigade combat teams, NATO allies and partners in support of NATO deterrence initiatives. Approximately 4,000 Soldiers from 14 nations participated in this event. (U.S. Army Reserve photo by Sgt. Kenneth Rodriguez)

THE CWMD "OPERATIONAL VOID"

A case for building DoD CWMD operational capability "from the middle out"

PAUL A. SIGLER & MAJ.(P) JAMES C. BOWEN

"It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so."

— *Mark Twain*

INTRODUCTION

An ancient Buddhist parable[1] speaks of six blind men who are asked to describe an elephant based only on that part they have personally touched. The man who feels the side of the elephant declares that it is like a wall; the man with the tail, a rope; the man with the trunk, a snake, and so on. Each of the men are correct based upon the information they have at hand, and each has a concrete experiential reason to doubt what he hears the others saying. Yet not a single one of them actually understands what an elephant really *is*.

Imagine that there are leaders responsible for managing the threat of wild elephants and all they have available to inform decisions on preparation and planning is the descriptions from the blind men. Would they prepare to scale a wall, cut a rope, or kill a snake?

Countering Weapons of Mass Destruction (CWMD) professionals spend a great deal of their waking hours dealing – wittingly or not—in a world bound by vague and often conflicting definitions.

The first, and most fundamental, is the definition of a Weapon of Mass Destruction (WMD). Department of Defense (DoD) Directive 2060.02 and Joint Pub (JP) 3-40 both agree that WMD are "chemical, biological, radiological, or nuclear weapons capable of a high order of destruction or causing mass casualties, excluding the means of transporting or propelling the weapon where such means is a separable and divisible part from the weapon."[2] Outside the DoD, the debate over whether pipe-bombs, cyber attacks, or fentanyls[3] belong in the realm of WMD is very much a live debate. Although DoD participates in these interorganizational debates, DoD strategy, policy, and joint doctrine largely insulate Joint Force Commanders from these arguments.[4] Where this conversation becomes contentious is the definition–and the practical application–of countering WMD activities within an operational campaign against a peer adversary.

The fact that CWMD practitioners often misuse their own terminology does little to help demystify the subject. Countering WMD is often juxtaposed against ostensibly competing terms such as strategic deterrence, biological defense, and chemical, biological, radiological, and nuclear (CBRN) defense. There is a long tradition within DoD literature of conflating, superimposing, or otherwise misusing these terms.[5] It is relatively common to see "CBRN defense" and "CWMD" combined within a single phrase as if they are distinct mission areas, despite the fact that CBRN defense is a tactical subset of the larger joint CWMD mission area. Likewise, distinguishing between tactical biological warfare agent defense and related but distinct operational/strategic public health campaigns has also proven nettlesome. Finally, the generalized actions which the DoD takes to deter WMD use by a nuclear-armed adversary (a CWMD activity) necessarily overlap with operational and policy actions meant to set the nation's strategic deterrence posture. Which of these activities live in the realm of CWMD vs. strategic deterrence? More importantly, assuming we could come to agreement on this question, what would we gain from the effort?

Yet perhaps the most common and harmful misuse of the term "CWMD" comes when DOD staff officers use it as a catch-all term to describe an activity that is really focused on a single threat actor or modility. Labeling a plan to counter Democratic People's Republic of Korea (DPRK) chemical weapons as a "CWMD" plan buries the lede and masks the true purpose of the proposal.

Senior leaders could be forgiven for finding these competing definitions bewildering, discouraging, and intimidating, and they might over time come to see the proponents of these ideas as a consortium of mad scientists and/or cranks. Such a characterization—unfair, but very real—becomes an obstacle to achieving a clear understanding of strategic and operational risk.

Decisions being made by those same senior leaders today will buy down operational risk within the forces being fielded in 2030, and will shape the operating concepts, capabilities, and overall WMD resilience of the Joint Force of 2040. Those decisions will be made on small resource margins and must be informed by a clear understanding of how those forces will "converge effects from all capabilities throughout the operating environment to achieve strategic objectives"[6] against peer adversaries with fully integrated WMD capabilities.

With the recent publication of the 2023 DoD CWMD Strategy, there is no better time than now to clarify what comprises operational CWMD activity. The best time to plant a shade tree is thirty years ago. The second-best time is always today.

This article is part of a series of introductory lectures within USANCA's CWMD Advisor Course that are meant to define CWMD activities at the operational level while also contextualizing those activities within complementary tactical and strategic efforts. Within the class—and within this article—the approach is to: 1). Trace CWMD activities and tasks from national policy down through applications at the tactical level; 2). Translate WMD threat into the language of operational risk; 3). Apply these principles in contemporary WMD problem sets to develop options and advice for the Joint Force Commander (JFC).

THE CWMD "OPERATIONAL VOID"

Within the 2018 "Insights and Best Practices Focus Paper on Interorganizational Cooperation," the Joint Staff J7 Deployable Training Division describes a number of challenges to coordination with interorganizational partners. Among these is a lack of planning and coordinating capacity at the operational level caused by "differences in coordination permissions, capacities, capabilities, and budget authorities between DoD and other interorganizational partners."[7] Thus, while an individual country team may be adequately staffed to support a tactical unit or Service component operating within a nation, and while Department of State (DoS) and DoD have the capability to coordinate policy actions for that country, the ability to coordinate these actions across a combatant commander's area of responsibility is complicated by lack of intermediate level DoS staffing, and differences in how the two Departments organize regionally.

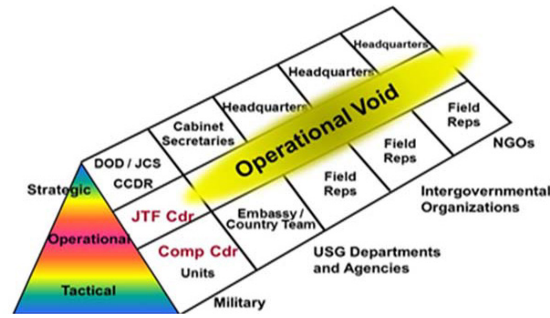


Figure 1. The interorganizational "operational void."[8]

Although this gap is long-standing, it didn't come to the fore until regional stability operations and counter-insurgency operations created an urgent demand among operational commanders for a means of augmenting military capabilities with all of the other aspects of national power. It is now accepted as an article of faith—and a precept of joint doctrine—that *unified action* is the best means of optimizing the Joint Force to achieve national objectives.[9] The modern JFC approach to unified action contrasts sharply with the DoD-led push to Baghdad in 2003 which purposefully froze out many other elements of the U.S. government.[10]

The current challenges faced by joint CWMD practitioners has a lot in common with the challenge faced by unified action advocates in early 2000s. With respect to nation-building and counterinsurgency, the most recent American experience dated back to the Vietnam War. Across a thirty years interregnum, hard-won lessons had faded from doctrine, practice, and the collective psyche of joint leadership. An entire generation of leaders had no professional education or first-hand experience with counterinsurgency operations or the interorganizational integration required to conduct nation-building.[11] More importantly, prior to 2003, DoD leaders didn't see nation-building as a valid mission, obviating the need for the structure and expertise on joint staffs to conduct theater-wide whole-of-government integration.

In a similar vein, the last time that the U.S. Joint Force faced a nuclear-armed peer adversary was in 1991.

During the intervening three decades, operational necessity drove the Joint Force to optimize itself toward countering limited tactical CBRN threats posed by extremist organizations such as al Qaeda or ISIS while curating the capability to exploit and eliminate WMD-related sites. The institutional knowledge required to deter and coerce a nuclear-armed peer while simultaneously assuring partners and allies gradually faded away.

In both cases *some* reservoir of experience did remain. The generation that fought in Vietnam still had a foothold within DoD senior leadership in 2003, just as there are a small number of Cold Warriors left in our ranks today that remember preparing to counter Soviet chemical and nuclear use in the Fulda Gap during the 1980s. The question in both cases is how many of these precepts had the staying power to remain true within a modern strategic and operational context. The U.S. could not, for instance, attack Taliban support networks using the same techniques it had used against the Vietcong in the early 1970s—while the principle of denying sanctuary remained valid, the geopolitical situations differed greatly.[12] Likewise, Cold War CWMD experience isn't perfectly analogous to a tri-polar world of revanchist powers and multi-domain competition. The strategic context, and the Joint Force itself, have all changed markedly in the interim. Blindly assuming that what once worked will work again is an approach that is fraught with risk.[13]

This brings us to the most important parallel: what Joint Force Commanders are now being required to do with respect to countering WMD is *fundamentally new*. As such, there is little resident understanding of how activities and tasks manifest at the operational level.

The natural counterargument to this premise is to point to the many examples of counterproliferation success over the past three decades—to include demilitarization of over 7600 Soviet-era nuclear warheads under the Cooperative Threat Reduction (CTR) program,[14] interdiction and seizure of Libya's aspirational nuclear weapons capability in partnership with other Proliferation Security Initiative (PSI) nations,[15] and the demilitarization of Syrian chemical weapons and precursors aboard the *M.V. Cape Ray*.[16] These are only a small sampling of the many strategic CWMD efforts that DoD has supported since the end of the Cold War. With such a bounty of collective experience, many might be skeptical that today's CWMD problem set is truly novel or unique.

The fact remains, however, that despite a long history of strategic nonproliferation activity and demilitarization of WMD components, current Joint and Service Component staffs struggle to define what operational CWMD activity means with respect to a peer adversary as part of an active campaign.

Today's Joint Force Commanders (JFC) and their staffs are required to simultaneously balance effort across multiple CWMD activities within a global strategic messaging campaign. They must align and synchronize strategic capabilities to enforce arms control treaties and export controls, employ operational capabilities to track and degrade WMD capabilities, and posture tactical capabilities to prevail in spite of WMD employment on the battlefield.

The operational staff must fold these echeloned CWMD-related activities into theater-level planning and targeting on a staff which is consumed by anti-access area denial (A2AD) defeat, despite the fact that the rest of the staff has vanishingly little familiarity with CWMD activities beyond a basic notion of tactical CBRN defense. To be successful, operational CWMD planners will need to develop partners and advocates across all of the boards, cells and centers that comprise a JFC staff. If they can achieve this, the staff will be positioned to produce Operations, Activities, and Investments (OAIs) as well as deterrence and response options that integrate all elements of national power and are risk-balanced against other operational and strategic imperatives.

This holistic campaign plan, once established, will be challenged with a steady barrage of mis- and dis-information running the gamut from public-health threats,[17] real and imagined nuclear power plant threats[18] and online conspiracies about DoD's support to biological weapons programs.[19] Combined, these narratives may threaten to restrict the ability of the JFC to flow forces freely throughout the theater or to recruit new partners to the cause. Some of this milieu of confusion will be adversary-connected; some will not. CWMD planners will face a constant challenge to sort through noise and misinformation shoulder-to-shoulder with the rest of the staff in order to determine if the fundamental WMD-related assumptions of the theater campaign plan remain valid, or if the ground has once again shifted underneath their feet.

It is difficult to argue that DoD prepares operational staff officers, the CWMD professionals who advise them, and the senior leaders who direct them for the range of tasks associated with this kind of campaign against a nuclear-armed peer adversary.

The CWMD operational gap is thus defined by the extent to which the Department falls short.

RESERVOIRS OF DOD CWMD COMPETENCY

A common pitfall across the CWMD enterprise is the tendency to overstate the problem at hand. This flaw is part of the reason that it is hard to get invited to parties as a CWMD professional. In the end, shockingly enough, commanders and senior leaders greatly prefer solvable problems to contemporary versions of the Kobayashi Maru.[20]

Luckily, as touched upon in the previous section, the mere presence of a void at the operational level implies that there is robust capability elsewhere.

In this case, it is important to understand that for much of DoD's history, marquee "CWMD" activities occurred at the strategic level and the tactical level, respectively. As a result, DoD retains a great deal of capacity and experience at the highest and lowest levels of the CWMD spectrum of operations.

At the strategic level, the DoD has a long history of working with the interagency to develop arms control agreements, treaties and enforcement mechanisms. These pre-date the relatively recent development of more formal interagency CWMD strategic documents, and more importantly, this community provided the foundation for emerging U.S. thought on CWMD.[21] Moreover, the U.S. has long experience with employing multinational treaty organizations, arms control surveillance and inspections and strategic interdiction to achieve national non-proliferation policy goals. These extant capabilities provided the means to pursue strategic non-proliferation and counter-proliferation opportunities via sustained interorganizational campaigns or bespoke solutions task-organized at time of need to accomplish a specific policy goal. They have provided the means to limit or challenge WMD programs in nations such as DPRK, Libya, Syria and Iran.[22]

Conversely, the ability of the Joint Force to employ chemical, biological and nuclear weapons while exploiting their effects for tactical gain pre-dates the arms control and non-proliferation efforts mentioned above. Dating back to the original establishment of the U.S. Army Chemical Warfare Service in 1918,[23] Army chemical capability combined complementary offensive and defensive programs all the way through 1990 when the U.S. began unilateral destruction of its chemical weapons programs[24]—well in advance of U.S. ratification of the Chemical Weapons Convention in 1997. President Nixon had already ended the U.S. offensive biological program in 1969 as the idea of using biological weapons as a deterrent fell out of favor.[25] Finally, all of the Services had non-strategic nuclear capabilities through 1992, when the Army finally divested of its tactical nuclear capability. The Navy Sea-Launched Cruise Missile (SLCM-N) had been ordered placed into storage a year prior.[26, 27]

Following the turn away from tactical nuclear weapons, DoD retained a robust ability to respond to nuclear accidents and incidents, while also building out an increasingly technical CBRN response capability that, over time, adapted to meet the demand for rapid response to the complex, highly variable improvised threats posed by violent extremist organizations. Within a resource-constrained Army, this focus on technical capability unsurprisingly came at cost to the organic CBRN self-defense capability and capacity of maneuver units. Regardless, it resulted in highly-capable (albeit low-capacity) units within United States Special Operations Command (USSOCOM), Theater Special Operations Commands (TSOCs), and the Army's 20th CBRNE Command that continue to serve as an exemplar for allies and a platform for building partner capacity across the globe.

With a little more thought on DoD's tactical and strategic capabilities, four insights arise with respect to our conversation on the operational CWMD void.

Tactical CBRN defense capability remains foundational to joint CWMD activity. JP 3-40 states that the specialized activity "CBRN Response" applies to adversary CBRN use, even if it does state this in a relatively backhanded manner.[28] Implicit to tactical CBRN defense is the ability to conduct Service-specific mission-essential tasks despite employment of a range of CBRN capabilities on the battlefield. Leaving aside that many operational WMD defeat activities require conventional forces to accompany or support technical forces, the simple inability of tactical formations to ensure continued operations against all modalities of CBRN threat places the ability of the JFC to deter and coerce adversaries while assuring partners and allies at immediate risk.

A century of experience with CBRN employment has created deep and exquisite expertise within the technical units of each Service. These units have a tradition of fielding, handling and training to employ these weapons, while also retaining the capability to respond to accidents and incidents. Over the past twenty years, these organizations have expanded in technical capability, and within the past decade the Army has developed doctrine to organize and employ many of these organizations as part of a multinational combined-arms team to secure, exploit and transport adversary WMD capabilities.[29] This provides a significant capability to support joint WMD Defeat activities in theaters where these teams can gain access to sites of interest.

Strategic capabilities which DoD has employed successfully against rogue states and regional powers show diminishing returns against a peer adversary. A veto on the U.N Security Council can be a powerful impediment to useful counter-proliferation tools such as UNSCR 1540.[30] Future employment of arms control enforcement, non-proliferation agreements, export controls, and coordination with multinational organizations (such as the International Atomic Energy Agency, the Organization for Prohibition of Chemical Weapons, and the World Health Organization) are likely to have marginal returns and must be closely coordinated with operational campaign activity to achieve the amplification required to impact a peer adversary's behavior.

The idea of a Joint Force Commander (JFC) leading multi-domain activities to counter peer-adversary WMD threats in competition remains nascent. Prior to the non-proliferation era, tactical CBRN offensive and defense capability dominated commanders' experience with this mission area. The idea of demilitarizing WMD capabilities only emerged in the late 1980s and early 1990s, and when it did, it was often seen as a responsibility of multi-national organizations supported by special technical units. The further evolution of that concept to include JFC-led WMD defeat missions within a larger kinetic operation began with the cautionary tale that was Task Force Disablement and Elimination during Operation Iraqi Freedom,[31] and later matured into a true multinational capability within U.S. Forces Korea over the course of almost 15 years.[32] Applying that evolutionary model to multidomain CWMD against peer adversaries indicates that a decade or more of engagement, advocacy and leader education may be required to build a sustainable JFC CWMD capability.

In summary, the Department has deep and exquisite CWMD capabilities at both the strategic and tactical levels that have often been combined with minimal operational intercession to achieve bespoke CWMD policy aims against VEO networks, rogue states, and regional powers. Flush from these successes, the 2014 DoD CWMD Strategy locked in a model of preventative CWMD operations that favored defeat of WMD pathways over employment of the full range of Joint Force capabilities to deter peer adversary WMD use.[33]

As DoD leaves that model of CWMD campaigning behind, it will require operational staffs capable of lashing together exquisite tactical capabilities, WMD-resilient joint forces, and strategic policy tools which have been optimized for a peer-adversary determined to contest U.S. diplomatic actions.

THE 2023 DOD CWMD STRATEGY: A SHIFT IN TONE

While the 2014 CWMD Strategy clearly prioritized actions taken by the Department to prevent WMD threats via pathway defeat, the new Strategy aims for a balanced approach that links closely with the 2022 National Defense Strategy concept of "integrated deterrence."[34] We will take a quick look at the strategic priorities, the ways the Strategy will achieve them, and some of the emergent opportunities to narrow the operational CWMD gap.

First, while authors of the 2023 DoD CWMD Strategy[35] do not rank-order the four strategic priorities (Defend, Deter, Enable and Prevent), the 2014 Strategy conveyed a very clear preference for the "prevent" organizing principle. Moreover, because many non-proliferation capabilities and authorities lie outside of DoD, this prevention-focused approach narrowed the number of operational players with the access, placement, and authority to contribute. Concurrently, a prevention-focused strategy demanded that the staff consistently prove a negative. Under the 2014 strategy, it soon became difficult to communicate goals and progress to senior leaders.

Compare this to the "deter" priority of the 2023 CWMD Strategy. JFCs faced with a nuclear-armed peer

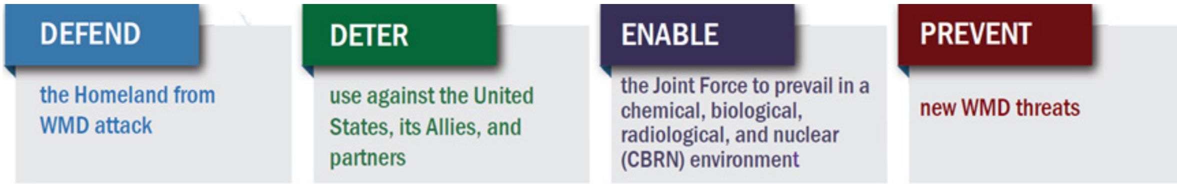


Figure 2. 2023 DOD CWMD Strategy strategic priorities.

adversary clearly understand how deterring "WMD use against the U.S., its Allies and partners" relates to the strategic objectives of the 2022 National Defense Strategy. Leaving aside the difficulty in measuring whether an adversary is truly deterred vice bored, uninterested, or distracted, the fact that a key priority of the Strategy is directly nested with an NDS objective provides immediate relevance. Moreover, JFCs clearly understand that they are enmeshed in national efforts to deter peer adversaries. One might argue the same was never really true about the 2014 CWMD Strategy's requirement to prevent new WMD threats—to the extent that a JFC *could* take action to defeat a WMD pathway, it was never clear how exactly that action aligned with superseding strategic priorities.

Finally, the Strategy makes clear that it is a Department priority to enable the Joint Force to prevail against peer-adversary WMD threats. As an added feature, the readiness of the Joint Force to conduct JMETs in a contemporary CBRN environment can—and should—be *measured* by Services and operational commanders.

For this reason, USANCA's CWMD Advisor Course focuses on how these operational staffs will enable the development and measurement of readiness and the translation of that readiness into a larger whole-of-staff approach with the goal of messaging the capability of joint and combined forces to hold key targets at risk in spite of WMD employment. Accomplishing this contributes to integrated deterrence by *denying benefit* while preserving options to *inflict costs* on an adversary.

In summary, even a cursory analysis of the new DoD CWMD Strategy makes clear that operational staffs—specifically Combatant Comanders and their component staffs—will be central to execution of this strategy. Yet, as discussed earlier, these staffs lack both the expertise and the recent experience to carry the water on these tasks.

WHAT CWMD *IS* DEPENDS ON *WHERE YOU SIT*

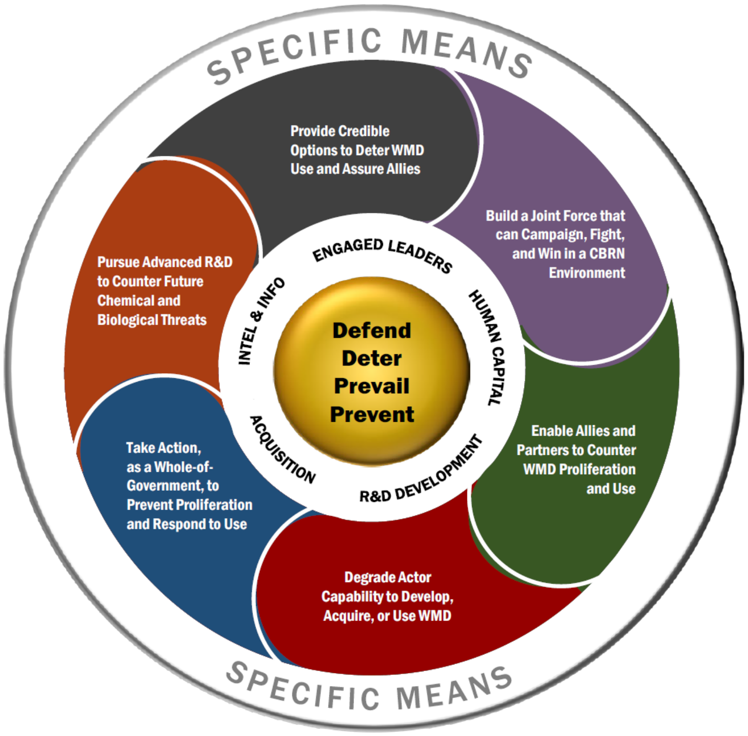
We have established at this point that the DoD approach to CWMD accepts significant risk within operational staffs while routinely overestimating the Department's ability to prevent threats before they could become operationally relevant.

The Department is now adapting to a CWMD reality which emphasizes deterring WMD employment and demonstrating the readiness of tactical maneuver units to overcome their battlefield effects. Within this new paradigm, prevention of new WMD capabilities will be frustrated by political and diplomatic realities, leading to the realization that the Department will be forced to consider ways to "degrade actor capability to develop, acquire or use WMD."[36]

In this reality, proxy conflicts take place under a nuclear shadow; battles for enduring advantage are won and lost during competition; tactical formations and operational staffs each play a continuous role in a strategic integrated deterrence scheme—witting or not. With the strategic framework now set, a brief survey of continuum of operations helps reveal what CWMD might now mean to commanders at each echelon.

Strategic Level

At the strategic level, the CWMD mandate is to maintain and strengthen strategic partnerships, deter conflict, prepare to manage escalation, and provide off-ramps if conflict arises. Strategic messaging, via multiple engagement tracks, aims to communicate that WMD use will be rapidly attributed and international response will be overwhelming and aimed at vital adversary interests. Whole-of-government capabilities are employed in coordination with allies, partners and JFCs to degrade adversary capabilities in furtherance of deterrence objectives.



2023 DoD CWMD Strategic "Ways"

- Provide credible options to deter WMD use and assure Allies and partners
- Build a Joint Force that can campaign, fight, and win in a CBRN environment
- Enable Allies and partners to counter WMD proliferation and use
- Degrade actor capability to develop, acquire, or use WMD
- Take action, as part of whole-of-government efforts, to prevent proliferation and respond to use of WMD
- Pursue advanced research and development efforts to counter future chemical and biological threats.

Figure 3. Strategic Approach and "Ways," 2023 DoD CWMD Strategy.

Operational Level

Operational staffs collectively curate and subtly message the resilience of Joint Force units to WMD effects while simultaneously conducting combined planning, capacity-building and rehearsals with host nations and international partners. The JFC's enduring intent is to assure partners and present hard targets to an adversary. Accordingly, CWMD professionals work across the staff to conduct WMD risk communication during active campaigning. Activities to degrade adversary WMD capabilities are balanced against actions to confound targeting, assure freedom of movement, and build redundancy and resiliency across the coalition.

Tactical Level

The tactical commander has two mandates with respect to CWMD:

1) Organize, train, and deploy forces to execute multi-domain operations on a transparent battlefield where the threat of non-strategic nuclear use is never ruled out and where threat-specific environmental CBR threats may appear with or without an attack signature.

2) Provide specific capabilities (Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR), long-range precision strike, technical CBRN capabilities, etc.) to support JFC flexible deterrence and response options.

For tactical commanders, protection aspects stemming from prompt nuclear and residual CBR effects are always a risk factor that weighs into their scheme of maneuver. Low-density CBRN defense capabilities must be carefully aligned against theater priorities, placing a premium on the ability of tactical units to plan their operations such that they reduce reduce vulnerability and maximize organic defense capabilities against WMD effects. Achieving this level of sustained readiness is the responsibility of Service headquarters and their theater components. Doing so frees operational staffs to focus on setting theater architecture, conducting of active campaigning, and capacity-building with allies and partners.

The take-away is that DoD's approach to CWMD is difficult to explain or defend using broad language and objectives. Commanders at each level are focused on a single part of the elephant, and their staffs often struggle to describe how each piece fits with the next. The next version of JP 3-40 should clearly elucidate how these interrelated tasks and activities nest and accrete to achieve the overall vision outlined by the 2023 DoD CWMD Strategy.

THE TOOLS FOR THE JOB

We've established that emerging DoD CWMD strategic guidance lays down a gauntlet to operational commanders to find a way to link strategic non-proliferation capabilities, resilient multi-domain-capable joint forces and low-density technical CBRN capabilities. They will accomplish this within a campaign framework that deters peer-adversary WMD use, assures allies and partners, and achieves U.S. strategic objectives. Achieving that tall order will require a number of supporting efforts.

By narrowing the focus to the operational CWMD void, it becomes clear that there is room for improvement in how we prepare and develop operational staffs. That begins with providing them with a strong planning and doctrinal basis to organize their activity. The emerging USSOCOM-led rewrite of the Functional Campaign Plan for CWMD will begin to address this gap, as will the coming revision of JP 3-40. The manner in which both of these key documents are implemented will set the tone for the campaign throughout the rest of the decade.

Within the joint professional military education (JPME) community, it would be worthwhile to review how WMD effects and CWMD activities are being presented to mid-grade leaders who constitute the bulk of CCMD and component staffs. The strategic environment has changed rapidly; existing JPME-1 learning objectives and capstone exercise scenarios will likely require continual adaptation and assessment to keep pace. The same argument can be made for JPME-2.

Within the Services, additional scrutiny on how CWMD professionals are prepared for operational assignments is needed. One Army example is within Functional Area 52, Nuclear and CWMD Officers. While these officers have always been provided a strong educational foundation in nuclear policy, stockpile management, and nuclear weapon effects, increasing assignment within broad operational CWMD roles exposed a gap in their functional education. In recognition of this, the Army FA52 Proponent recently directed that Phase II of the CWMD Advisor Course (D1) be incorporated into the FA 52 Qualification Course beginning in FY24. This relatively small change will—over time— ensure that FA52 officers being assigned across DoD bring a strong foundational knowledge in both nuclear operations and CWMD activities.

Across the DoD, senior leaders require direct engagement with CWMD professionals in order to update their assumptions on operational nuclear deterrence and CWMD activities in the context of peer competition. There is no one organization that owns this responsibility; it is incumbent on knowledge incubators across the DoD CWMD enterprise to seek out and demystify the mission area to the leaders responsible for planning, programming and executing the critical capabilities that underpin CWMD activity.

Existing operational staffs engaged in active campaigning cannot wait the years that it would take for common-core and functional PME reform to gradually raise CWMD fluency of their staffs and supporting agencies. They require immediate training and education solutions that can build the capability of assigned CWMD professionals, develop a network of CWMD "integrators" across the rest of the staff, and increase the capability of the CWMD advisors that augment their staffs from supporting agencies such as Defense Threat Reduction Agency (DTRA), the 20th CBRNE Command, and USSOCOM J10.

Finally, all of these staffs require planning frameworks and organizational processes that link CWMD activities to operational and strategic objectives within the context of peer competition. Within the CWMD Advisor Course, we have focused on the manner in which the staff assesses and portrays WMD risks to the JFC.

A detailed breakdown of this methodology will be the subject of another article, but the problem statement can be summarized as follows: Although compliance-based risk assessment (see Figure 4) is fit for purpose in many tactical applications with rapid decision cycles and limited scope of effects, those same models quickly break when applied at the operational level, especially when WMD is part of the calculation.

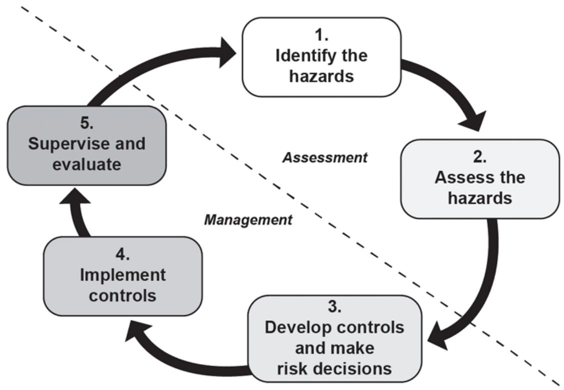


Figure 4. An Army compliance-based risk management model.[38]

The Joint Risk Assessment Model provides a more fulsome tool, but it too breaks down in operational application due to the speed at which WMD employment reverberates at the operational and strategic level, with immediate implications to campaign and coalition management, strategic deployment, and escalation control. It is important to note that operational commanders' ability to execute their current missions informs the Department of Defense's capability to generate forces, fulfill its functions, and account for future challenges. Commanders accounting for and responding to the risk of WMD employment across warfighting functions ensures the challenge of a WMD equipped adversary doesn't affect the Department of Defense's ability to function, and instead informs policy makers on how to account for future challenges. Slowing and managing the "risk cascade" endemic to WMD employment while also understanding how risk is communicated in competition and campaigning (see Figure 5) is a major focus of the CWMD Advisor course.[39]

We make no promises within the course that we've arrived at the answer to this wicked problem—our goal is simply to arm operational staffs with the right questions We're confident that they will guide all of us all to best solution in the fullness of time. The students spill a little more light on the pathway within every class.

CONCLUSION

Countering WMD in today's context is a tremendously complex endeavor that involves deterring and degrading adversary WMD capabilities, managing regional WMD threats, and actively combating trans-national networks and violent extremist organization (VEO) threats while defending the Homeland against attack and assuring partners and allies. These activities take place in all domains and across all dimensions. They are continuous through all operational phases and they require harmonized efforts from commanders at all levels from tactical through strategic. Finally, the consequences of failure or miscalculation are severe.

Commanders understand the importance of WMD in the operational space, but are often uncertain how to mitigate risk because of the inability of CWMD professionals to describe their own mission space in operational terms. WMD threats are often lacking in context and are not scoped against competing operational risks, leaving leaders to apply their own judgement, which is often poorly-informed due to thirty years of institutional inattention and conceptual atrophy. Just as nature abhors a vacuum, senior leader information gaps are quickly filled by myths, platitudes, and fatalism.

Combating this tendency requires development of a robust network of CWMD professionals, supported by CWMD "integrators" distributed across key joint staff directorates, and augmented by competent advisors from supporting joint and Service-provided organizations. Finally, it requires consistent and intentional leader engagement. In an era of constant crisis, it is unrealistic to expect senior leaders to take a knee and focus on this mission set. They—and their staffs—are likely to have to continue to learn to conduct CWMD activities against a peer adversary while at a dead run.

Windows for meaningful engagement will be fleeting and few. When the opportunity presents, will we be able to clearly describe CWMD campaigning against a peer adversary in the language of operational risk? Or will it be yet another case of blind men describing an elephant? ■

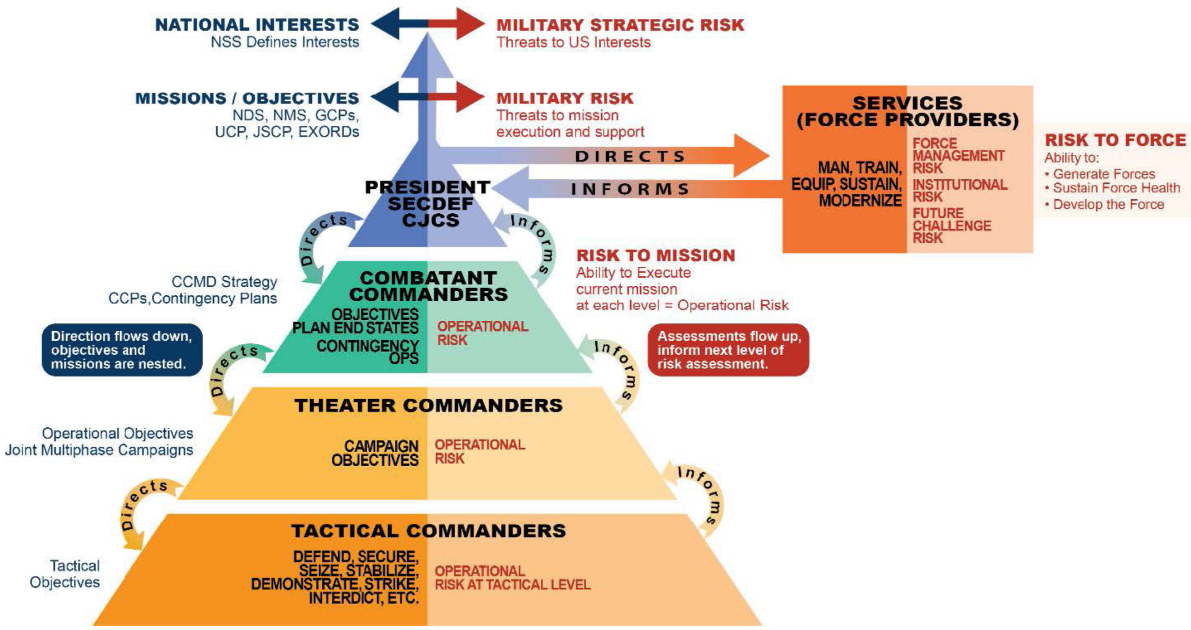


Figure 5. Organizations and Risk[40]

MR. PAUL A. SIGLER

leads the Nuclear and CWMD Integration Division at the U.S. Army Nuclear and CWMD Agency (USANCA), at Ft. Belvoir VA. He has a B.S. in Chemical Engineering from Rose-Hulman Institute of Technology, an M.A. in National Security and Strategic Studies from the Navy War College, and an M.S. in WMD Studies from Missouri State University. He was previously assigned as the CWMD Readiness Division Chief, also at USANCA. His email address is paul.a.sigler.civ@army.mil.

MAJ.(P) JAMES C. BOWEN

is the CWMD Advisor Course Manager at the United States Army Nuclear and CWMD Agency, HQDA G3/5/7 in Fort Belvoir, Virginia. He has a B.S in Physics from the United States Military Academy and a M.S. in Physics from the Naval Postgraduate School. He was previously assigned as a Deputy Team Chief for a Nuclear Disablement Team at the 20th CBRNE Command. His email address is james.c.bowen22.mil@army.mil.

ENDNOTES

1. There are many descriptions of this particular story. This link goes to one of my favorites: https://buddhismnow.com/2018/02/16/tittha-sutta-buddhist-parable-of-the-blind-men-and-the-elephant/.

2. Department of Defense, DoD Directive 2060.02 “DoD Countering Weapons of Mass Destruction (WMD) Policy”, 27 January 2017, p. 11.

3. Caves, John P. Jr. “Fentanyl as a Chemical Weapon”, *CSWMD Proceedings*, December 2019. https://wmdcenter.ndu.edu/Publications/Publication-View/Article/2031503/fentanyl-as-a-chemical-weapon/.

4. For a much more detailed discussion of the many definitions of “WMD”, see *Occasional Paper #8: Defining Weapons of Mass Destruction*, by W. Seth Carus, https://wmdcenter.ndu.edu/Portals/97/Documents/Publications/Occasional%20Papers/08_Defining%20Weapons%20of%20Mass%20Destruction.pdf.

5. For one example as to how long this particular malapropism has persisted, see: Ms. Elizabeth Felling and Mr. Keith Sloan, “CWMD is not CBRN: All WMD require CBRN, but CBRN does not encompass all CWMD”, *CWMD Journal*, Issue 11, 2014, pp. 2-4. https://www.usanca.army.mil/Portals/114/CWMD_Journal/CWMD%20Journal%20Issue%2011.pdf?ver=BW1WWkMkhdNCHm0EIAscWQ%3d%3d.

6. Joint Publication 1, Volume 1, *Joint Warfighting*, 27 August 2023, p. III-1. Available on the Joint Electronic Library (JEL+) at https://jdeis.js.mil/jdeis/index.jsp?.

7. Deployable Training Division, Joint Staff J7, “Insights and Best Practices Focus Paper: Interorganizational Cooperation, Fifth Edition”, April 2018, p.5.

8. Ibid.

9. The preface of Joint Publication 1, Volume 1, *Joint Warfighting*, places among its key goal the description of “the organization and command and control mechanisms of joint command organizations to execute joint all domain operations, achieve unified action, and carry out global military strategic and operational integration.”

10. See the description of the State Department’s ”Future of Iraq’ project by James Fallows, “Blind into Baghdad”, *The Atlantic*, Jan/Feb 2004. https://www.theatlantic.com/magazine/archive/2004/01/blind-into-baghdad/302860/.

11. One brief example is a 9 October 20021 press conference with Secretary of Defense Donald Rumsfeld when asked about the future government of Afghanistan: “Because the United States and others that are deeply concerned about terrorism and the enormous damage that can be done to thousands of human beings by terrorists, because we have that concern and we go in and root out terrorists, I don't think leaves us with a responsibility to try to figure out what kind of government that country ought to have.” This approach typified the U.S. military approach to both Iraq and Afghanistan post-conflict planning. https://www.washingtonpost.com/wp-srv/nation/specials/attacked/transcripts/rumsfeld_100901.html.

12. This story spans twenty years of operations in Afghanistan. You can read a concise summary here: https://www.atlanticcouncil.org/blogs/new-atlanticist/us-pakistan-dialogue-of-the-deaf/.

13. The Kilcullen work mentioned above applies here as well. https://smallwarsjournal.com/documents/kilcullen1.pdf.

14. https://armscontrolcenter.org/fact-sheet-the-nunn-lugar-cooperative-threat-reduction-program-2/.

15. The full story of the establishment of the Proliferation Security Initiative to include the interdiction of the Libya-bound vessel *BBC China* is described in Susan J. Koch’s paper “Proliferation Security Initiative: Origins and Evolution”, National Defense University Press, June 2012. https://wmdcenter.ndu.edu/Portals/97/Documents/Publications/Occasional%20Papers/09_Proliferation%20Security%20Initiative.pdf.

16. For a complete timeline of efforts to eliminate Syria’s chemical weapons capability (to include the role of the *M.V. Cape Ray*), see: https://www.armscontrol.org/factsheets/Timeline-of-Syrian-Chemical-Weapons-Activity.

17. See https://www.hhs.gov/sites/default/files/surgeon-general-misinformation-advisory.pdf.

18. See https://abcnews.go.com/US/happen-russia-blows-zaporizhzhia-nuclear-power-plant/story?id=100846888.

19. The State Department highlights this particular example: “One of the Kremlin’s most notable false claims is that the United States worked with Ukraine to train an army of migratory birds, mosquitos and even bats to carry biological weapons into Russia.” https://www.state.gov/the-kremlins-never-ending-attempt-to-spread-disinformation-about-biological-weapons/.

20. Given the readership of this Journal, footnoting this particular reference might be perceived as an insult. However, you may read more about this particular pop-culture reference here: https://en.wikipedia.org/wiki/Kobayashi_Maru.

21. DoD established the Center for the Study of Weapons of Mass Destruction (CSWMD) in 1994, and the original founder of that organization, Ambassador Robert Joseph went on to author the first (and only) *National Strategy to Combat Weapons of Mass Destruction* in 2002.

22. The most concise summary of all of these CWMD campaigns can be found in the country-specific fact sheets published by the Arms Control Association. See: https://www.armscontrol.org/factsheets.

23. See https://www.archives.gov/research/guide-fed-records/groups/175.html.

24. See https://www.defense.gov/News/Releases/Release/Article/3451920/us-completes-chemical-weapons-stockpile-destruction-operations/.

25. See https://2001-2009.state.gov/r/pa/ho/frus/nixon/e2/83597.htm.

26. See https://fas.org/publication/tomahawk/.

27. The full series of nuclear reductions in 1991-1992 are described in Susan Koch's Case Study "The Presidential Nuclear Initiatives of 1991-1992", National Defense University Press, 1 September 2012. http://wmdcenter.ndu.edu/Publications/Publication-View/Article/627149/the-presidential-nuclear-initiatives-of-1991-1992/.

28. From JP 3-40, *Joint Countering Weapons of Mass Destruction*, 27 November 2019, p. IV-11: "For major operations and campaigns, which balance offensive, defensive, and stability operations, [CBRN Response] supports the joint force's defensive and stability actions. Within the construct of such operations, *the joint force needs to be prepared for a variety of WMD situations*, such as an inadvertent release, release due to joint force action, or an actor of concern's employment of CBRN materials." The emphasis of "balance" across the various joint CWMD activities in the new DoD CWMD Strategy will necessitate revision of JP 3-40 to match the new strategic tone, which clearly connects CBRN resiliency of the Joint Force to integrated deterrence.

29. See ATP 3-37.11 *Chemical, Biological, Radiological, Nuclear, and Explosives Command* and ATP 3-90.40 *Multi-Service Tactics, Techniques, and Procedures for Combined Arms Countering Weapons of Mass Destruction*.

30. See https://www.un.org/en/sc/1540/1540-fact-sheet.shtml.

31. For a detailed description of WMD elimination in Iraq, see Rebecca K.C. Hersman "Eliminating Adversary WMD: What's at Stake?", National Defense University Press, 2004. https://wmdcenter.ndu.edu/Publications/Publication-View/Article/621472/eliminating-adversary-wmd-whats-at-stake/

32. For an example of how 20th CBRNE partners with the operational commanders and ROK allies to provide this a capability, see: https://www.dvidshub.net/news/209352/20th-cbrne-command-certifies-jtf-e.

33. The SECDEF's foreword of the 2014 DoD CWMD Strategy plainly states: "…this strategy emphasizes early action through pathway defeat, shaping the environment to dissuade actors from pursuing WMD, and cooperating with partners to achieve countering WMD goals." For more detail, see: https://apps.dtic.mil/sti/citations/ADA603433.

34. "*Integrated deterrence* entails working seamlessly across warfighting domains, theaters, the spectrum of conflict, all instruments of U.S. power and our network of Alliances and partnerships… Integrated deterrence is enabled by combat-credible forces prepared to fight and win as needed, and backstopped by a safe, secure, and effective nuclear deterrent." Department of Defense, *2022 National Defense Strategy of the United States of America*, p. 1. https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF.

35. Department of Defense, *2023 Department of Defense Strategy for Countering Weapons of Mass Destruction*, 28 September 2023. https://media.defense.gov/2023/Sep/28/2003310413/-1/-1/1/2023_STRATEGY_FOR_COUNTERING_WEAPONS_OF_MASS_DESTRUCTION.PDF.

36. Ibid, p. VIII.

37. USSOCOM as the DoD Coordinating Authority for CWMD prepares and assesses performance against this CWMD-specific functional campaign plan per guidance in the Joint Strategic Campaign Plan. See JP 3-40, *Joint Countering Weapons of Mass Destruction*, 27 November 2019, pp III-4 to III-5.

38. ATP 5-19, *Risk Management*, November 2021, p. 1-4.

39. We would like to acknowledge the outstanding work of Lt. Col. Diana Cruz and Maj. Taylor Harrington in developing the risk module currently being taught within the CWMD Advisor Course.

40. CJCSM 3105.01A, *Joint Risk Analysis Methodology*, 12 Oct 21, p. A-2.

EXPLAINING THE DOD AND DOE ROLES IN THE U.S. NUCLEAR ENTERPRISE

- AND -

COMPARING MODERNIZATION EFFORTS BETWEEN THE U.S., CHINA, AND RUSSIA

CAPT. DILLON M. LYNCH

INTRODUCTION

The United States has a long, storied history of assuring U.S. national security through the development and forward deployment of nuclear weapons. Since WWII, the United States has developed and brought into service ninety-nine types of warheads and multiple delivery systems.[1] During the Cold War, the U.S. continuously modernized and developed new, advanced nuclear weapons and delivery systems to stay ahead of and deter the Soviet Union from conducting a nuclear strike. After the fall of the Soviet Union, the new geopolitical environment saw the United States go through a period of defense reductions that shifted focus toward domestic concerns. National Security Strategy focused the defense sector on planning for regional conflicts where the United States would have technological advantages over its adversaries, most of which would not possess nuclear weapons. Following the collapse of the Soviet Union, the Base Force Design and the Bottom-Up Review cut funding for the Department of Defense. After September 11, 2001, the defense sector saw a boost in funding but directed most of these funds to efforts in the Middle East to combat terrorism.

While the War on Terror continued to be the main priority of the United States, funding for nuclear weapon modernization was given a lower priority. This relegation was explained in the 2010 Nuclear Posture Review (NPR) and altered the nuclear weapons strategy of the United States. In the NPR, the executive branch took a hard stance that focused on reducing the role of nuclear weapons in U.S. strategy. The review devoted an entire chapter to discussing the policy shift and listed reducing the role of nuclear weapons as its second highest priority, behind nuclear nonproliferation and ahead of maintaining strategic deterrence.[2] Nuclear weapon modernization efforts were further constrained after the signing of the New Strategic Arms Reduction Treaty (New START) in 2010 between the U.S. and Russia, which specified limits on the number of deployable weapons and delivery systems for both countries and significantly reduced those quantities from previous treaty levels, and by the 2011 Budget Control Act which set limits on defense appropriations. This period of rapprochement and strained budgets further justified the reduced emphasis and role of nuclear weapons in U.S. National Security Strategy. The strategy outlined in the 2010 Nuclear Posture Review would be the leading nuclear weapons strategy until another review was published in 2018. The 2018 Nuclear Posture Review concluded that reducing the role of nuclear weapons was not producing the intended results and began adjusting the focus back to modernization.

> "Despite concerted U.S. efforts to reduce the role of nuclear weapons in international affairs and to negotiate reductions in the number of nuclear weapons, since 2010, no potential adversary has reduced either the role of nuclear weapons in its national security strategy or the number of nuclear weapons it fields. Rather, they have moved decidedly in the opposite direction. As a result, there is an increased potential for regional conflicts involving nuclear-armed adversaries in several parts of the world and the potential for adversary nuclear escalation in crises or conflict."[3]

The refocused efforts on nuclear modernization in 2018 has carried forward in budget request documents through the current administration. However, in the 2022 Nuclear Posture Review, an emphasis on reducing the role of nuclear weapons returned. Nevertheless, the review also outlined (indirectly) that modernization efforts enacted under the previous administrations would continue.

With the re-ignition of great power competition, codified by the rise of Russia and China as great power competitors, the United States must now assess its nuclear modernization efforts to compete with the changing geopolitical environment. As these two nations challenge the U.S.-led rules-based international order, with Russia invading Ukraine and suspending its participation in New START and China increasing its nuclear weapons modernization and procurement activities, the current administration must make tough choices that will affect the ability of the U.S. nuclear enterprise to continue to deter aggression from its adversaries. The following paragraphs will explain the U.S. nuclear weapons enterprise, outline the different responsibilities of the Department of Defense and Department of Energy for nuclear modernization and maintenance, provide a brief overview of the budgeting process that is directed towards modernizing the nuclear enterprise, discuss current modernization programs, and compare the current and future capabilities of the U.S., Russia, and China.

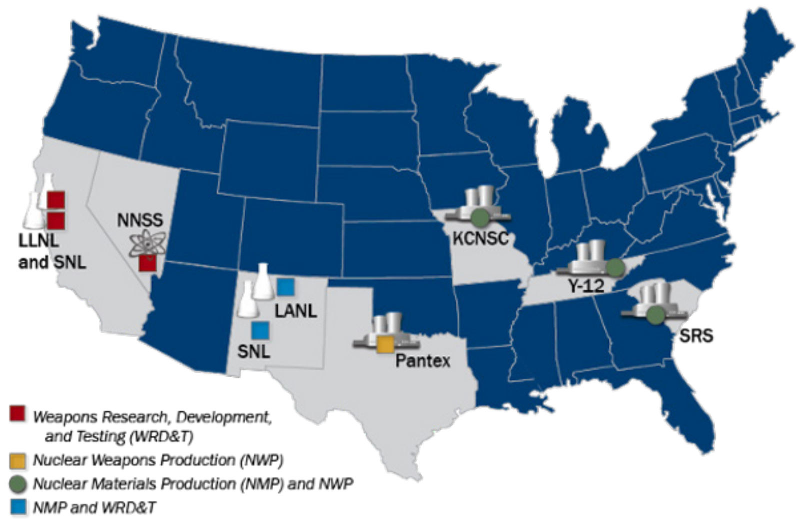


Figure 1. NNSA Nuclear Security Enterprise. Retrieved from Nuclear Matters Handbook 2020 Chapter 5: NNSA Nuclear Security, pp.52.

U.S. NUCLEAR WEAPONS ENTERPRISE: DOD AND DOE

The U.S. Nuclear Weapons Enterprise consists of the U.S. Nuclear Weapons Complex, managed by the Department of Energy (DOE), and Strategic Nuclear Forces, managed by the Department of Defense (DOD). The Nuclear Weapons Complex is comprised of the leading facilities used to maintain and develop U.S. nuclear weapon stockpiles. It consists of nine facilities across seven states and the Tennessee Valley Authority (TVA) nuclear reactor.[4] Figure 1 depicts a map of the nuclear weapons complex.

The Department of Energy's sub-agency, the National Nuclear Security Agency (NNSA), oversees "the research, development, test, and acquisition programs that produce, maintain, and sustain nuclear warheads."[5] To fulfill this mission, the NNSA controls and manages facilities around the U.S. that are involved in the procurement, production, and/or enrichment of plutonium, uranium, lithium, and tritium, all of which are part of the weapons package that produces nuclear yield. The NNSA also works with the National Labs to align research and support requirements to meet the enterprise's objectives.

While the NNSA is tasked with warhead development, the Department of Defense is tasked to "develop, deploy, and operate the missiles, submarines, and aircraft that deliver nuclear warheads and generate the military requirements for the warheads carried on those platforms."[6] DOD manages the United States' nuclear triad – the combination of nuclear warheads, launchers, and delivery platforms – the purpose of which is to deter strategic nuclear attacks on the United States, as well as other types of attacks on the U.S. and its allies. The nuclear triad deters attacks by guaranteeing that the U.S. has a global capability to launch a nuclear first-strike or counter-strike. The U.S. nuclear triad has three legs – air, land, and sea – and consists of 14 Ohio Class ballistic missile submarines (SSBN), 400 LGM-30G Minuteman III ground-based intercontinental ballistic missiles (ICBMs), and 66 heavy bomber aircraft (20x B-2As and 46x B-52s).[7] The United States also maintains fighter aircraft (F-15E), designated as Dual Capable Aircraft (DCA), that can carry conventional missiles or gravity bomb nuclear payloads. These aircraft are not considered strategic systems because of the limited ranges that the aircraft can fly. U.S. dual capable aircraft are forward stationed in Europe under NATO guidelines.

The United States designates nuclear payloads as either bombs (B) or warheads (W). Payloads designated with (B) are gravity bombs that are dropped from an aircraft onto a target. The United States currently deploys two different bomb designs: the B61 and B83.[8] Payloads designated with a (W) are warheads carried by missiles to a target. They are deployed on submarines and in-ground silos and can be deployed from aircraft using air-launched cruise missiles (ALCM). The United States' current force structure consists of five types of warheads: W76, W78, W80, W87, and W88.[9] The United States' last newly developed nuclear warhead was the W88, designed and produced over three decades ago.

BUDGETING

The DOD and NNSA use the Planning, Programming, Budgeting, and Execution (PPBE) process for requesting funding and developing future year budgets. Once assessed by the Office of Management and Budget (OMB) and approved by the President, the proposals are sent to Congress for further vetting, markups, and approval. Congress then authorizes and appropriates the funding. Funding for both is allocated through the National Defense budget identified as the "050" account. As stated in the Nuclear Matters Handbook, "this account is divided into sub-accounts: 051 for DoD national security funding; 052 for classified budgeting for certain specific national security activities; 053 for Department of Energy (DOE)/National Nuclear Security Administration (NNSA) defense programs; and 054 for defense-related activities in other departments."[10] All nuclear modernization efforts are funded through one of these accounts.

The Congressional Budget Office conducted a study estimating the costs for the U.S. nuclear enterprise from 2021-2030. The study assesses that the U.S. will require $551 billion to maintain and modernize its nuclear enterprise during this period. The allocation of the $551 billion is divided into four separate cost sections, which are strategic ($297 billion) and tactical ($17 billion) nuclear delivery systems and weapons, DOD's Nuclear Command and Control System (NCCS) and early warning system ($94 billion), and DOE's nuclear weapons facilities and supporting activities ($142 Billion).[11]

Additionally, within the CBO analysis of the $551 billion estimated for the U.S. nuclear weapons complex from 2021 to 2030, $188 billion is anticipated for nuclear modernization, of which $175 billion would be dedicated to the strategic nuclear triad.[12] Of the $188 billion estimate, $154 billion would be programmed for DOD and dedicated to modernizing delivery systems. In comparison, the remaining $34 billion would be programmed for DOE to develop new warheads, refurbish current warheads, and develop a new naval nuclear reactor.[13] Notably, within the CBO cost estimate was also an anticipated requirement of $35 billion to modernize DOE facilitates.

The NNSA divides its funding allocations across all its mission sets, which include stockpile management and development, nonproliferation, counterterrorism, and naval nuclear reactor missions, each of which is a line item within its budget. Stockpile management, development, and modernization are all listed together in NNSAs budget under the title "Weapons Activities" and historically consume the most significant portion of its budget. For example, in FY2022, the NNSA was allocated $20.37 billion, of which $15.92 billion was allocated to weapons activities.[14]

After reviewing the Department of Energy and NNSA budget requests and future years' planning, weapons activities continue to receive and request increased funding from FY2022 to FY2028. From FY 2022 to 2023, the budget increased by 7% from $15.92 billion to $17.12 billion.[15] The current FY 2024 budget requests an additional increase of 10.3%, which is well above the yearly inflation estimate, currently at 6%.[16] The FY 2024 budget requests $18.83 billion and projects steady increases in funding to $20.7 billion by 2028.[17] The future estimates within the budget increase NNSA funding by less than 6% from 2024 to 2025 and level off to approximately 2% increases from 2025 to 2028. The NNSA would receive a boost in real dollars of funding from FY 2024 to FY 2028. However, since the Federal Reserve has a target inflation rate of 2% the funding analysis depicts that these requests are only set to keep pace with a standard inflation rate of 2%, effectively flatlining the budget for NNSA weapons activities. Figure 2 provides an overview of NNSA's budget forecasts along with inflation data.

NNSA Weapons Activities Budget Forecast			
Year	Request	% Change	Inflation Rate/ Anticipated Rate
FY 2022	$15,920,000.00	-	6.5%
FY 2023	$17,116,119.00	7.5%	6%
FY 2024	$18,832,947.00	10.03%	2.4%
FY 2025	$19,390,942.00	2.9%	2.3%
FY 2026	$19,818,932.00	2.2%	2.3%
FY 2027	$20,285,683.00	2.35%	2.3%
FY 2028	$20,747,386.00	2.27%	2.3%

Figure 2. Data retrieved from Budget Justification and inflation rates obtained through OECD websites at: https://knoema.com/kyaewad/us-inflation-forecast-2022-2023-and-long-term-to-2030-data-and-charts.

NUCLEAR MODERNIZATION

Modernization is advancing from one generation of weapons systems to the next. It involves enhancing the capability or capacity of modernized items by using more advanced technologies. Modernization of the U.S. nuclear enterprise consists of not only nuclear warheads but also modernizing the weapon's delivery platforms, delivery vehicles, and the NCCS. Government agencies and executive administrations have also used the term modernization to describe upgrading the facilities and infrastructure of the nuclear weapons enterprise, specifically when discussing stockpile development and management under NNSA. As stated in the 2018 NPR, "Over half of NNSA's infrastructure is over 40 years old, and a quarter dates back to the Manhattan Project era."[18] When reviewing NNSA budget documents, line items for facilities are designated as modernization efforts. For example, under its "Production Modernization" sections, the NNSA has requested funding for modernizing its plutonium production capabilities at Los Alamos National Lab and the Savannah River Plutonium Processing Facility.[19]

NNSA Modernization

It has been argued that the nuclear weapons complex has fallen prey to the train wreck thesis, which states that since the Cold War, the U.S. has not properly or consistently modernized. The current stockpile of warheads in the U.S. arsenal were all developed in the 1970s and 1980s and had initial design lives of 20 years.[20] Since the end of the Cold War, the United States has invested predominantly in modernizing delivery platforms and vehicles, choosing to conduct life extension programs (LEP), modifications (MOD), and alterations (ALT) on most warheads. LEPs are conducted to address aging and performance issues of the warhead over time and are intended for the warhead to maintain its designed capability. MODs use different types of components to change the operational characteristics of a nuclear package but are based on the design of the original weapon. For example, the B61 has twelve different modifications. These MODS are designated by adding the modification number after the design, i.e., B61-1 to B61-12. ALTs occur when minor changes are made to modified designs but do not result in a change to the system's operational performance.

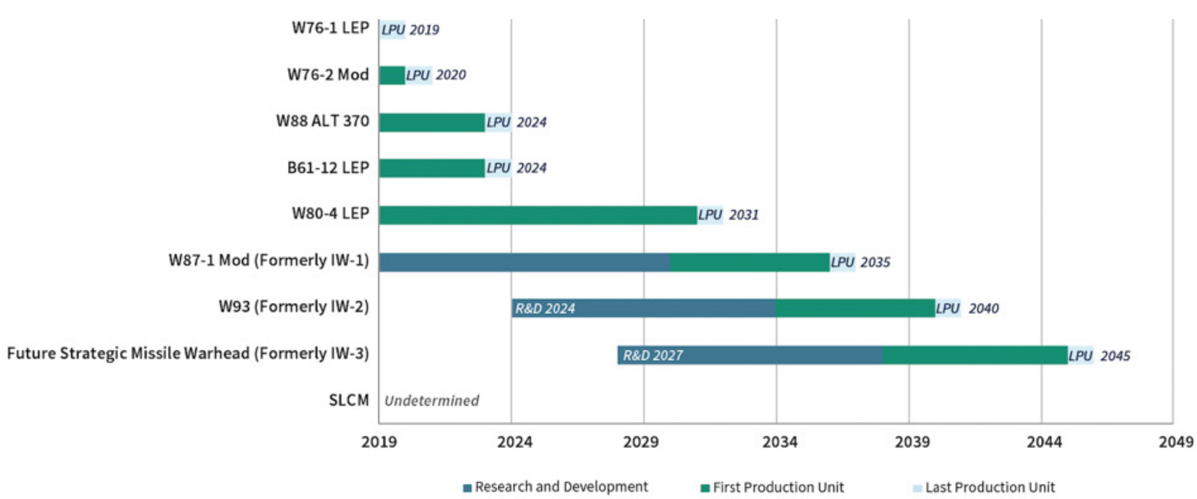


Figure 3. Chart retrieved from CSIS article "US Nuclear Warhead Modernization and 'New' Nuclear Weapons" pp. 3.

For example, the B61-4 has a program to increase its security features. The alteration of this program results in the warhead naming convention of B61-4 ALT 370. LEPs, MODs, and ALTs are essential to ensure the reliability of U.S. nuclear warheads, but definitionally, does not constitute modernization of the warhead. The U.S. has continuously increased the service life of its warheads using the LEP, MOD, and ALT systems to upgrade features and exchange deteriorating pieces and parts.

The NNSA currently has seven appropriations in its budget classified as warhead modernization programs. These are the B61-12 LEP, the W88 ALT 370, the W80-4 LEP, the W80-4 ALT-SLCM, W87-1 MOD, the W93, and the Future Strategic Missile Warhead.[21] Figure 3 displays NNSA's most recent modernization efforts. It has six active or scheduled modernization programs and two recently completed programs. Six of the eight programs are considered MODs, LEPs, or ALTs. The total appropriated funding for these programs in FY 2023 is $2.9 billion, with the FY 2024 budget requesting a 6.9% increase to $3.1 billion.[22]

The SLCM-N annotated in Figure 3 was a program focused on developing a low-yield sea-launched cruise missile like the tomahawk land-attack cruise missile that was deployed during the Cold War and retired in 2013. The 2022 Nuclear Posture Review officially canceled the program, and funding was removed from the FY 2024 budget, citing prohibitive cost acquisition.[23] The removal of funding for the system is annotated in the NNSA FY 2024 budget under W80-4 ALT SLCM, which has an allocation of $0 for FY 2024 – FY 2028.[24] Both the Secretary of Defense and Chairman of the Joint Chiefs confirmed to Congress the value of having the SLCM-N within the U.S. arsenal, nevertheless, the current administration has decided the capabilities of the W76-2, a modification completed in 2020, provides a sufficient deterrent to cover the gaps.[25] However, unlike the Cold War era tomahawk nuclear cruise missile, the W76-2 is not designed for deployment on surface ships or attack submarines.[26] Therefore, the number of W76-2's deployed on strategic nuclear submarines is limited by New START treaty obligations, whereas the ability to deploy the SLCM-N on attack submarines and surface ships, which do not count towards treaty obligations, would allow the U.S. additional options to combat the growing threat and quantity of the Chinese and Russian arsenals.[27] These fundamental differences, among others, have caused debate in the defense community on whether the SLCM-N should be reconsidered in the future. Although the choice has been made to cancel the program, future administrations may choose to restart it.

Currently, the United States is designing two warhead capabilities that are in various stages of the RDT&E process. The first, the W93, is designed to be a submarine-launched ballistic missile and will either complement or replace the W88 and/or the W76, both deployed on Ohio Class Submarines. The W93 completed Phase 6.1 (Concept Assessment) of the Phase 6.X process in FY 2022 and funds have been allocated to complete Phase 6.2 (Feasibility Study) from 2023 to 2024, with the first production scheduled for FY 2034.[28] The second warhead, the Future Strategic Missile Warhead, is slated to conduct Phase 6.1 assessment in FY 2027, with the first production approximately scheduled for 2038.[29] NNSA has forecasted a requirement of $70 million in funds for the program for FY 2027 and $112 million for FY 2028. (See Figure 4 for Phase 6.X Process)

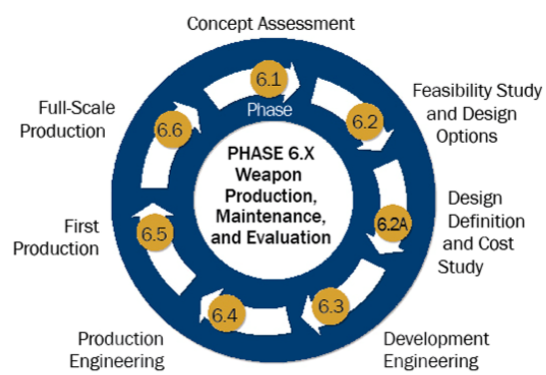


Figure 4. Displays the Phase 6.X Process for Developing Nuclear Weapons. The Chart was retrieved from the Nuclear Matters Handbook 2020 Chapter 7: Nuclear Weapons Life Cycle pp. 79.

Although the nuclear weapons complex continues to modernize, there are signs that the enterprise may have fallen prey to the train wreck thesis. This is mostly seen within the production facilities of the nuclear weapons complex. For example, the ability of the U.S. to produce plutonium pits has been degraded since 1989, and its current stockpile of low-enriched uranium (LEU) will run out by the mid-2020s.[30] In the 2022 Nuclear Posture Review, the NNSA was tasked with instituting a Production-based Resilience Program (PRP) to ensure the United States develops and maintains an infrastructure system to produce plutonium pits for its nuclear weapons. Officials estimated a requirement to produce 80 pits annually by 2030 to replace the entire stockpile's pits by 2080. However, in the 2023 House Armed Services Committee Summary of the Fiscal Year 2023 National Defense Authorization Act, Congress acknowledged that the NNSA plan to produce 80 pits a year needed to be revised and tasked DOD and the NNSA to develop more realistic pit production plans.[32] Furthermore, based on a 2017 assessment, the United States will soon be unable to produce enough tritium for its nuclear weapons after shutting down its only LEU processing center in 1998.[33] This facility generated the LEU required fuel to produce tritium, which, by law, must be made in the United States. Without this capability, the United States risks not being able to produce enough tritium to replace its warheads by 2030.[34]

DOD Modernization

As stated, the DOD manages and maintains the country's nuclear triad. Modernization programs have begun for each leg, including developing new delivery systems, platforms, and launchers. The Air Force is the lead management agency responsible for modernizing the air and ground legs of the nuclear triad. It operates the heavy bomber and DCA fleet and maintains the ground-based Minuteman III missiles. The Air Force has three air-leg modernization programs and one ground-leg modernization program currently in development. The air modernization programs are the development of the B-21 heavy bomber, acquiring a new air-launched cruise missile named the Long-Range Standoff Weapon (LRSO), and the certification of the F-35 fighter aircraft as a DCA.

The B-21 heavy bomber is being designed as a dual-capable aircraft (DCA) that can carry both conventional and nuclear munitions and will replace the aging B-2A and B-1 bomber aircraft.[35] Its estimated unit cost is $692 million (2022 dollars), and the first unit is scheduled to enter service in the mid-2020s.[36] The AGM-86 is a nuclear air-launched cruise missile (ACLM), which enhances the survivability of the B-52 heavy bomber by allowing the aircraft to hold targets at risk without entering an adversary's airspace. The LRSO is set to replace the aging AGM-85 ALCM, which has been used since 1982 and is designed for use on the B-52 and the B-21.[37] The certification of the F-35 as a DCA does not have a solidified date, but the U.S. plans to have the aircraft certified to use the B61-12 by NATO's stated required operational date of January 2024.[38]

The Air Force is also procuring the Sentinel ICBM, formerly the Ground Based Strategic Deterrent, to replace the 400 Minuteman III missiles in current operation. The Air Force also plans to modernize all 450 U.S. missile silos to accommodate the new Sentinel missiles. The Air Force plans to procure a total of 659 Sentinel ICBMs at an estimated price tag of $93 - $96 billion and will conduct a one-for-one swap with the current missiles while maintaining a non-deployed stockpile of spares.[39] Although the price tag seems high, each missile is designed for a 60-year lifespan and will incorporate an open technology architecture which allows the missiles to accept technology upgrades as they are developed over time.[40]

The Navy is the lead management agency responsible for modernizing the sea leg of the triad. It operates 14 Ohio Class strategic ballistic missile submarines. It plans to replace the Ohio Class with 12 of the next-generation Columbia Class ballistic missile submarines, the first of which is scheduled for delivery to the Navy in FY 2027. Each Columbia Class submarine has a scheduled 6-year timeline from the beginning of construction to delivery of the vessel.[41] Although it will receive its first ship in FY 2027, the Columbia Class is not expected to begin its first patrol until FY 2031. Due to funding shortfalls stemming from the FY 2013 Defense Budget, the procurement schedules of the Columbia Class were delayed. As a result, the Navy's original plan to retire one Ohio Class with the introduction of one Columbia Class became unfeasible. The Navy plans to retire two Ohio Class submarines before the first Columbia Class enters service. This means the U.S. Navy will only operate ten instead of the planned twelve strategic nuclear missile submarines beginning in FY 2029 and will reach the planned twelve in FY 2041.[42] The Navy addresses the coverage gaps in its FY 2024 budget justification, which requests increased funding for the Columbia Class program to speed up the delivery schedules of the next-generation submarine.[43] Additionally, the Navy has stated that it is considering short-term life extensions for up to five Ohio Class submarines to cover the gap; however, an official decision has yet to be made.[44] The Ohio Class was brought online in the 1970s with an original design life of 30 years. The Navy conducted a life extension program on these ships, extending its design life to 42 years, but five of the current Ohio Class ships will exceed 42 years in service by 2030.[45]

The Navy is also pursuing an LEP on the Trident II D5 submarine-launched ballistic missile. The LEP is being conducted to extend the life of the Trident II D5 through 2042 and consists of upgrading its flight guidance systems and refreshing internal components.[46]

The Trident II D5 missiles are deployed on Ohio Class submarines and will also be deployed on the Columbia Class. Each Ohio Class submarine can carry up to 20 Trident II D5 missiles, and each missile can carry up to eight nuclear warheads; however, due to New START limits, the U.S. currently only deploys four warheads per missile, giving each strategic submarine a total of 80 warheads.[47]

It is important to note that the Ohio Class was initially designed with twenty-four missile tubes per vessel. However, four tubes in each Ohio Class vessel were permanently sealed to account for New START obligations. The Columbia Class submarine is being procured with only sixteen missile tubes, or only 2/3 the number of tubes than the original Ohio Class. Although the Columbia Class is the most technologically advanced submarine the United States has designed and will build, the procurement strategy may require re-evaluation. The decreased procurement quantities of the submarine, coupled with a decrease in missile capacity, may decrease the credibility of the sea leg og the nuclear triad. A counterargument to this line of analysis may lie in the Common Missile Compartment (CMC), which was jointly developed by the US and UK for use on both the Columbia Class and the UK Dreadnought Class SSBNs and carry Trident II D5 missiles.[48] Although the U.S. is reducing it carrying capacity, it is increasing its interoperability with a strategic ally, while reducing its costs for deterrence. Notwithstanding this development, a way to expand capcity would be to increase the number of warheads per submarine; however, that would result in the U.S. going over the limits prescribed in New START. With Russia suspending its participation in New START and the treaty expiration approaching in 2026, the United States should develop a strategy addressing these concerns before the treaty expires.

COMPARING ARSENALS AND MODERNIZATION PROGRAMS: U.S., RUSSIA, CHINA

Although the United States is modernizing its nuclear weapons enterprise, it is essential to compare the U.S.' pursuits with those of its two peer adversaries – China and Russia. Figure 5 offers a comparison of current delivery systems and deployed missiles.

Country	US	Russia	China
Silo Based ICBM Launchers	450	399	354
Deployed ICBMs	400	812	142
Mobile ICBM Launchers	0	180	28
Heavy Bombers	66	75	20
Ballistic Missile Submarines	14	11	6
Deployed SLBMs	240	166	72

Figure 5. China, Russia, and the US' current numbers of delivery systems and deployed missiles. Data retrieved from the 2022 IISS Military Balance and the Nuclear Notebook referenced in citations published by the Bulletin of the Atomic Scientist.

Russia currently possesses 5,977 strategic nuclear warheads, of which approximately 1,588 are deployed. Its current strategic arsenal consists of air, land, and sea delivery systems, a nuclear triad like the United States. Its strategic sea capability comes from eleven sub-surface nuclear ballistic submarines (SSBN) with a carrying capacity of 576 submarine-launched ballistic nuclear missiles (SLBM-N).[49] It has 399 land-based launchers with 812 intercontinental ballistic missiles (ICBMs) and approximately seventy-six bomber aircraft capable of delivering over 200 nuclear-enabled ballistic missiles and gravity bombs.[50] Russia also possesses an estimated 2,000 non-strategic nuclear warheads not factored into the verified counts of strategic nuclear warheads. These warheads are not subject to treaty limitations, and the status of these non-strategic nuclear warheads is unknown.[51]

Russia has been modernizing its nuclear weapons and developing new delivery platforms over the last 20 years. Modernization efforts are occurring for both its strategic and non-strategic stockpiles. Although the U.S. and Russia are modernizing nuclear forces, the most alarming Russian efforts are the development of new capabilities that the United States is not currently pursuing. These new capability investments have been in nuclear-powered cruise missiles and the development of the Poseidon autonomous underwater vehicle. Both delivery systems seek to operate autonomously, powered by nuclear reactors, allowing them to patrol the oceans and skies for extended periods and over extremely long distances, making it more difficult for the United States to deter an attack. Both systems would also be able to carry low-yield nuclear weapons, decreasing the threshold for nuclear employment during conflict.

China also possesses a nuclear triad, but its current systems have lesser capabilities than those of the United States and Russia. It currently employs the H-6N and H-6K bombers, which have ranges over 3,100 km. For comparison, the United States and Russian strategic bombers have a maximum range of 10,000 – 14,000 km. China has an estimated total of twenty bombers. The H-6N bombers can launch one nuclear-capable Air-Launched Ballistic Missile (ALBM), while the H-6K bomber can carry one nuclear gravity bomb.[52] Its sea leg contains six Type-094 Jin Class nuclear-powered ballistic missile submarines, each carrying up to twelve JL-2 submarine-launched nuclear ballistic missiles. The ground leg of China's triad consists of approximately 450 land-based ICBM launchers. China is estimated to have 142 ICBMs deployed across its 450 launchers.[53]

China has exerted immense amounts of time, money, and effort to build up its nuclear forces at an astounding rate. In 2020 the U.S. estimated that China had 100 ICBM launchers. As of October 2022, the U.S. estimated that China increased the quantity of its ICBM launchers to 450.[54] Furthermore, in 2015 it was estimated that China possessed 250 nuclear warheads, but as recently as March 2023, that estimate has grown to 410.[55] At its current pace of modernization and buildup of its nuclear forces, the Pentagon estimates that China will have a total of 1,500 warheads by 2035.[56] China is able to maintain this pace because of its economic power. According to the World Bank, China boasted a GDP of $17.9 trillion in 2022, which ranked second in the world behind the U.S. at $25.4 trillion.[57] For comparison, Russia's GDP in 2022 was only $2.4 trillion, or less than 10% of that of the United States. The continued growth of the Chinese economy will allow it more access and opportunity to devote more of its resources toward furthering its nuclear aspirations.

The Russian Federation and the People's Republic of China also have hypersonic capabilities. The United States is also pursuing a hypersonic capability and U.S. defense industries are developing counter-hypersonic systems.[58] However, the U.S. needs to catch up in its development compared to its competitors. Furthermore, the United States has explicitly stated that its future hypersonic capability is intended for conventional use only, while Russia and China are designing nuclear capable hypersonic missiles. Moreover, Russia and China also possess a mobile ICBM capability that the United States does not. This mobile capability makes Russian and Chinese systems more survivable as they become increasingly harder to detect as they move around the battlefield.

When comparing future programs, the results depict that the United States is being out modernized in quantity of systems and in certain areas of technological sophistication. The United States is pursuing only one ground-based modernization, the Sentinel ICBM. The Russian Federation is pursuing three and China is pursuing six. Two of Russia's three ground modernization programs, its new ground-launched cruise missile (GLCM) and ICBM, will be fully deployed within the next ten years. China's pursuits are especially alarming because five out of its six ground-based efforts are to design and deploy ICBMs that will be able to reach the mainland of the United States. Four of these programs will be fully deployed by 2030.

At sea, the United States is procuring the Columbia Class submarines,whose procurement schedule has been delayed. Meanwhile, the Russian Federation has already fielded five of its 4th generation Borei class nuclear-powered SSBNs and plans to have ten by 2030. Russia also released design concepts for a next-generation stealth submarine and, in January of 2023, stated that its autonomous nuclear-powered nuclear payload torpedo (Poseidon) is ready for operational deployment.[59] If Poseidon is genuinely ready to be deployed, it will be almost ten years ahead of the United States estimate for its production and deployment. Additionally, China is also ahead of the United States in procurement of its next generation Type 096 Tang Class strategic ballistic missile nuclear powered submarine and upgraded JL-3 missile. China will operate the Type 094 Jin Class and Type 096 Tang Class concurrently and plans to enter two Tang Class submarines into service by 2030, increasing its submarine fleet to eight vessels.[60]

In the air, the United States is leading with its current and future programs. Russia and China currently do not possess stealth bombers, while the U.S B-2 does possess stealth capabilities. The B-21 Raider stealth bomber program has approximately five B-21s in the final stages of production, with test flight trials scheduled for later in 2023. Russia and China both have current stealth bomber programs. Russia's PAK-DA stealth bomber is estimated to enter service by 2027, while China's H-20 stealth bomber is estimated to enter by 2030.[61]

AN EMERGING THREAT IN NORTH KOREA

The risks described above are further complicated by the Democratic People's Republic of Korea (DPRK) whose nuclear program and relationships with China and Russia should not be overlooked. North Korea, like China, has been expanding its nuclear arsenal at an alarming rate. However, it does not receive the same coverage as great power competitors. North Korea developed its first nuclear weapon in the 1990s and has continued to invest in developing diverse types of weapons and delivery platforms over the last 30 years. Because of North Korea's status as a Hermit Kingdom, information is limited about its program and most unclassified information is estimative in nature. For example, the Institute for Science and International Security has been tracking and estimating DPRK nuclear weapon stockpiles since the 1990s. Its most recent estimate, published in April 2023, discusses three different estimate amounts based on North Korea's access to nuclear materials and probable types of weapon cores (simple, composite, and one-stage thermonuclear).[62] The range of the three estimates varies widely from 17 to 96 nuclear weapons but averages North Korea's arsenal to be between 35 and 63 weapons with varying core combinations.[63] These numbers are up from 2005, where the Institute estimated that North Korea possessed between five and 13 nuclear weapons.[64] Furthermore, the United States and the West's sanctions on Russia for its invasion of Ukraine has resulted in expanded relations between Russia and North Korea as epitomized by Supreme Leader Kim Jong Un's visit to Russia in September 2023. Analysts at the Council on Foreign Relations believe the warming of relations will result in mutually beneficial trade between the nations, primarily in weapons, food, and technology, which would be used to bolster Russia's efforts in Ukraine and elevate the defense capabilities of North Korea.[65]

CONCLUSION

Overall, U.S. next generation delivery platforms and systems remain more technologically superior to competitor systems. Be that as it may, Russia and China are continuously working to close the gap. Under the current geopolitical environment, the United States must consider further modernization efforts and changes to its national security strategy to compete against and deter two peer nuclear-armed adversaries and one endeavoring near-peer nuclear threat. The current pace of China's modernization, Russia's invasion of Ukraine and suspension of New START, and the growing relations between Russia, China, and North Korea have increased the challenge of strategic deterrence. As these adversaries become more nuclear-capable, their commitment to increasing capabilities and capacities may embolden these nations to alter intentions towards the United States. Therefore, the United States must continue to invest in enhancing its capabilities and should consider investing in new and more reciprocal systems that are more survivable, and that will continue to deter adversaries of the United States. ■

CAPT. DILLON LYNCH

is an FA52 assigned to the CBRNE Cell at III Corps HQ in Fort Cavazos, TX. He has a B.A. in Intelligence Studies from Mercyhurst University and a M.A. in Statecraft and National Security from the Institute of World Politics. His email address is dillon.m.lynch.mil@army.mil.

NOTES

1. “Nuclear Matters Handbook 2020 [Revised],” NMHB 2020 [Revised] (Deputy Assistant Secretary of Defense for Nuclear Matters, 2020), https://www.acq.osd.mil/ncbdp/nm/NMHB2020rev/acronyms.html, pp. 42, Figure 4.1.

2. “2010 Nuclear Posture Review Report,” 2010 Nuclear Posture Review Report § (2010), https://dod.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf, pp.iii.

3. “2018 Nuclear Posture Review,” Department of Defense § (2018), https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF, pp. 7.

4. Amy F. Woolf and James D. Werner, “The U.S. Nuclear Weapons Complex: Overview of Department of Energy Sites,” The U.S. Nuclear Weapons Complex: Overview of Department of Energy Sites § (2021), https://sgp.fas.org/crs/nuke/R45306.pdf, pp.

5. Ibid.

6. Ibid.

7. “America's Nuclear Triad,” U.S. Department of Defense, accessed April 17, 2023, https://www.defense.gov/Multimedia/Experience/Americas-Nuclear-Triad/.

8. “Nuclear Matters Handbook 2020 [Revised],” NMHB 2020 [Revised] (Deputy Assistant Secretary of Defense for Nuclear Matters, 2020), https://www.acq.osd.mil/ncbdp/nm/NMHB2020rev/acronyms.html pp, 31

9. Ibid.

10. “Nuclear Matters Handbook 2020 [Revised],” pp. 210

11. “Projected Costs of U.S. Nuclear Forces, 2021 to 2030,” Congressional Budget Office, May 2021, https://www.cbo.gov/publication/57240.

12. Ibid.

13. Ibid.

14. “FY 2024 Congressional Justification National Nuclear Security Administration Federal Salaries and Expenses Weapons Activities Defense Nuclear Nonproliferation Naval Reactors,” Department of Energy Budget Justification Book § (2023), https://www.energy.gov/sites/default/files/2023-03/doe-fy-2024-budget-vol-1-nnsa.pdf, pp. 1.

15. Ibid.

16. “Prices - Inflation (CPI) - OECD Data,” OECD, accessed April 17, 2023, https://data.oecd.org/price/inflation-cpi.htm#indicator-chart.

17. “FY 2024 Congressional Justification National Nuclear Security Administration Federal Salaries and Expenses Weapons Activities Defense Nuclear Nonproliferation Naval Reactors”, pp. 3.

18. “2018 Nuclear Posture Review,” Department of Defense § (2018), https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF, pp. 61.

19. “FY 2024 Congressional Justification National Nuclear Security Administration Federal Salaries and Expenses Weapons Activities Defense Nuclear Nonproliferation Naval Reactors”, pp. 105-106.

20. “Nuclear Matters Handbook 2020 [Revised],” pp. 34.

21. “FY 2024 Congressional Justification National Nuclear Security Administration Federal Salaries and Expenses Weapons Activities Defense Nuclear Nonproliferation Naval Reactors”, pp. 110.

22. Ibid. pp. 105.

23. “Nuclear-Armed Sea-Launched Cruise Missile (SLCM-N),” crsreports.congress.gov (Congressional Research Service, December 16, 2022), https://crsreports.congress.gov/product/pdf/IF/IF12084, pp. 1.

24. “FY 2024 Congressional Justification National Nuclear Security Administration Federal Salaries and Expenses Weapons Activities Defense Nuclear Nonproliferation Naval Reactors”, pp. 110.

25. “Nuclear-Armed Sea-Launched Cruise Missile (SLCM-N),” crsreports.congress.gov (Congressional Research Service, December 16, 2022), https://crsreports.congress.gov/product/pdf/IF/IF12084, pp. 1.

26. Patty-Jane Geller, “The Gaping Logic Hole in the Administration's Nuclear Posture Review,” The Heritage Foundation, accessed April 17, 2023, https://www.heritage.org/defense/commentary/the-gaping-logic-hole-the-administrations-nuclear-posture-review.

27. Ibid.

28. Joseph Rodgers, Rebecca Hersman, and Bryce Farabaugh, “U.S. Nuclear Warhead Modernization and ‘New’ Nuclear Weapons,” CSIS, accessed April 17, 2023, https://www.csis.org/analysis/us-nuclear-warhead-modernization-and-new-nuclear-weapons, pp. 3.

29. Ibid.

30. Amy F. Woolf and James D. Werner, “The U.S. Nuclear Weapons Complex: Overview of Department of Energy Sites,” The U.S. Nuclear Weapons Complex: Overview of Department of Energy Sites § (2021), https://sgp.fas.org/crs/nuke/R45306.pdf, pp. 32.

31. “2022 Nuclear Posture Review,” U.S. Department of Defense, October 27, 2022, pp. 23-24, https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF

32. House Armed Services Committee, "Summary of the Fiscal Year 2023 National Defense Authorization Act," armedservices.house.gov (House Armed Services Committee, 2022), https://armedservices.house.gov/_cache/files/c/8/c891c085-1494-4854-bb28-d145ea24ee99/C2675EB2D76A24A2A90546C41E6E993C.20220701-fy23ndaa-bill-summary-vfinal.pdf, pp. 24.

33. Franklin C. Miller and John R. Harvey, "The Looming Crisis for U.S. Tritium Production," Defense News (Defense News, August 19, 2022), https://www.defensenews.com/opinion/commentary/2017/03/06/commentary-the-looming-crisis-for-us-tritium-production/.

34. Ibid.

35.“World Gets First Look at B-21 Raider,” U.S. Department of Defense, accessed April 17, 2023, https://www.defense.gov/News/News-Stories/Article/Article/3235326/world-gets-first-look-at-b-21-raider/.

36. “B-21 Raider,” Air Force, accessed April 17, 2023, https://www.af.mil/About-Us/Fact-Sheets/Display/Article/2682973/b-21-raider/.

37. John A. Tirpak, “B-21: Shape of the Future,” Air & Space Forces Magazine, February 17, 2023, https://www.airandspaceforces.com/article/b-21-shape-of-the-future/.

38. “F-35 Dual Capable Aircraft Team Meets Goals Ahead of Schedule, Earns Prestigious Award,” DVIDS, February 17, 2022, https://www.dvidshub.net/news/414834/f-35-dual-capable-aircraft-team-meets-goals-ahead-schedule-earns-prestigious-award.

39. Amy F. Woolf, “U.S. Strategic Nuclear Forces: Background, Developments, and Issues,” crsreports.congress.gov (Congressional Research Service, December 14, 2021), https://crsreports.congress.gov/product/pdf/RL/RL33640/69, pp. 20.

40. Ibid., pp. 21.

41. “Fiscal Year (FY) 2023 Budget Estimates, Shipbuilding and Conversion, Navy,” secnav.navy.mil (Department of Defense, April 2022), https://www.secnav.navy.mil/fmc/fmb/Documents/23pres/SCN_Book.pdf, pp. 45

42. “Class: Delivery Schedule,” Columbia, accessed April 17, 2023, http://columbia-class.com/schedule.asp.

43. “Fiscal Year (FY) 2023 Budget Estimates, Shipbuilding and Conversion, Navy,” pp. 70

44. Emma Helfrich, “Navy Eyeing Life Extension of Nine Ohio Class Submarines,” The Drive, May 18, 2022, https://www.thedrive.com/the-war-zone/navy-eyeing-life-extension-of-nine-ohio-class-submarines.

45. Caitlin M. Kenney, “A Handful of Ohio Subs Could Get Yet Another Service Life Extension,” Defense One (Defense One, November 2, 2022), https://www.defenseone.com/threats/2022/11/another-possible-service-life-extension-handful-ohio-subs/379214/.

46. “Trident II (D-5) Sea-Launched Ballistic Missile – Life Extension Program Variant ,” dote.osd.mil (Department of Defense), accessed April 17, 2023, https://www.dote.osd.mil/Portals/97/pub/reports/FY2022/navy/2022trident.pdf?ver=foTQCGHeWFAwHfqABBA5LQ%3D%3D.

47. Anna Schumann, “Fact Sheet: The United States' Nuclear Inventory,” Center for Arms Control and Non-Proliferation, May 5, 2021, https://armscontrolcenter.org/fact-sheet-the-united-states-nuclear-arsenal/.

48. Development. Strategic Systems Programs > About Us > SSP Mission > Development. (n.d.). https://www.ssp.navy.mil/About-Us/SSP-Mission/Development/

49. “Nuclear Disarmament Russia,” The Nuclear Threat Initiative, October 26, 2022, https://www.nti.org/analysis/articles/russia-nuclear-disarmament/.

50. John Chipman et al., “The Military Balance 2022,” IWP.edu (The International Institute for Strategic Studies: Routledge Taylor & Francis Group, 2022),pp. 193 https://www.iwp.edu/wp-content/uploads/2019/05/The-Military-Balance-2022.pdf.

51.Woolf, Amy F. “Nonstrategic Nuclear Weapons.” FAS.org. Congressional Research Service, March 7, 2022. https://sgp.fas.org/crs/nuke/RL32572.pdf.

52. Eliana Reynolds, Matt Korda, and Hans M. Kristensen, “Nuclear Notebook: Chinese Nuclear Weapons, 2023,” Bulletin of the Atomic Scientists (Bulletin of the Atomic Scientists, March 13, 2023), https://thebulletin.org/premium/2023-03/nuclear-notebook-chinese-nuclear-weapons-2023/.

53. Ibid.

54. Hans M. Kristensen, Eliana Reynolds, and Matt Korda, “STRATCOM Says China Has More ICBM Launchers than the United States – We Have Questions,” Federation Of American Scientists (Federation of American Scientists, February 10, 2023), https://fas.org/blogs/security/2023/02/stratcom-says-china-has-more-icbm-launchers-than-the-united-states/.

55. Eliana Reynolds, Matt Korda, and Hans M. Kristensen, “Nuclear Notebook: Chinese Nuclear Weapons, 2023,” Bulletin of the Atomic Scientists (Bulletin of the Atomic Scientists, March 13, 2023), https://thebulletin.org/premium/2023-03/nuclear-notebook-chinese-nuclear-weapons-2023/.

56. Phil Stewart and Idrees Ali, “China Likely to Have 1,500 Nuclear Warheads by 2035: Pentagon,” Reuters (Thomson Reuters, November 29, 2022), https://www.reuters.com/world/china-likely-have-1500-nuclear-warheads-by-2035-pentagon-2022-11-29/.

57. World Development Indicators Database, World Bank, 1 July 2023, pp 1 https://databankfiles.worldbank.org/public/ddpext_download/GDP.pdf

58. Counter Hypersonics” (Northrop Grumman, October 18, 2022), https://www.northropgrumman.com/space/counter-hypersonics/

59. Matthew Gault, “Russia Says Its 'Unstoppable' Nuclear Underwater Drone Is Ready to Go,” VICE (VICE NEWS, January 18, 2023), https://www.vice.com/en/article/pkg5w9/russia-says-its-unstoppable-nuclear-underwater-drone-is-ready-to-go.

60. Office of the Secretary of Defense, “Military and Security Developments Involving the People's Republic of China 2021,” defense.gov (Department of Defense, November 2021), https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF, pp. 49.

61. Alex Hollings, “Russia's Pak Da Stealth Bomber Is a Big, Powerful Paper Plane,” Sandboxx, September 23, 2021, https://www.sandboxx.us/blog/russias-pak-da-stealth-bomber-is-a-big-stealthy-paper-plane/.

62. David Albright, “North Korean Nuclear Weapons Arsenal: New Estimates of its Size and Configuration” (Institute for Science and International Security, April 10, 2023). https://isis-online.org/uploads/isis-reports/documents/North_Korean_Nuclear_Weapons_Arsenal_New_Estimates_of_its_Size_and_Configuration_April_10_2023.pdf pp. 2.

63. Ibid. pp. 2.

64. Ibid. pp. 3.

65. Scott A. Snyder. “The Perils of a Renewed North Korea-Russia Relationship”. (Council on Foreign Relations. September 7, 2023). https://www.cfr.org/in-brief/perils-renewed-north-korea-russia-relationship.

THE ARMY'S CONTRIBUTION TO INTEGRATED DETERRENCE VIA CWMD READINESS

OR: HOW I LEARNED TO STOP WORRYING AND LOVE READINESS

LT. COL. SEAN CARMODY

"If deterrence fails, we will field a force that is resilient and prepared to prevail in a CBRN contested environment."

Secretary of Defense Lloyd Austin, *Strategy for Countering Weapons of Mass Destruction,* 29SEP23

RESILIENT ARMY FORCES GENERATE INTEGRATED DETERRENCE

The 2022 National Defense Strategy (NDS) departs from our previous strategies, most notably, by making the concept of integrated deterrence central to what the Department does. While the ideas and concepts underpinning Integrated Deterrence are not new, they will increasingly focus the Department on activities central to deterrence, key among them Countering Weapons of Mass Destruction (CWMD).

Integrated Deterrence entails working seamlessly across warfighting domains, theaters, the spectrum of conflict, all instruments of U.S. national power, and our network of Alliances and partnerships. Tailored to specific circumstances, it applies a coordinated, multifaceted approach to reducing competitors' perceptions of the net benefits of aggression relative to restraint. Integrated deterrence is enabled by combat-credible forces prepared to fight and win, as needed, and backstopped by a safe, secure, and effective nuclear deterrent.[1]

Additionally, this Strategy openly acknowledges our primary threat actors' intentional pursuits of WMD capabilities.[2] The Department anticipates increasingly complicated escalation dynamics given advances in technology including advanced Chemical-Biological Weapons (CBW) and non-strategic nuclear weapons.[3]

As the Services reorient to these realities, the demand to synchronize policy, strategy, and concepts with Combatant Command (COCOM) activities is increasingly salient to successfully implement the Defense Strategy. Integrated deterrence demands collaborative and shared responsibilities by COCOMs and Services to demonstrate resilient posture and forces ready to operate in the face of WMD.

THE CWMD STRATEGIC LANDSCAPE IS CLEAR

The NDS defines the ways of deterrence as by denial of effect, resilience of the Joint Force, and direct & indirect cost imposition.[4] Given the Services' functions to build, man, train, and equip the force; they play the predominant role in resilience. The Army creates resilience through the supporting concept of denial of benefits. The Army denies benefits of aggression by demonstrating, "the ability to withstand, fight through, and recover quickly from disruption."[5] The tailored approaches to deterrence required by the NDS factor the problem, competitor, and setting to include resilience by, "improving conventional forces' ability to operate in the face of limited nuclear, chemical, and biological attacks so as to deny adversaries benefit from possessing and employing such weapons."[6] The Nuclear Posture Review (NPR) continues by directing that the U.S. will demonstrate, "the resolve of the United States to both resist nuclear coercion and act as a responsible nuclear power."[7] To deny benefit of nuclear employment specifically, the NPR clearly articulates that,

> When engaged in conventional operations against a nuclear-armed adversary the Joint Force must be able to survive, maintain cohesion, and continue to operate in the face of limited nuclear attacks. This form of resilience sends a distinct deterrence message to an adversary – that limited nuclear escalation will not render U.S., Allied, and partner forces incapable of achieving our warfighting aims. It is also critically important that the Joint Force can fight and win in a chemical, biological, radiological, and nuclear (CBRN)-contaminated environment.[8]

The recently published Strategy for CWMD extends this logic stressing the importance of resilience in one of the strategies six ways as, "Build a Joint Force that can campaign, fight, and win in a CBRN environment."[9] As noted, the Services uniquely, and the Army in particularly, are essential to this way given that the preponderance of WMD effects in any conflict would be shouldered largely by the land component. The strategy establishes four key priorities; Defend the Homeland from WMD attack, Deter WMD Attacks, Prevail in a CBRN Environment, and Prevent New WMD Threats.[10] To prevail, the Total Force must demonstrate readiness to fight, win, and reconstitute.

> "If potential adversaries perceive the Joint Force or Allied and partner capabilities to be vulnerable to severe degradation by WMD employment, they will be more confident in escalating with WMD use to gain advantage or prevent defeat. A resilient Total Force is better able to contain and defeat threats away from the homeland, operate through disruption and WMD scenarios in the homeland, strengthen deterrence credibility, and provide options to prevent proliferation."[11]

The strategy further cements the importance of resilience to diminish adversary advantages and deny benefit of WMD employment. As important as the resilience itself, the strategy emphasizes the messaging of that resilience to achieve the deterrent effect. "U.S. denial and resilience activities domestically and internationally send a distinct message that a strategy reliant on WMD escalation on the battlefield is not a conduit to victory. The inability to achieve desired outcomes may encourage a decision-maker to view off-ramps more favorably."[12]

ARMY SUPPORTING CWMD STRATEGIES

While pre-dating the latest DoD Strategy, two Army Strategies directly support and enable the Army's ability to implement a resilient force that can prevail in the face of WMD; *Army Strategy For Integrating Nuclear Implications Into Conventional Operations and The Army Biological Defense Strategy* (ABDS).

The former, referred more commonly as Conventional-Nuclear Integration (CNI) Strategy, sets out to achieve a range of end states ensuring the Army can, "Dominate operations in and through a nuclear environment; Exploit its resiliency advantage; Provide conventional operational support to nuclear operations, if requested; and Execute post-strike recovery at anticipated scale to continue mission."[13] The CNI Strategy outlines the contributions the Army must make, as a non-nuclear service, to face a nuclear-armed adversary. Uniquely, the Strategy's implementation ensures a force resilient, not only to employment of adversary nuclear weapons, but to ensure conventional operations integrate and are resilient to friendly employment which further advances the credibility of the nuclear deterrent.

The ABDS, also a predecessor to the recently published DoD Biodefense Posture Review, addresses the pervasive threat of biological hazards by expanding biological defense knowledge; enhancing comprehensive biological defense situational awareness; modernizing the Army biological defense enterprise; and enabling effective planning, preparation, and training to protect the force in competition, crisis, or conflict.[14]

THE ARMY IMPLEMENTS CWMD POLICY & STRATEGY THROUGH CAMPAIGNING

The Army's way to implement its role in integrated deterrence is through campaigning. As part of the Army's approved Campaign Plan for 2030, Objective 10B "Enhance CBRN Readiness," the Army will increase lethality, survivability, and readiness of maneuver formations to deter WMD use and, if necessary, operate in a CBRN environment during large scale combat operations (LSCO).

The Army's enhanced CBRN Readiness Campaign is a multi-phase effort, with Phase 1 spotlighting CBRN readiness in EUCOM via a Proof-of-Concept. 2nd Armored Brigade Combat Team, 3rd Infantry Division conducts the Proof-of-Concept to increase personnel, equipment, and training readiness to fight and win in a CBRN LSCO environment. The unit successfully demonstrated its readiness during a National Training Center rotation and will receive a final assessment during a Joint Multinational Readiness Center (JMRC) rotation stimulated by realistic CBRN events including adversary use of limited nuclear escalation. This demonstration supports theater strategic communications designed to deter adversary WMD employment against US and Allied forces.

Phase 2 includes a Pilot unit enhancing readiness in USARPAC while Phase 3 and beyond enhances readiness of Priority Divisions. Future Phases of the Campaign emphasize implementing best practices by enhancing additional priority units to ensure both the Army today and of 2030 is CBRN ready.

In addition to the unit focused demonstrations of CBRN readiness, the Campaign Objective aligns over 30 distinct enhancements across the DOTMLPF-P spectrum to reform and generate enduring CBRN readiness for the future. These enhancements include integration of Professional Military Education (PME) subjects; concept development; doctrinal reforms; and a range of training & policy activities.

The key to early, and anticipated successes, of Objective 10B is consistency in campaigning. The steady and increasingly comprehensive strategy and policy landscape allows the Army's Campaign Plan, and Objective 10B specifically, to chart a predictable and effective course. This was a historical challenge in the CWMD space, noted in the NDS, that, "rather than exacerbate risk by isolating and stove-piping CWMD as a separate effort and having sporadic emphasis that occurs only in the midst of immediate hostilities, engaged leaders must integrate CWMD into all phases of efforts and planning."[15]

COCOMS EMPLOY ENHANCED CBRN READINESS FOR INTEGRATED DETERRENCE

The Services building ever more resilient forces to WMD employment is laudable, but insufficient. COCOMs' posture, training, plans, and messaging ultimately deliver that resilience to the point of application from competition, through crisis, into conflict. Each COCOM works daily to reform and improve CWMD posture; increase the frequency & quality of CWMD training in exercises; and layer CWMD operations into plans. Additionally, each COCOM messages their efforts for deterrence of adversaries and assurance of Allies & Partners. The traditional barriers between operational and institutional authorities and priorities are eroding by the day, allowing for improved force design and development that meets the needs of planners and Commanders to take on the WMD challenges of today and tomorrow.

"Although DoD will deepen specialized expertise within the CWMD enterprise, the WMD problem set is a problem for the entire Department. This will require breaking down barriers between conventional and CWMD communities to understand how CBRN weapons can influence or undermine plans and operations. Only when these barriers have been eliminated can DoD maximize its ability to prevail in CBRN environments. This will include leveraging Joint Professional Military Education (JPME) and Total Force education, continuing education, and enhanced training."[16]

As the Army continues to implement its campaign for enhanced CBRN readiness, greater synchronization with COCOM efforts will allow for the formation of tailored deterrence approaches demanded of the NDS.

DEMONSTRATING CWMD POSTURE & RESILIENCE COMPLETES THE CIRCLE OF INTEGRATED DETERRENCE

A fallen tree with no witness is unheard, and so too is CWMD deterrence.

> "Central to tailoring deterrence is the ability to communicate clearly that an explicit WMD threat will not coerce or prevent the United States from protecting its vital national interests. An actor that does not receive and understand U.S. intent is less likely to be deterred. As a result, the Defense Department, in concert with other U.S. departments and agencies, must carefully consider when and how to deliver a message to enable deterrence effectiveness."[17]

Building a resilient, capable, trained, and ready force is insufficient but necessary. "To improve the CBRN operational readiness of the Joint Force, Combatant Commands, Military Departments, and the Services must commit to integrating CBRN considerations into individual and unit level training, readiness standards, and apply these acquired skills in associated unit and theater exercises."[18] Across Warfighting Functions, the Army is increasingly tailoring training scenarios and objectives to the specific demands of the theaters and plans Army units are most likely to support. This increase in tailored training is mirrored in the Army

Campaign Objective 10B efforts to enhance the quality and frequency of CWMD training by venue and echelon.

Shaping an effective theater CWMD posture too is insufficient but necessary. The Army is advancing efforts to enable Service Components to posture forces and resources for rapid transition to crisis, and if necessary, conflict. These efforts are mirrored in the Campaign Objective 10B by enhancing theater armies' ability to build and sustain WMD resilient forces and stationing. "CWMD activities that strengthen resilience and support force deployment from the homeland are key to reducing risk and provide additional tools, often unique to chemical and biological threats. These activities also help shape an actor's decision calculus at the operational level by diminishing the potential advantage gained from WMD use."[19] Demonstrating those posture, plans, and resilience through effective messaging ensures the fullness of the deterrent effect.

> "To have a deterrent effect on an actor's decision-making, the Department must communicate the Joint Force's ability to operate effectively in a CBRN environment. This includes the proactive release of information tailored to a specific threat and context to deter potential adversary WMD use. As such, the Department will enhance its ability to provide clear, credible information to our Allies and partners, other U.S. Government departments and agencies, the U.S. population, and potential adversaries. U.S. messages will be deliberate and support the open release of sufficient information to counter an adversary's disinformation campaign." [20]

ARMY WMD RESILIENCE, INTEGRATED WITH THEATERS, AND MESSAGED FOR DETERRENCE

The Services are not islands. The COCOMs are not sequestered. CWMD is not divorced from the core defense strategy. Effective CWMD readiness necessitates collaborative campaigning and deliberate demonstrations by Services and COCOMs alike to achieve integrated deterrence. While the Army is well positioned and making significant strides on the backs of our strategies and Campaign Objective, much work remains to habituate the CWMD mindset, advance training methods, and educate the force. It's a policy. It's a strategy. It's a campaign…if we can keep it! ■

LT. COL. SEAN CARMODY

is the Army Campaign Integrator at the U.S. Army Nuclear & CWMD Agency, in Fort Belvoir, VA. He has a B.S. in Astrophysics from the University of Michigan, a M.S. in Environmental Science from Webster University, and a M.M.A.S in Theater Operations from the School of Advanced Military Studies. He was previously assigned as the Commander of the 22d Chemical Battalion, Fort Bliss, TX. His email address is sean.t.carmody2.mil@army.mil.

ENDNOTES

1. U.S. Department of Defense, "2022 National Defense Strategy of The United States of America," 2022, 1.
2. Ibid. hereafter NDS, 2-3.
3. Ibid., 6.
4. Ibid., 8-9.
5. Ibid., 6.
6. Ibid., 10.
7. U.S. Department of Defense, "2022 Nuclear Posture Review," 2022, 2.
8. Ibid., 10.
9. U.S. Department of Defense, "Strategy for Countering Weapons of Mass Destruction," 20223, viii.
10. Ibid. hereafter CWMD Strategy, 7-8.
11. Ibid., 8.
12. Ibid., 8.
13. U.S. Army, "Army Strategy For Integrating Nuclear Implications Into Conventional Operations," 2022, 5.
14. U.S. Army, "Army Biological Defense Strategy," 2021.
15. NDS, 14.
16. Ibid., 14.
17. CWMD Strategy, 9.
18. NDS, 15.
19. CWMD Strategy, 7.
20. NDS, 15.

Opposite: U.S. Army Soldiers, assigned to the 3rd Infantry Division, exit an underground tunnel complex while conducting a tactical radiological reconnaissance survey during Combined Resolve 24-01 at the Joint Multinational Readiness Center near Hohenfels, Germany, Oct. 24, 2023.

Combined Resolve is U.S. Army Europe and Africa exercise for U.S. Soldiers and NATO allies and partners, providing training in support of NATO deterrence initiatives. Approximately 4,000 Soldiers from 14 nations are participating in Combined Resolve 24-01. (U.S. Army photo by Spc. Leonard Beckett)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AVOIDING STRATEGIC MISCALCULATION

MAJ. KIRK SHOEMAKER

WHY THE U.S. ARMY MUST PREPARE TO FIGHT LARGE SCALE COMBAT OPERATIONS IN A CHEMICALLY CONTAMINATED ENVIRONMENT

A Policy Approach Aimed at Building a Better Framework to Ensure the U.S. Army can Fight and Win on a Future Chemically Contaminated Battlefield

INTRODUCTION TO THE PROBLEM:

In the last 20 years, the U.S. Army has developed, trained, and refined its ability to conduct chemical, biological, radiological, and nuclear (CBRN) operations in a counterinsurgency (COIN) and counterterrorism (CT) environment. Today, following two decades of combat operations in Afghanistan and the Middle East, the U.S. Army, and the Department of Defense (DoD) are rapidly pivoting away from COIN and CT and returning to an era that is dominated by readiness for Large Scale Combat Operations (LSCO). As the U.S. Army makes this strategic shift, it must prioritize new policy, doctrine, resources, and training to deter, compete, fight, and win against China as a pacing challenge and Russia as an acute threat. To complicate this challenge, the U.S. Army also faces two persistent threats, North Korea, and Iran. All four of these actors possess chemical weapons or the knowledge and capability to produce them. As the U.S. Army conducts its strategic transition, leaders must not ignore adversary capabilities or their interest in exploiting U.S. Army vulnerabilities.

It is likely that China, Russia, and Iran are willing to ignore long standing chemical weapons treaties and exploit U.S. Army CBRN vulnerabilities to win during Multi-Domain Operations (MDO). Challenging assumptions that the 1997 Chemical Weapons Convention multilateral treaty will prevent strategic, acute, and persistent threat actors from using chemical weapons, this article argues for a policy approach that promotes prioritization of U.S. Army chemical preparedness above current levels and offers six broad recommendations for implementation.

Opposite: The Combat Support Training Exercise 91-18-01 taking place at Fort Hunter Liggett, California during July 2018 brings various support units from across the country (and from other countries as well) to work together on various scenarios. (Photo by Cynthia McIntyre, Fort Hunter Liggett Public Affairs Office)

A FATALLY FLAWED PREMISE:

The prolific essayist and mathematical statistician Nassim Nicholas Taleb likes to say that "Things always become obvious after the fact."[1] However, as this article argues, there are also times when transitions are identifiable, definable, and therefore require changes to policy and doctrine. This policy perspective contends that U.S. Army faces one of these transition periods now. Therefore, the U.S. Army must reassess what future land warfare looks like when faced with strategic, acute, and persistent threat actors who possess, or may possess CBRN programs and capabilities.

The U.S. Army, and the greater DoD relies on an assumption that its adversaries will abide by the 1997 Chemical Weapons Convention, a legally binding international disarmament and non-proliferation treaty that outlawed chemical weapons use during war.[2] Such a premise is fatally flawed and must be reexamined. As strategic, acute, and persistent threat actors take steps to exploit U.S. Army chemical readiness vulnerabilities, U.S. Army leaders must act. As the world's premier land combat force, the U.S. Army can lead in preparing to fight and win in a chemically contaminated environment. Through deliberate decisions, crafted policy, and bold action, the U.S. Army should develop a stronger response framework to adversary chemical weapons use. This framework will not only help deter adversaries from using chemical weapons, but it also increases U.S. Army Soldier confidence and provides key capabilities allowing the U.S. Army to fight and win. To set conditions for further analysis and help decision-makers understand the magnitude of the threat, it is important to provide examples of recent adversaries' efforts to exploit gaps in U.S. Army chemical training and readiness.

...Russia likely views chemical contamination as a condition on the battlefield that, when employed strategically on constrictive, canalizing terrain, provides conditions for force overmatch.

UNDERSTANDING THE THREAT ENVIRONMENT:

The U.S. Army and the DoD face numerous chemical weapons challenges from adversaries that either possess, or are suspected to possess, chemical weapons capabilities.[3] The four key actors discussed are China, Russia, North Korea, and Iran. Throughout this article, China is considered a strategic U.S. competitor and U.S. pacing challenge, while Russia, in light of actions in Ukraine, is understood to pose an acute threat to U.S. interests.[4] Additionally, North Korea and Iran are determined to be persistent U.S. threats.[5] Much of the categorical threat language used in this article is from the 2023 Office of the Director of National Intelligence Threat Assessment,[6] the 2022 National Defense Strategy,[7] as well as the recently released 2023 Department of Defense Strategy for Countering Weapons of Mass Destruction.[8]

Throughout the persistent, long running war in Syria,[9] it is assessed that chemical weapons have been used by the Syrian government 50 times since the start of the conflict.[10] Even as a member of the Chemical Weapons Convention, Syria persistently withholds information on its chemical weapons program, stockpiles, and weapons use.[11] Sadly, Russia, an acute threat[12] and rival of the U.S., supports Syria's use of chemical weapons[13, 14] while also developing and employing its own chemical weapons capabilities. In its own use of prohibited chemical weapons, Russia has conducted at least three[15] assassination attempts and continues to undermine international chemical weapons norms.[16] While it is possible that there are undocumented accounts of Russian chemical use, two alleged events stand out, though Russia denies both.[17] The first is the 2018 poisoning of Sergei Skripal and his daughter Yulia in the United Kingdom. Both Skripals were poisoned by a Novichok nerve agent known to have been developed by the Soviet Union.[18] By design, Novichok weapons are intended to be more toxic and are considered fourth-generation chemical weapons developed under a former Soviet program called "Foliant."[19] Again, in August 2020, Russia is accused of attempting to assassinate Russian opposition leader Alexei Navalny using the Novichok chemical weapon.[20] It is probable that Russia has observed the atrophy in the U.S. Army's ability to operate in a chemically contaminated environment. To exploit this vulnerability, Russia realigned its CBRN forces[21] and is conducting training to fight in LSCO and chemically contaminated environments.[22, 23] Today, Russia likely views chemical contamination as a condition on the battlefield that, when employed strategically on constrictive, canalizing terrain, provides conditions for force overmatch.

China, the U.S.'s strategic competitor and pacing challenge,[24] is believed to maintain a smaller scale, covert CBRN program.[25] While publicly available information on China's chemical programs are difficult to find, it is nevertheless assessed as a rival who continues to refine and develop its chemical capabilities.[26] A November 2021 DoD report stated, "Based on available information, the United States cannot certify that the People's Republic of China has met its obligations under the Chemical Weapons Convention."[27] The report noted significant and growing concerns over China's "research of pharmaceutical-based agents (PBAs) and toxins with potential dual-use applications."[28]

Although Iran is not considered a U.S. strategic rival, and instead falls into the category of persistent threat,[29] a potential Iranian chemical program must be considered. Currently, the U.S. and international community have largely avoided definitive, public conclusions on an Iranian chemical weapons program. However, in 2007, an Intelligence Community report held that "Iran maintains the capability to produce chemical weapon agent in times of need and conducts research that may have offensive applications."[30]

A final, but important non-strategic rival and persistent threat to the U.S. is North Korea.[31] As noted by U.S. Army Field Manual 3-11, North Korea "maintains a robust CBRN program that threatens the Republic of Korea and surrounding countries."[32] Within North Korea's spectrum of CBRN capabilities, chemical weapons are assessed to play a central role. As the only country of four discussed here who is not a party to the Chemical Weapons Convention, North Korea denies it has any chemical weapons.[33]

The international community assesses that North Korea in fact has a robust chemical capability and therefore must be of strategic concern to U.S. Army leaders.

One primary reason for this concern is that there are at least 30,000 U.S. Army Soldiers stationed in South Korea (this number does not include U.S. military families).[34] Current unclassified estimates believe that North Korea possesses “2,500-5,000 tons, including mustard, phosgene, blood agents, sarin, tabun and V-agents (persistent nerve agents).”[35] While North Korea’s stockpile of chemical weapons is not assessed to be growing, North Korea’s chemical weapons can be delivered “using a variety of conventional shells, rockets, aircraft, and missiles.”[36] It is known that North Korea also “manufactures its own protective suits and detection systems for chemical warfare”[37] and North Korean forces are “prepared to operate in a [chemically] contaminated environment; they train regularly in chemical defense operations.”[38]

Critically important for U.S. Army leaders to reflect upon is recent discussions of a U.S. conflict with North Korea. In an article from February 2018 that captures the tension, journalist Yochi Dreazen notes that during a conversation with retired U.S. Navy Admiral James Stavridis and former Under Secretary of Defense for Policy Ms. Michèle Flournoy, the situation was bleak. During the interview, Stavridis said “there was at least a 10 percent chance of a nuclear war between the U.S. and North Korea, and a 20 to 30 percent chance of a conventional conflict that could kill a million people or more.”[39] After numerous other interviews, Dreazen concluded, “There is a genuine risk of a war on the Korean Peninsula that would involve the use of chemical, biological, and nuclear weapons…[where] millions would die.”[40] In June 2018, Pentagon leaders admitted that the force was not ready for LSCO in a chemically contaminated environment. At that time, previously unreported Pentagon audits surfaced that indicated the U.S. Army “lacked sufficient medical countermeasures, protective gear and technology to identify so-called chem-bio agents, [and] troops are insufficiently trained, manned and equipped for such a fight.”[41] Echoing these concerns, Andrew Weber, a former head of the Pentagon’s chem-bio defense programs said “We are definitely under-invested in countering North Korea’s chemical and biological threats.”[42]

U.S. ARMY CHEMICAL READINESS AS A STRATEGIC MODEL:

This policy approach argues that current U.S. Army chemical readiness does not match the adversary threat, nor is it likely to keep pace with a rising threat. The following policy recommendations are an attempt to provide a forward-leaning approach to support the U.S. Army’s ability to fight and win in a chemically contaminated environment. If these recommendations are implemented successfully, and chemical readiness increases, the policy approach could be expanded or scaled to address other force vulnerabilities in nuclear and biological readiness.

To better prepare the Army for LSCO in a chemically contaminated environment, U.S. Army leadership must continue to prioritize investment in chemical readiness. Currently, the U.S. Army is in the early stages of implementing Army Campaign Plan Objective 10B which aims to significantly enhance readiness across all aspects of CBRN. Designed as a seven-year plan, 10B “will increase lethality, survivability, and readiness of maneuver formations to deter WMD use and, if necessary, operate in a CBRN environment during large scale combat operations.”[43] Using the Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Policy (DOTMLPF-P) framework, the U.S. Army has developed specific Enhancements that are anticipated to significantly enhance CBRN readiness by 2030. To ensure a comprehensive approach, 10B’s 30 distinct enhancements and four cross-cutting efforts, including Proof of Concept effort, Pilot, Army Service Component Commands CBRN readiness, and Public Affairs Guidance, each improve important aspects of Army readiness.[44] To date, the U.S. Army has conducted a successful proof of concept demonstration with an Armored Brigade Combat Team and plans to run a pilot program of additional 10B Enhancements in 2024.

Although the Chemical Readiness as a Strategic Model approach in this article was written as a separate and distinct perspective from ongoing 10B Enhancements, many of the recommendations are overlapping and complementary to what the U.S. Army is already implementing. In that spirit, the following recommendations for U.S. Army chemical readiness should be viewed as complimentary and reinforcing to the focus of Objective 10B. Fundamentally, both approaches argue that the U.S. Army needs to increase its overall readiness to fight in a CBRN environment during LSCO.

As a first step to increasing readiness, U.S. Army leaders must address the risks inherent in trusting that strategic, acute, and persistent threat actors will follow accepted international norms prohibiting chemical weapons use. As outlined previously, China, Russia, and Iran are all signatories of the Chemical Weapons Convention. Taking a realistic and pragmatic approach, this article believes that U.S. adversaries are likely to abandon and break chemical weapons treaties during future LSCO. As discussed previously, it is not hard to find examples where threat actors are upending chemical weapons international norms. To ensure readiness for such destabilizing actions on future battlefields, the U.S. Army must act now as readiness takes time, money, and a deliberate approach to ensure success. Here, success comes from the following: Leader Prioritization, Threat Focused Training, Specialized Funding, and Rapid Equipment Fielding.

Leader Prioritization:

For the U.S. Army Chemical Readiness as a Strategic Model to find success, U.S. Army senior leadership must be actively involved at the outset and subsequently remain engaged. While often undervalued, senior leader prioritization sets the tone for the U.S. Army and results in a trickle-down effect to all subordinate echelons and commanders. Starting with the Army Chief of Staff, involvement could take the form of senior leader symposiums and discussions of changing U.S. Army priorities. An example of such an event was a Center for Strategic and International Studies discussion where the Army Chief of Staff outlined the U.S. Army's priorities.[45] Another excellent forum where U.S. Army senior leaders can highlight the importance of chemical readiness could be through a reissue of the Army Chief of Staff's "Army Multi-Domain Transformation Paper (2021)." Such documents, while not doctrine, provide strategic guidance to subordinate echelons and commanders. The Army Chief of Staff is best positioned to be a catalyst of change to ensure that the U.S. Army is prepared for chemical threats and successfully implements chemical readiness as a strategic model.

Threat Focused Training:

Once senior U.S. Army leaders have prioritized the threat and determined that the Army must pivot toward increased chemical readiness, the next step is to draft training guidance and develop a proof of concept model. While training guidance will likely be initiated by the strategy, plans, and policy section in the headquarters of the U.S. Army, this article recommends that the U.S. Army Nuclear and Countering Weapons of Mass Destruction Agency (USANCA) continue to be a focal point for Counter-WMD and CBRN issues. As recognized by the ongoing Objective 10B efforts, USANCA possesses the requisite talent and experience to help the Army reorient toward preparing to fight and win in a chemically contaminated environment. The draft training guidance should enable maneuver formations at echelon, to conduct operations in LSCO at speed and range against adversaries who possess chemical weapons. The endstate of the training guidance should be a maneuver force who can operate in a chemical environment with speed and lethality.

To test the newly developed training guidance, the Army Chief of Staff should select a Brigade Combat Team (BCT) that is preparing to start its training cycle. This approach strongly recommends that the selected BCT is assigned to participate in a persistent presence and deterrence rotation to either the U.S. European Command (USEUCOM) or U.S. Indo-Pacific Command (USINDOPACOM) theater. The BCT should be provided with updated, chemical readiness focused, training guidance and resources such as specialized instruction and training that is theater chemical threat specific. All soldiers in the BCT must understand that the purpose of their rotation is to serve as a proof of concept for the U.S. Army on how it should train its force to fight and win in a chemically contaminated environment. Providing guidance and a clear endstate to all soldiers helps them understand the importance of their mission and will strengthen unity of purpose resulting in a better outcome.

Upon completion of individual soldier chemical training at their home station, the selected BCT should spend roughly 30 days at the National Training Center (NTC) or the Joint Readiness Training Center (JRTC). This training venue allows commanders and their units to integrate home station chemical readiness training throughout the entire 30-day Combat Training Center scenario. To ensure that the BCT's leadership and all subordinate leaders understand the intent of this training rotation, the Army Chief of Staff should speak with the BCT leadership either in-person or via a virtual engagement. Not only does this add critical emphasis, but it also provides BCT leaders with the ability to ask questions and gain clarity on the importance of chemical readiness for the maneuver force. A key aspect the Army Chief of Staff should highlight to the entire BCT leadership is that they expect and want to see failure during training. This failure-based learning model provides leaders at all levels the freedom and flexibility to test new ideas and experiment with new techniques. By supporting this model, the Army Chief of Staff encourages the innovation and creativity that is required to build readiness in complex and hard problems. With the proper framing of the chemical problem, the Army Chief of Staff can provide subordinate commanders the level of comfort needed to truly develop unique solutions to survive, fight, and win on a chemically contaminated battlefield. Without senior leader encouragement, the culture of the U.S. Army is frequently fearful of failure, thus limiting overall LSCO readiness.[46, 47]

Upon completion of the NTC or JRTC rotation, the BCT would transition its forces to the forward theater where it is assigned to act as a deterrent and persistent presence force. While in theater, the BCT would be assigned to the theater U.S. Army commander who would provide specific chemical training aligned against that theater's threat actor. Having just completed 30 days of training in the U.S. focused on conducting combat operations in a chemically contaminated environment, the BCT must continue to train doing similar tasks while forward. During the rotation, the BCT should be prepared to participate in multinational exercises that showcase the BCT's increased chemical readiness, not only to U.S. allies and partners, but also to strategic, acute, and persistent threat actors. Through deliberate messaging and employment of new skills, the BCT not only encourages allies and partners to increase their chemical weapons readiness, but also deters adversaries from using chemical weapons on the battlefield. Using one BCT as a deliberate, proof of concept, the U.S. Army notifies its adversaries that use of chemical weapons no longer provides overwhelming advantage. Because U.S. Army forces are now proven to be capable of fighting and winning in a chemically contaminated environment, this can help deter use of chemical weapons. It remains possible that U.S. Army proven competency, developed through rigorous training, could shift adversaries back toward abiding by Chemical Weapons Convention prohibitions.

Specialized Funding and Rapid Equipment Fielding:

While leadership prioritization and threat focused training guidance are likely to be low-cost endeavors, the training and resources required for a proof of concept BCT will increase costs. To address this funding requirement, the U.S. Army should seek to increase topline funding by a an estimated $1 million for each rotational unit that is assigned to deploy to the USEUCOM or USINDOPACOM theater.[48] Although not a precise estimate of increased chemical preparedness costs, the suggested $1 million per BCT was derived from current costs associated with ongoing CBRN readiness efforts in support of the approved Campaign Plan for 2030, Objective 10B.[49]

Identifying overall FY 2024 costs associated with rotational BCTs proved difficult, however, FY 2021 costs were approximately $690 million for a non-rotational, Active-Component Armored Brigade Combat Team (ABCT) and $580 million for a non-rotational, Active-Component Infantry Brigade Combat Team (IBCT).[50] Using the FY 2021 estimates, the additional $1 million for chemical preparedness per non-rotational BCT is an estimated total of $691 million for an ABCT and $581 million for an IBCT. In his detailed, 2017 analysis, John Deni estimates that rotational BCTs cost roughly $1.2 billion per brigade (assuming a nine-month rotation).[51, 52] Using John Deni's 2017 estimates and adding the recommended $1 million for chemical preparedness, the cost per rotational BCT would be roughly $1.201 billion. Of note, these numbers have not been adjusted for inflation and are likely higher.

In order to help pay for this increase, the $1 million per rotational BCT for chemical preparedness could be reallocated internally, or funded through the already existing European Deterrence Initiative (EDI)[53] and the Pacific Deterrence Initiative (PDI).[54] While EDI and PDI have traditionally been used to fund rotational units once they arrive in theater, EDI and PDI could be amended to authorize some home station training, specifically focused on mitigating strategic and acute actor CBRN threats in the European, Asian, and other theaters. Current FY 2024 EDI is at $3.6 billion[55] and is aimed at enhancing "cooperation with Eastern European countries and to deter Russia on their flank."[56, 57] The FY 2024 PDI is at $9.1 billion[58] and is meant to improve the U.S. "posture in the region, both with direct investments in DoD capabilities and by strengthening partnerships to counter China."[59] Both initiatives are ideally suited for the requested increase in chemical preparedness spending as they focus on China as a pacing challenge and Russia as an acute threat actor.

While costs associated with rotational BCTs are admittedly small, an increase of $1 million per BCT would provide critical resources to bolster unit chemical training, equipment, and overall readiness. Additionally, the funding could be used to cover costs related to chemical equipment wear and tear, as well as rapid fielding of equipment and novel solutions generated from BCTs working with theater Army elements and alongside allies and partners. Returning to the idea of a proof of concept and model for future CBRN readiness, $1 million per BCT could lay a foundation to bolster capabilities in areas beyond chemical readiness. Taking a long-term view, after chemical readiness is achieved across the U.S. Army, the added funding could support efforts to mitigate other aspects of the CBRN threat spectrum, specifically nuclear and biological threats.

Taken together, leader prioritization, threat focused training, specialized funding, and rapid equipment fielding as this framework described, seeks to develop chemical readiness as a strategic model. Through careful observation and assessment of the BCT's planning, training, and performance, U.S. Army leaders can assess how the U.S. Army should approach chemical readiness in LSCO. Additionally, by collecting data and performance metrics through the entire proof of concept model, the entire U.S. Army can determine the validity of the approach which will likely increase subordinate commander buy-in at echelon and greater positive outcomes initially for chemical, and later for overall CBRN readiness.

RECOMMENDED APPROACH AND SUGGESTED IMPLEMENTATION STRATEGY:

To ensure successful implementation of this policy approach, the U.S. Army must take the following steps.

Implementation Step 1 – Reassess the Threat and Inform Commanders at all Echelons (Immediate and Iterative Process):

The U.S. Army must update and accurately assess the increasing threat posed by strategic, acute, and persistent threat actors who possess and are assessed to possess chemical weapons. A proper understanding of threats and vulnerabilities is foundational to ensuring that action is taken to better prepare the U.S. Army to fight and win in a chemically contaminated environment. Current U.S. intelligence professionals must prepare an accurate, even if unpopular, intelligence picture on the U.S. Army's adversaries and their abilities to exploit force vulnerabilities. This updated intelligence picture provides U.S. Army leaders with the details they require to request additional resources, support, and emphasis for U.S. Army chemical readiness.

Implementation Step 2 – Build a Common Operating Picture (Persistent):

As U.S. Army leadership, specifically the Chief of Staff of the U.S. Army, becomes aware of the dire threat that chemical weapons pose to U.S. Army forces in LSCO, they must act. As the key decision-maker for this Army-wide change, the Army Chief of Staff must champion the recommendations suggested in this policy approach. Starting with senior leaders in the U.S. Army, the Army Chief of Staff should convene and chair an advisory group. Not only would this provide needed gravitas, but it also ensures that the message and concerns are clear to senior leaders. Included in this advisory group are the Secretary of the Army; Director, Strategy, Plans and Policy; Director of U.S. Army Operations, Readiness, and Mobilization; Director of U.S. Army Force Management; and the USANCA Director, to only name a key few. Ensuring that senior U.S. Army leaders understand, not only the U.S. Army's lack of chemical readiness, but also the Army Chief of Staff's intent and vision, supports more efficient organizational change.

The U.S. Army staff must also begin to engage subordinate commanders and leaders through classified and unclassified engagements. In the past, U.S. Army leadership has used numerous methods to include drafting new strategies, white papers, safety standdowns,[60] Army force wide emails, as well as virtual workshops, and sensing sessions. To implement this policy approach, the following is recommended:

- Establish a virtual discussion and forum with key U.S. Army leaders and push access to the discussion across the force for widest distribution. This virtual discussion could take the form of a teleconference that is live and recorded for all Combatant Commands.

- Reissue the Army Chief of Staff's Army Multi-Domain Transformation Paper (2021) with updates to the chemical threat and actions the U.S. Army will take that are in line with the policy recommendation presented here.

- Provide the U.S. Army force with an unclassified, one page document that explains the plan, vulnerabilities, reasons for concern, and provides a clear and concise timeline with milestones for implementation. This document should be distributed across the force through the enterprise email system.

- Schedule quarterly touchpoints and discussions that highlight progress, challenges, and new ideas and solutions. Send notes and due outs from each meeting to the force through the enterprise email system. Frequent updates from senior leaders not only help inform the force, but they also strengthen overall accountability.

Implementation Step 3 – Provide Updated Training Guidance (Within Six Months):

The U.S. Army staff should help inform updated training guidance and provide the Director of U.S. Army Force Management with a proof of concept model for a USEUCOM or USINDOPACOM BCT entering its training cycle. New training guidance must be threat specific and encourage subordinate commanders at echelon to employ the failure-based learning model. The failure-based learning model runs counter to Army culture and will need to be championed by the Army Chief of Staff and senior leaders to gain traction.[61, 62] Leveraging the failure-based learning model, subordinate commanders can be applauded for taking bold and creative action during training to better understand and prepare for the extremely difficult and complex scenario where an enemy uses a chemical weapon. Collectively, U.S. Army senior leaders must provide subordinate commanders with the flexibility to think resourcefully and develop unique solutions to survive, fight, and win on a chemically contaminated battlefield.

Implementation Step 4 – Secure Funding for Proof of Concept (Within 12 Months):

To ensure success, the U.S. Army must secure funding for its proof of concept model. As recommended in this policy approach, the amount of $1 million should be allocated to a U.S. Army BCT that can act as a model for future training and chemical readiness efforts. The amount of $1 million could at first be reallocated and aligned internally within the U.S. Army budget to ensure that the proof of concept BCT is paid for rapidly. The U.S. Army FY 2024 budget is roughly $185.5 billion[63,64] and there is room for adjustments and reallocation of funds if justified appropriately.[65] Once the BCT completes its home station training, a rotation at a U.S. Army Combat Training Center, a deployment to USEUCOM or USINDOPACOM, and a theater level exercise, the U.S. Army can move forward with requests for permanent funding of future chemical readiness efforts through earmarked funds within EDI[66] and PDI.[67]

Implementation Step 5 – Test Concept and Capture Results (Within 18 Months):

A crucial step in efforts to prepare the U.S. Army for LSCO in a chemically contaminated environment is the meticulous capture of results from the proof of concept BCT. This article recommends that information on how the BCT plans, trains, and performs is captured using qualitative and quantitative methods. Qualitative information is, "the process of collecting, analyzing, and interpreting non-numerical data, such as language,"[68] and this will provide the framework for how the BCT preforms. Quantitative information is the internal detail and nuance of the BCT's performance and "involves the process of objectively collecting and analyzing numerical data to describe, predict, or control variables of interest."[69] Both of these methods and measures when combined provide U.S. Army leaders and commanders with a clear understanding of the cost and benefits associated with prioritizing chemical readiness and allocating additional funds to each rotational BCT.

...proven chemical readiness can influence an adversary's decision-making, deny benefit, and ultimately help deter the use of chemical weapons.

The first proof of concept BCT should be a unit that is preparing to enter the start of its training cycle. The unit should be informed in clear, concise language why it was selected, and the importance of its efforts as a model and proof of concept for the U.S. Army. This approach recommends that the Army Chief of Staff speak directly with the brigade leadership or the entire brigade formation if appropriate. It is recommended that U.S. Army provide dedicated observer controllers[70] and data scientists,[71] who are specifically trained to capture data and information on a unit's training and performance. These key enablers should be embedded with the unit throughout home station training as well as during subsequent training events. An excellent example for how the U.S. Army should collect this information is the methodology behind the data collection for the Army Combat Fitness Test.[72] Critically important to this effort is the BCT's Combat Training Center rotation either at the National Training Center or the Joint Readiness Training Center where it will validate the effectiveness of its home station chemical readiness training and the impact of any additional resources it was provided. Finally, a key for successful implementation is the BCT's participation in a theater, large-scale, multinational training event. This will not only provide additional, theater threat specific training, it is a reminder to U.S. allies and adversaries that the U.S. Army is taking active and deliberate steps to prepare for and deter chemical weapons use in LSCO. This article promotes that observable, proven chemical readiness can influence an adversary's decision-making, deny benefit, and ultimately help deter the use of chemical weapons.

Implementation Step 6 – Establish Enduring Readiness (Within 24 Months):
Following the above implementation steps provides the U.S. Army with a deliberate and systematic approach to fixing a vulnerability and strengthening combat readiness. By collecting data and performance metrics through the entire proof of concept model, the U.S. Army can determine the validity of this recommended policy approach. Based on the results provided through qualitative and quantitative data analysis, the U.S. Army can determine if the results from the proof of concept BCT justifies a request to Congress for permanent funding and equipment.

While the goal for this policy approach is implementation as described above, reality requires a brief examination of several obstacles. First, each policy and funding decision entails a tradeoff in an increasingly finite resource environment. The Army Chief of Staff and U.S. Army leaders continually face a barrage of competing requirements that include ever expensive innovative technology. These requirements, coupled with rising inflation, could be prohibitive to the additional funds requested by the policy approach. Additionally, the U.S. Army remains challenged by short time horizons for senior leaders. Often at senior, decision-maker levels, U.S. Army leaders are only in their assigned roles for two through four-year periods. As noted by the implementation timeline discussed previously, the Army Chief of Staff might make the strategic decision to increase U.S. Army chemical readiness, but it is unlikely that they will be in position to see it through. Such frequent shifts in senior leadership are often accompanied by shifts in priorities. Changes in personalities and priorities pose a risk to this policy approach's completion and the development of the proof of concept model. A final obstacle to consider is flawed or unfavorable qualitative and quantitative data. If the policy approach is not successful, or the recommended approach does not prove to be effective, there is a risk to future efforts to prepare the U.S. Army to fight and win in chemically contaminated environments. Flawed data and/or a poorly executed plan decreases U.S. Army chemical readiness while adversary chemical weapons threats are likely to adapt and multiply.

Going forward, if this policy approach proves successful, the U.S. Army should seek to conduct a similar process to mitigate risks in other aspects of the CBRN threat spectrum. At the end of 24 months, if the U.S. Army is better prepared to fight in a chemically contaminated environment, U.S. Army leaders should consider a similar approach to address nuclear and biological warfare vulnerabilities across the force. Using the framework for chemical readiness as a springboard, the U.S. Army is already well on its way to improving readiness in subsequent CBRN areas of concern.

CONCLUSION AND FINAL THOUGHTS:
Today, the U.S. Army faces an important and strategic decision on how it will tackle vulnerabilities that have emerged over two decades of COIN and CT operations in Afghanistan and the Middle East. The U.S. Army Cold War era chemical readiness is not available to deter strategic, acute, and persistent threat actors who either have chemical weapons or plan to develop and use them during LSCO. The choice facing U.S. Army leaders is how the Army should plan, train, and equip itself to reduce vulnerabilities, deter adversaries, and ensure that it is prepared to fight and win the Nation's wars.

One of the main purposes of this policy analysis is to question assumptions that U.S. adversaries will abide by international norms and chemical weapons prohibitions. Additionally, this policy article seeks to provide leaders and decision-makers with a thoughtful policy approach for consideration. While this policy approach was written separately from the U.S. Army's ongoing Campaign Plan 2030, Objective 10B efforts, it should be seen as complementary and not competing. Both approaches understand that the U.S. Army must become better trained, manned, and equipped to fight in a CBRN environment and that increasing chemical readiness promotes lethality and survivability while also deterring WMD use. The task is now to take the information provided here and weigh it against other options, costs, and priorities. As a former Army Chief of Staff acknowledged during a March 2022 discussion of U.S. Army Priorities, each decision must be carefully weighed as "every decision is a tradeoff."[73]

In closing, ongoing world events such as the 2022 Russian invasion of Ukraine[74] make it difficult for critics of the recommendations provided here to discount the need for the U.S. Army focus on chemical readiness for LSCO. While the U.S. has so far refrained from committing ground forces to the Russia-Ukraine war, if the U.S. Army did become involved in combat, they would be facing a chemically armed actor who has repeatedly disregarded Chemical Weapons Convention prohibitions and trained to use chemical weapons on the battlefield. Now more than ever, the U.S. Army should consider this policy approach and establish a deliberate plan using the outlined implementation steps to not only prepare to fight and win in a chemically contaminated environment, but also establish a strategic model for chemical readiness that can be expanded in the future to encompass nuclear and biological force readiness. In an adage as old as time, and attributed to many, it is frequently said that "Armies prepare to fight their last war, rather than their next war."[75] Today, the U.S. Army has a unique opportunity to flip the script and prepare for, while also deterring, chemically armed adversaries from using chemical weapons on the U.S. Army or its allies.[76] ■

MAJ. KIRK SHOEMAKER

is an active-duty Army Functional Area 52 (FA52), Nuclear and Countering Weapons of Mass Destruction (WMD) and Special Forces officer previously stationed in Stuttgart, Germany with 1st Battalion, 10th Special Forces Group. While stationed in Germany, Maj. Shoemaker served as a member of a specialized unit that conducted unique training focused on counterterrorism (CT) and countering-WMD (CWMD) operations. During this period, Maj. Shoemaker was fortunate to work alongside members of the Defense Threat Reduction Agency (DTRA), the U.S. Department of State, United States European Command (EUCOM), Special Operations Command Europe (SOCEUR), and several members of the FA52 Community. These experiences sparked an interest in counter-WMD efforts and helped shape this project. Maj. Shoemaker currently serves as a Program Manager at DTRA in Research and Development. The ideas and perspective in this project are the author's alone and do not represent the U.S. Army FA52 Community, U.S. Army Special Forces, the U.S. Department of Defense or DTRA.

ENDNOTES

1. Nassim Nicholas Taleb, "Nassim Nicholas Taleb Quote," A-Z Quotes, accessed January 25, 2022, https://www.azquotes.com/quote/389789.

2. State Secretariat for Economic Affairs SECO, "Chemical Weapons Convention," www.seco.admin.ch, March 10, 2022, https://www.seco.admin.ch/seco/en/home/Aussenwirtschaftspolitik_Wirtschaftliche_Zusammenarbeit/Wirtschaftsbeziehungen/exportkontrollen-und-sanktionen/exportkontrollpolitik/das-chemiewaffenuebereinkommen--cwue-.html.

3. Al Mauroni et al., "A Weapons of Mass Destruction Strategy for the 21st Century," War on the Rocks, September 8, 2021, https://warontherocks.com/2021/09/a-weapons-of-mass-destruction-strategy-for-the-21st-century/.

4. U.S. Department of Defense, "DOD Releases National Defense Strategy, Missile Defense, Nuclear Posture Reviews," U.S. Department of Defense, October 27, 2022, https://www.defense.gov/News/News-Stories/Article/Article/3202438/dod-releases-national-defense-strategy-missile-defense-nuclear-posture-reviews/.

5. Ibid.

6. Office of the Director of National Intelligence, "2023 Annual Threat Assessment of the U.S. Intelligence Community," www.dni.gov, February 6, 2023, https://www.dni.gov/index.php/newsroom/reports-publications/reports-publications-2023/3676-2023-annual-threat-assessment-of-the-u-s-intelligence-community.

7. U.S. Department of Defense, "DOD Releases National Defense Strategy, Missile Defense, Nuclear Posture Reviews," U.S. Department of Defense, October 27, 2022, https://www.defense.gov/News/News-Stories/Article/Article/3202438/dod-releases-national-defense-strategy-missile-defense-nuclear-posture-reviews/.

8. U.S. Department of Defense, "DOD Announces Release of 2023 Strategy for Countering Weapons of Mass Destruction," U.S. Department of Defense, September 28, 2023, https://www.defense.gov/News/Releases/Release/Article/3541619/dod-announces-release-of-2023-strategy-for-countering-weapons-of-mass-destructi/.

9. BBC, "Why Is There a War in Syria?," BBC News, March 12, 2021, https://www.bbc.com/news/world-middle-east-35806229.

10. United Nations, "Syria's Declaration of Chemical Weapons Program Not Considered Accurate, Thorough, Disarmament Chief Tells Security Council | Meetings Coverage and Press Releases," www.un.org, December 8, 2021, https://www.un.org/press/en/2021/sc14722.doc.htm.

11. ReliefWeb, “Syria Chemical Weapons Declaration Still Not ‘Accurate and Complete’, Disarmament Chief Tells Security Council, as Delegates Debate Frequency of Meetings - Syrian Arab Republic,” ReliefWeb, March 10, 2022, https://reliefweb.int/report/syrian-arab-republic/syria-chemical-weapons-declaration-still-not-accurate-and-complete.

12. U.S. Department of Defense, “Fact Sheet: 2022 National Defense Strategy,” U.S. Department of Defense, March 28, 2022, https://media.defense.gov/2022/Mar/28/2002964702/-1/-1/1/NDS-FACT-SHEET.PDF.

13. Kenneth Ward, “Syria, Russia, and the Global Chemical Weapons Crisis | Arms Control Association,” www.armscontrol.org, September 2021, https://www.armscontrol.org/act/2021-09/features/syria-russia-global-chemical-weapons-crisis.

14. Anthony Deutsch, “U.S. Accuses Russia of Helping Syria Cover up Chemical Weapons Use,” Reuters, November 28, 2019, sec. Editor’s Picks, https://www.reuters.com/article/us-syria-crisis-chemicalweapons-idUSKBN1Y21IJ.

15. BBC News, “Ukraine: What Are Chemical Weapons and Could Russia Use Them?,” BBC News, March 11, 2022, sec. Europe, https://www.bbc.com/news/world-europe-60708350.

16. Congressional Research Service, “CRS INSIGHT Prepared for Members and Committees of Congress INSIGHTi Resurgence of Chemical Weapons Use: Issues for Congress,” March 11, 2022, https://sgp.fas.org/crs/nuke/IN10936.pdf.

17. Yuliya Talmazan, “New Questions Arise after Chemical Weapons Body Confirms Novichok in Navalny’s Blood,” NBC News, October 7, 2020, https://www.nbcnews.com/news/world/russia-faces-new-questions-after-chemical-weapons-body-confirms-novichok-n1242390.

18. Kenneth Ward, “Syria, Russia, and the Global Chemical Weapons Crisis | Arms Control Association,” www.armscontrol.org, September 2021, https://www.armscontrol.org/act/2021-09/features/syria-russia-global-chemical-weapons-crisis.

19. BBC, “What Are Novichok Nerve Agents?,” BBC News, July 5, 2018, sec. Europe, https://www.bbc.com/news/world-europe-43377698.

20. Michael Schwirtz, “Nerve Agent Was Used to Poison Navalny, Chemical Weapons Body Confirms,” The New York Times, October 6, 2020, sec. World, https://www.nytimes.com/2020/10/06/world/europe/navalny-opcw-russia-novichok.html.

21. Lester Grau and Charles Bartles, “The Russian Way of War Force Structure, Tactics, and Modernization of the Russian Ground Forces,” 2016, https://www.armyupress.army.mil/Portals/7/Hot%20Spots/Documents/Russia/2017-07-The-Russian-Way-of-War-Grau-Bartles.pdf.

22. Mason Clark et al., “Institute for the Study of War,” Institute for the Study of War, September 25, 2020, https://www.understandingwar.org/backgrounder/warning-russia%e2%80%99s-kavkaz-2020-military-exercise.

23. Mathieu Boulègue, “Russia’s Zapad-21: Lessons Learned | CEPA,” Center for European Policy Analysis, September 20, 2021, https://cepa.org/russias-zapad-21-lessons-learned/.

24. U.S. Department of Defense, “Fact Sheet: 2022 National Defense Strategy,” U.S. Department of Defense, March 28, 2022, https://media.defense.gov/2022/Mar/28/2002964702/-1/-1/1/NDS-FACT-SHEET.PDF.

25. The Nuclear Information Project, “Chemical and Biological Weapons - China Special Weapons,” nuke.fas.org, August 1, 2008, https://nuke.fas.org/guide/china/cbw/.

26. Albert Mauroni, “United States Air Force Center for Strategic Deterrence Studies Envisioning a New Strategy to Counter Great Power Use of Weapons of Mass Destruction,” January 2022, https://media.defense.gov/2022/Feb/03/2002932493/-1/-1/0/62%20GREAT%20POWER%20WMD%20STRATEGY.PDF

27. United States Department of Defense, “DOD Releases 2021 Report on Military and Security Developments Involving the People’s Repu,” U.S. Department of Defense, November 2021, https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF.

28. Ibid.

29. U.S. Department of Defense, “Fact Sheet: 2022 National Defense Strategy,” U.S. Department of Defense, March 28, 2022, https://media.defense.gov/2022/Mar/28/2002964702/-1/-1/1/NDS-FACT-SHEET.PDF.

30. Nuclear Threat Initiative, “Iran Chemical Overview,” The Nuclear Threat Initiative, January 23, 2020, https://www.nti.org/analysis/articles/iran-chemical/.

31. U.S. Department of Defense, “Fact Sheet: 2022 National Defense Strategy,” U.S. Department of Defense, March 28, 2022, https://media.defense.gov/2022/Mar/28/2002964702/-1/-1/1/NDS-FACT-SHEET.PDF.

32. U.S. Army, “Army FM 3-11: Chemical, Biological, Radiological, and Nuclear Operations,” armypubs.army.mil, May 23, 2019, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007035.

33. Cindy Vestergaard, “What Are North Korea’s Chemical-Weapon Capabilities?,” www.lowyinstitute.org, April 24, 2017, https://www.lowyinstitute.org/the-interpreter/what-are-north-korea-s-chemical-weapon-capabilities.

34. William Gallo, “How the Afghanistan Withdrawal Looks from South Korea, America’s Other ‘Forever War,’” VOA, August 20, 2021, https://www.voanews.com/a/usa_how-afghanistan-withdrawal-looks-south-korea-americas-other-forever-war/6209777.html.

35. International Crisis Group, “North Korea’s Chemical and Biological Weapons Programs,” Crisis Group, June 18, 2009, https://www.crisisgroup.org/asia/north-east-asia/korean-peninsula/north-korea-s-chemical-and-biological-weapons-programs.

36. Council on Foreign Relations, “What’s the Status of North Korea’s Nuclear Program?,” Council on Foreign Relations, December 22, 2021, https://www.cfr.org/backgrounder/north-korea-nuclear-weapons-missile-tests-military-capabilities.

37. Ibid.

38. U.S. Department of Defense, “Military and Security Developments Involving the Democratic People’s Republic of Korea 2017,” www.hsdl.org (United States. Department of Defense. Office of the Secretary of Defense, December 15, 2017), https://www.hsdl.org/?abstract&did=810813.

39. Yochi Dreazen, “North Korea: What War with the US Would Look Like,” Vox (Vox, February 8, 2018), https://www.vox.com/world/2018/2/7/16974772/north-korea-war-trump-kim-nuclear-weapon.

40. Ibid.

41. John Donnelly, “The Other North Korean Threat: Chemical and Biological Weapons,” Roll Call, June 12, 2018, https://rollcall.com/2018/06/12/the-other-north-korean-threat-chemical-and-biological-weapons/.

42. Ibid.

43. Lt. Col. Sean Carmody, Army Campaign Plan Objective 10B Discussion with Campaign Integrator, US Army Nuclear & Countering WMD Agency (USANCA), HQDA G-3/5/7, interview by Maj. Kirk Shoemaker, September 26, 2023.

44. Ibid.

45. CSIS Interview Featuring General James C. McConville, “US Army’s Priorities with GEN McConville, Army Chief of Staff,” www.csis.org, March 8, 2022, https://www.csis.org/events/us-armys-priorities-gen-mcconville-army-chief-staff.

46. Harold Schyberg, “In Praise of Failure | Small Wars Journal,” smallwarsjournal.com, August 4, 2017, https://smallwarsjournal.com/jrnl/art/in-praise-of-failure.

47. Christopher Ingram, “6 Ways the Military Can Overcome Its Fear of Failure,” Task & Purpose, July 15, 2015, https://taskandpurpose.com/leadership/6-ways-the-military-can-overcome-its-fear-of-failure/.

48. Lt. Col. Sean Carmody, Army Campaign Plan Objective 10B Discussion with Campaign Integrator, US Army Nuclear & Countering WMD Agency (USANCA), HQDA G-3/5/7, interview by Maj. Kirk Shoemaker, September 26, 2023.

49. Ibid.

50. Congressional Budget Office, “The U.S. Military’s Force Structure: A Primer, 2021 Update,” https://www.cbo.gov/system/files/2021-05/57088-Force-Structure-Primer.pdf, May 1, 2021.

51. Andrew Gregory, “Maintaining a Deep Bench: Why Armored BCT Rotations in Europe and Korea Are Best for America’s Global Security Requirements,” Modern War Institute, July 31, 2017, https://mwi.usma.edu/maintaining-deep-bench-armored-bct-rotations-europe-korea-best-americas-global-security-requirements/.

52. John Deni, “Carlisle Barracks, PA and UNITED STATES ARMY WAR COLLEGE PRESS Rotational Deployments vs. Forward Stationing: How Can the Army Achieve Assurance and Deterrence Efficiently and Effectively?,” August 2017, https://publications.armywarcollege.edu/pubs/3359.pdf.

53. U.S. Department of Defense, “EUROPEAN DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_EDI_JBook.pdf.

54. U.S. Department of Defense, “PACIFIC DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_Pacific_Deterrence_Initiative.pdf.

55. U.S. Department of Defense, “EUROPEAN DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_EDI_JBook.pdf.

56. Congressional Research Service, “The European Deterrence Initiative: A Budgetary Overview,” July 1, 2021, https://sgp.fas.org/crs/natsec/IF10946.pdf.

57. Judy Dempsey, “NATO’s Eastern Flank and Its Future Relationship with Russia,” Carnegie Europe, 2017, https://carnegieeurope.eu/2017/10/23/nato-s-eastern-flank-and-its-future-relationship-with-russia-pub-73499.

58. U.S. Department of Defense, “PACIFIC DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_Pacific_Deterrence_Initiative.pdf.

59. Matthew Crouch et al., “A New Strategy for US Global Defense Posture,” Atlantic Council, August 5, 2021, https://www.atlanticcouncil.org/content-series/strategic-insights-memos/a-new-strategy-for-us-global-defense-posture/.

60. Jonathan Perdelwitz, “Army Safety Stand Down,” www.army.mil, March 6, 2021, https://www.army.mil/article/244012/kfor_aviation_conducts_safety_stand_down#:~:text=The%20goal%20of%20the%20stand.

61. Harold Schyberg, “In Praise of Failure | Small Wars Journal,” smallwarsjournal.com, August 4, 2017, https://smallwarsjournal.com/jrnl/art/in-praise-of-failure.

62. Christopher Ingram, “6 Ways the Military Can Overcome Its Fear of Failure,” Task & Purpose, July 15, 2015, https://taskandpurpose.com/leadership/6-ways-the-military-can-overcome-its-fear-of-failure/.

63. Assistant Secretary of the U.S. Army, “FY2024 President’s Budget Highlights Assistant Secretary of the Army (Financial Management and Comptroller),” March 1, 2023, https://www.asafm.army.mil/Portals/72/Documents/BudgetMaterial/2024/pbr/Army%20FY%20 2024%20Budget%20Highlights.pdf.

64. Mark F. Cancian, “Military Forces and Acquisition Programs: How Did They Fare in the FY 2024 Budget?,” Www.csis.org, March 17, 2023, https://www.csis.org/analysis/military-forces-and-acquisition-programs-how-did-they-fare-fy-2024-budget.

65. Kimberly Amadeo, “US Military Budget, Its Components, Challenges, and Growth,” The Balance (The Balance, September 3, 2020), https://www.thebalance.com/u-s-military-budget-components-challenges-growth-3306320.

66. U.S. Department of Defense, “EUROPEAN DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_EDI_JBook.pdf.

67. U.S. Department of Defense, “PACIFIC DETERRENCE INITIATIVE Department of Defense Budget Fiscal Year (FY) 2024,” 2023, https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY2024_Pacific_Deterrence_Initiative.pdf.

68. Saul McLeod, “What’s the Difference between Qualitative and Quantitative Research?,” Simply Psychology, 2019, https://www.simplypsychology.org/qualitative-quantitative.html.

69. Ibid.

70. Zachary Stahlberg, “The Observer Controller Trainer Team from the Joint Multinational Readiness Center (JMRC) Supervises,” www.army.mil, August 8, 2019, https://www.army.mil/article/225500/the_observer_controller_trainer_team_from_the_joint_multinational_readiness_center_jmrc_supervises.

71. Jason Crist, “From the Server to the Battlefield, How Data Scientists Are Key to Winning Future Conflicts,” www.army.mil, August 2, 2021, https://www.army.mil/article/249036/from_the_server_to_the_battlefield_how_data_scientists_are_key_to_winning_future_conflicts.

72. Michael Grinston and John Spencer, “Leaders, We Need Your Data: The Key to Refining the Army Combat Fitness Test,” Modern War Institute, March 21, 2021, https://mwi.usma.edu/leaders-we-need-your-data-the-key-to-refining-the-army-combat-fitness-test/.

73. CSIS Interview Featuring General James C. McConville, “US Army’s Priorities with GEN McConville, Army Chief of Staff,” www.csis.org, March 8, 2022, https://www.csis.org/events/us-armys-priorities-gen-mcconville-army-chief-staff.

74. Paul Kirby, “Is Russia Going to War with Ukraine and Other Questions,” BBC News, March 2, 2022, sec. Europe, https://www.bbc.com/news/world-europe-56720589.

75. Barry Popik, “Barry Popik,” www.barrypopik.com, December 26, 2010, https://www.barrypopik.com/index.php/new_york_city/entry/generals_always_fight_the_last_war/.

76. U.S. Army, “Army FM 3-11: Chemical, Biological, Radiological, and Nuclear Operations,” armypubs.army.mil, May 23, 2019, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007035.116.

Above: Nuclear Disablement Team 1 trained with the 5th Special Forces Group (Airborne) during an air assault exercise that took them from Fort Campbell, Kentucky, to Hollywood, Alabama, where they successfully simulated powering down the Bellefonte Nuclear Power Plant. A CH-47 "Chinook" from the 101st Combat Aviation Brigade supported the air assault training exercise. Courtesy photo.

NUCLEAR DISABLEMENT TEAM VALIDATES MISSION AT SIMULATED NUCLEAR POWER PLANT IN ALABAMA

WALTER T. HAM IV

A one-of-a-kind U.S. Army team validated its ability to shut down a simulated nuclear power plant during an air assault training exercise in Hollywood, Alabama.

Nuclear Disablement Team 1 trained with the 5th Special Forces Group (Airborne) during an exercise that took them from Fort Campbell, Kentucky, to Hollywood, Alabama, where they successfully simulated powering down the Bellefonte Nuclear Power Plant.

The plant is not operational, unfinished, and does not store nuclear fuel, making the site a safe and realistic training ground for this exercise.

Capt. David D. Manzanares, the Nuclear Medical Science officer from NDT 1, said the exercise increased interoperability and mission readiness. "The possibility of dealing with a damaged nuclear power station or emergencies involving nuclear reactors in a hostile environment is an emerging threat," said Manzanares. "This training event was complex, dynamic and challenged our technical expertise."

Originally from Managua, Nicaragua, Manzanares immigrated to the U.S. when he was five and was raised in Miami. He joined the Army in 2003 and served as a Health Physics NCO before becoming a Nuclear Medical Science officer.

As the Nuclear Medical Science officer on NDT 1, Manzanares fills the force health protection role by identifying radiological health risks for current and future operations and maintaining team occupational radiation doses as low as reasonably achievable. Manzanares also advises on-scene commanders, command staff and the NDT chief on operational exposure guidance and radiation health risk.

During the exercise, Manzanares leveraged his experience from serving as a Health Physics NCO at the Armed Forces Radiobiology Research Institute (AFRRI) in Bethesda, Maryland. “The radiation platforms utilized at AFFRI allow researchers to run experiments at high or very high radiation fields,” said Manzanares, who earned his bachelor’s degree from Thomas Edison State University with a concentration in Mathematics and Science. “Radiation dose rates would be similar to those experienced in a nuclear or radiological event.”

Maj. Aaron J. Heffelfinger, the deputy chief of the NDT 1, said the Idaho National Laboratory provided a simulator that helped to create a more realistic nuclear power plant.

Heffelfinger said the exercise was unique because shutting down the reactor was incorporated in a tactical training exercise. “The simulator was placed within the control room, which for all training intents and purposes, created a realistic nuclear power plant for the force to assault, seize, and deliberately power down,” said Heffelfinger. “Our formal reactor training has been with industry or at a national lab in a more classroom-oriented environment. It was always instructional training, whereas this was a validation of all the training we have previously received.”

A native of Moore Township, Pennsylvania, who previously served as an Air Defense Artillery officer, Heffelfinger said the exercise validated the NDTs critical mission of disrupting the nuclear fuel cycle at a nuclear power plant (NPP).

Heffelfinger said the mission disrupts the nuclear fuel cycle and keeps adversaries from obtaining nuclear weapons. “NPPs are a key part of the nuclear fuel cycle. It is the place all plutonium is produced. Therefore, reactors are a key area in nuclear weapon pathway defeat,” said Heffelfinger. “The NDT’s ability to assess the state of a reactor, and if needed, control and shut it down, is crucial for our mission success and those we are directly supporting.”

As the U.S. military trains to deter or defeat near-peer adversaries, Heffelfinger said having NDTs that are trained, equipped and ready is critical for supporting joint conventional and Special Forces during large-scale combat operations. “The NDTs are the only asset in the DoD with this skillset,” said Heffelfinger. “The training event helped the teamwork through logistical issues, integration with a Special Forces unit and ensuring the right people with the right skillsets were

Below: Nuclear Disablement Team 1 trained with the 5th Special Forces Group (Airborne) during an air assault exercise that took them from Fort Campbell, Kentucky, to Hollywood, Alabama, where they successfully simulated powering down the Bellefonte Nuclear Power Plant. (From the left) Capt. Samuel J. Bunn, Maj. Aaron J. Heffelfinger, Capt. David D. Manzanares and Staff Sgt. Rigoberto Olmeda from Nuclear Disablement Team 1 participate in the training exercise. Courtesy photo.

Above: Nuclear Disablement Team 1 trained with the 5th Special Forces Group (Airborne) during an air assault exercise that took them from Fort Campbell, Kentucky, to Hollywood, Alabama, where they successfully simulated powering down the Bellefonte Nuclear Power Plant. (From the left) Maj. Aaron J. Heffelfinger, Staff Sgt. Rigoberto Olmeda, Capt. David D. Manzanares and Capt. Samuel J. Bunn from Nuclear Disablement Team 1 participate in the training exercise. Courtesy photo.

brought to bear on the objective. The lessons learned will absolutely increase the teams' lethality supporting future contingency operations or large-scale combat operations."

Nuclear Disablement Team 1 (NDT 1) is part of the 20th Chemical, Biological, Radiological, Nuclear, Explosives (CBRNE) Command, the U.S. military's premier CBRNE formation. The U.S. Department of Defense's only Nuclear Disablement Teams — NDT 1 "Manhattan," NDT 2 "Iron Maiden" and NDT 3 "Vandals" – are all stationed on Aberdeen Proving Ground, Maryland.

NDTs include Nuclear and Countering WMD (FA 52) officers, an Explosive Ordnance Disposal officer, a Nuclear Medical Science officer and a Health Physics noncommissioned officer.

As the U.S. Department of Defense's nuclear subject matter experts, NDTs directly contribute to the nation's strategic deterrence by staying ready to exploit and disable nuclear and radiological WMD infrastructure and components to deny near-term capability to adversaries. The NDTs facilitate follow-on WMD elimination operations.

Nuclear Disablement Teams also serve on the FBI-led National Technical Nuclear Forensics Ground Collection Task Force, which trains to conduct post-blast nuclear forensics.

In addition to three NDTs, the Aberdeen Proving Ground, Maryland-headquartered 20th CBRNE Command is home to 75 percent of the active-duty U.S. Army's Chemical, Biological, Radiological, Nuclear (CBRN) specialists and Explosive Ordnance Disposal technicians, as well as the 1st Area Medical Laboratory, CBRNE Analytical and Remediation Activity and five Weapons of Mass Destruction Coordination Teams. ■

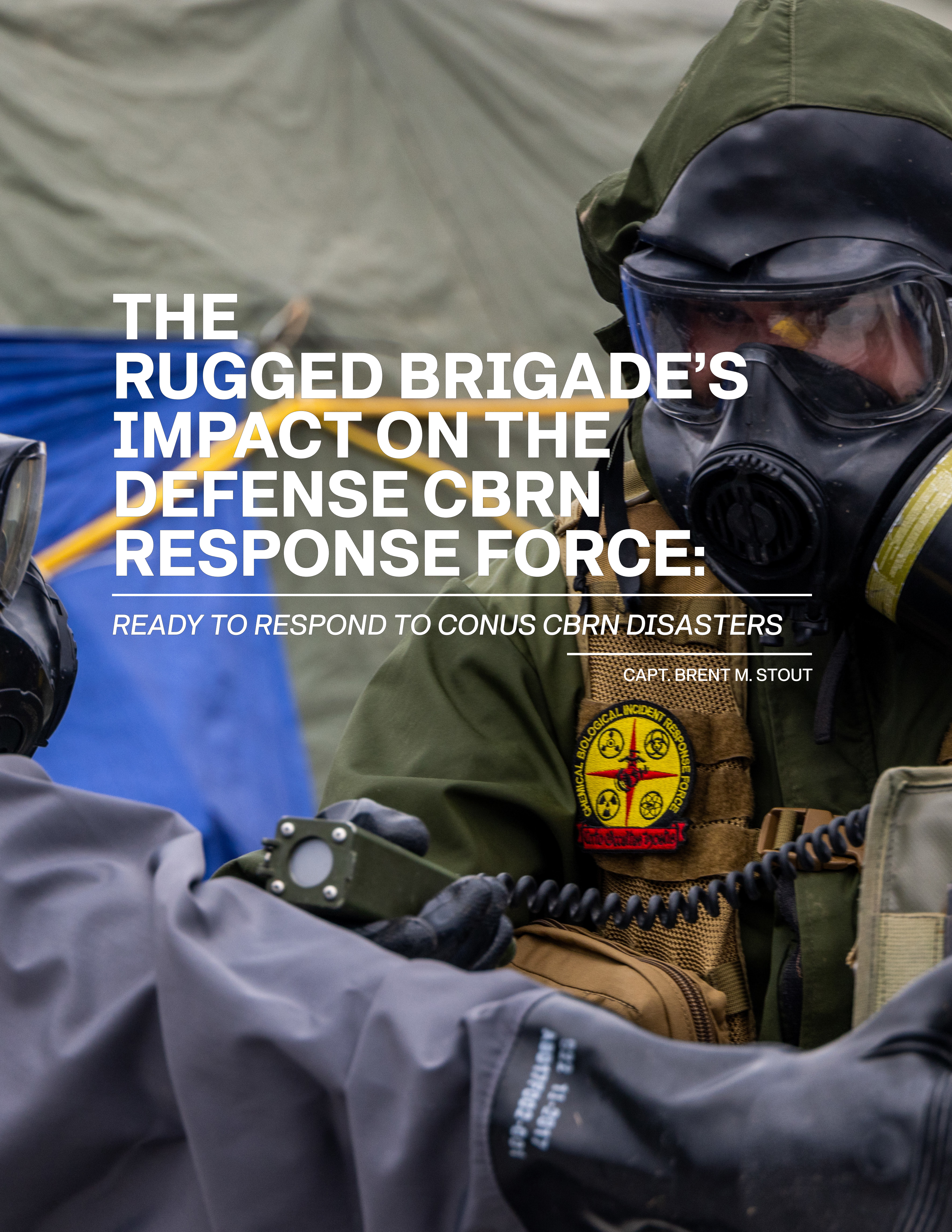
WALTER T. HAM IV

is the Deputy Public Affairs Director for the 20th Chemical, Biological, Radiological, Nuclear, Explosives (CBRNE) Command, the U.S. Department of Defense's premier multifunctional and deployable CBRNE formation. A retired U.S. Navy Chief Journalist with a master's degree in nonfiction writing from Johns Hopkins University, he previously served as a Pacific Stars & Stripes reporter and a civilian public affairs officer for the U.S. Navy, U.S. Air Force, U.S. Coast Guard and U.S. Department of Defense.

THE RUGGED BRIGADE'S IMPACT ON THE DEFENSE CBRN RESPONSE FORCE:

READY TO RESPOND TO CONUS CBRN DISASTERS

CAPT. BRENT M. STOUT



ENGINEER RELEVANCE AND HISTORY

Engineers have always been the problem solvers of the battlefield and remain the most versatile and diverse branch within the Department of Defense across the spectrum of military applications today, both in Large Scale Combat Operations (LSCO) and Defense Support of Civil Authorities (DSCA) operations. Evidence of engineers' impact on warfare can be found throughout world history and dates back to the beginning of war itself. From the defensive fortifications and watch towers of the Iron Age, the sophisticated Greek catapults of the 3rd century BC, and innovative Roman fortresses of the 5th century AD, the history and impact of the military engineer is recognizable wherever you find advances in fortifications, armament, or terrain shaping techniques and technology. Famously, the French employed Sappers, or "trench diggers", during 17th-century siege warfare, who dug trenches towards and underneath besieged forts to explosively breach enemy positions. Essentially, the military engineer has always answered the call to find and apply innovative solutions to the rising military challenges of every era.

MODERN ENGINEER VERSATILITY

In the modern US Army, almost 20 engineer military occupational specialties collectively comprise the versatile, problem-solving Engineer branch. Each specialty contributes to shaping the operational environment and addressing relevant challenges. Notably, there are engineer divers, surveyors, firefighters, power production and distribution specialists, geospatial experts, electricians, plumbers, carpenters, masons, concrete and quarrying specialists, heavy equipment operators, and combat engineers, among numerous others. Whether the engineers are tasked to construct tactical obstacles, build infrastructure, fix airfields, destroy minefields, clear routes, or make maps, each specialty enables the Engineer Branch to fill any job description and tackle any task. Fittingly, the motto, *Essayons*, translated from French as "Let Us Try", hints at the branch's versatile application and inherently adaptable nature necessary on the modern battlefield.

Above: U.S. Marine Corps Lance Cpl. Jacob Whitecomb, a decontamination Marine assigned to the Chemical Biological Incident Response Force, scans a U.S. Army Soldier for notional radiation and chemical particulates during Exercise Sudden Response at Coryell Health Hospital, Gatesville, Texas, Dec. 10, 2022. (U.S. Marine Corps photo by Staff Sgt. Jacqueline A. Clifford)

THE DEFENSE CBRN RESPONSE FORCE

Today, one of the challenging missions required of the Army is to train, maintain, and employ a joint CONUS-based all-hazards no-notice response force known as the Defense Chemical, Biological, Radiological, Nuclear (CBRN) Response Force (DCRF). The DCRF formation is one portion of the greater DoD CBRN Response Enterprise (CRE), which comprises dedicated and allocated local, state, and federal forces to conduct emergency CBRN response operations against CBRN incidents within the United States and its Territories (See Figure 1). While probable response scenarios encompass chemical plant explosions or other emergencies potentially caused by large natural disasters like hurricanes or wildfires, the most dangerous response scenario is the detonation of a nuclear device in a major metropolitan city. Ultimately, DCRF aims to augment local and state efforts to save lives and minimize human suffering. The DCRF mission resides on the Defense Support of Civil Authorities (DSCA) side of military application. Therefore, it requires a thorough understanding of the legal implications of employing Title 10 military forces within the United States and its Territories. Training, maintaining, and employing a joint all-hazards response force requires versatility and sufficient skill in a broad spectrum of specialties instead of a narrow application of a niche skillset. It is no wonder why the Department of Defense continues to rely on US Army Engineer Brigades to command and control the tactical elements of this consequential joint response force.

TASK FORCE OPERATIONS (TF-OPS)

Annually, FORSCOM tasks an active-duty US Army Engineer Brigade to command and control Task Force Operations (TF-OPS), the tactical core of the DCRF formation (See the DCRF TASKORG). DCRF falls under USNORTHCOM, which tasks Joint Task Force Civil Support (JTF-CS) to command and control the entire DCRF force, including Three Brigade and one Battalion-level task forces—Task Force Operations (TF-OPS), Task Force Aviation (TF-AVN), Task Force Medical (TF-MED), and Task Force Logistics (TF-LOG) — and various other specialty enablers that offer additional signal, human resources, legal, chemical, medical, and religious support capabilities. It is the responsibility of the TF-OPS commander and staff to synchronize task force movement in and around the response area, receive guidance from JTF-CS, liaise with the Incident or Area Commander of the civilian emergency response infrastructure within the lead federal agency, and coordinate for aviation, logistics, and medical

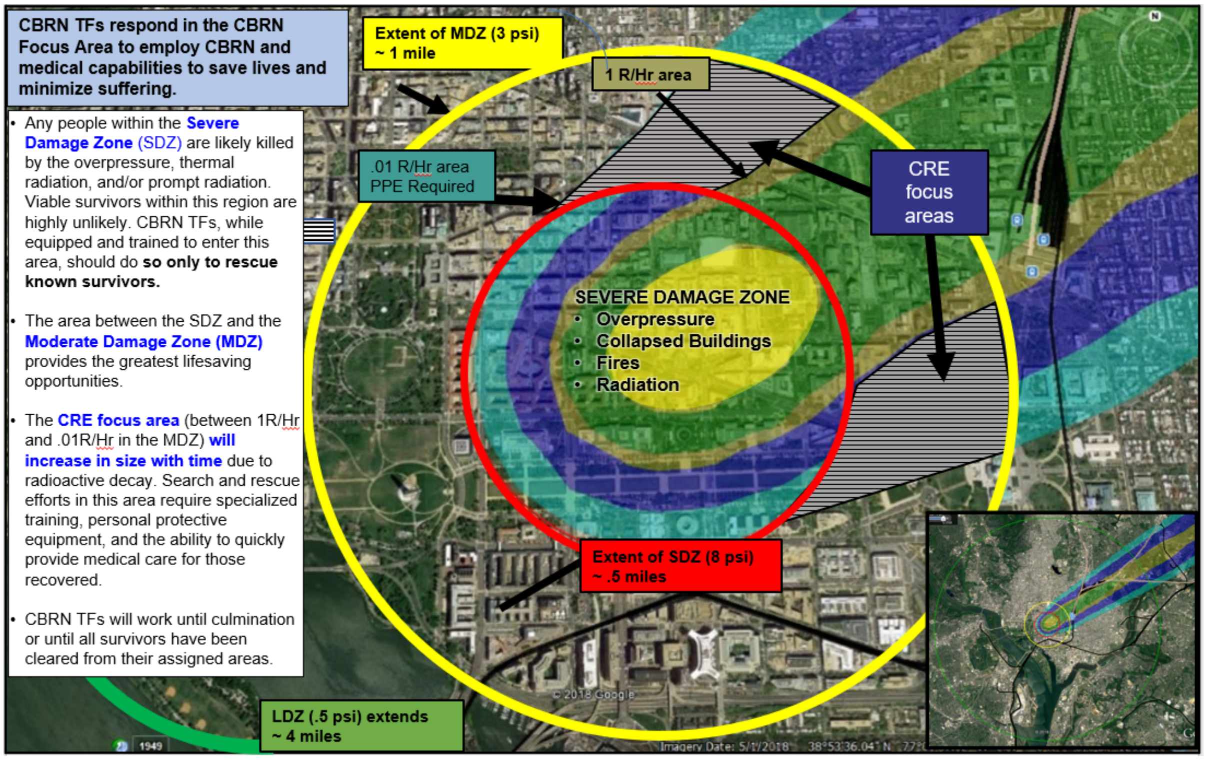


Figure 1. DCRF Concept of Employment

support from the other brigade task forces. The two-year DCRF assignment in TF-OPS consists of training and equipping nearly 5,200 Soldiers during the first year and sustaining readiness in the second year, or "mission year". During the train-up year, units receive special equipment, conduct key leader conferences and tabletop exercises, validate technical training, and command post operations, and execute internal staff exercises and leader development courses. During the mission year, units receive a Prepare to Deploy Order (PTDO), requiring TF-OPS units to be ready to deploy in 24 or 48 hours from a no-notice disaster event, depending on the force package to which the unit is assigned. Units maintain readiness through regular task force status update briefs and by executing various joint sustainment exercises.

THE TF-OPS HQ AND FORMATION

The TF-OPS formation includes three Battalion Task Forces (BN TFs) and five distinct enabler units (See Figure 2). Each of the BN TFs are identical in capability and purpose but are led by either an Engineer, Chemical, or Military Police battalion HQ. Each battalion has a CBRN company (Hazard Response), an Area Support Medical Company (MCAS), an Urban Search and Rescue (US&R) platoon, and a General Purpose Force (GPF) company. An Engineer Construction Company usually fills the US&R sourcing requirement, and each GPF may comprise either an engineer company or a military police company. The enablers under TF-OPS are critical to overall DCRF mission success and create a joint force that consolidates the necessary specialized capabilities from the US Army, Air Force, and Marines under one command. Specifically, TF-OPS enablers include the Air Force Radiation Assessment Team (AFRAT), an Army Engineer Construction Company (ECC), an Army Mortuary Affairs Platoon, and the Air Force Rapid Engineer Deployable Heavy Operational Repair Squadron Engineers (RED HORSE). The USMC Chemical Biological Incident Response Force (CBIRF) primarily supports the National Capital Region but allocates one of its two Incident Response Forces (150 pax) to support DCRF. For some of the units in the TF-OPS TASKORG, like the MCAS or the CBRN Company, their assigned DCRF tasks align with their unit's organic Mission Essential Task List (METL). For others, like the Battalion Headquarters, the engineer construction company sourcing the US&R platoon, or the engineer or MP companies sourcing the General Purpose Force (GPF), the required

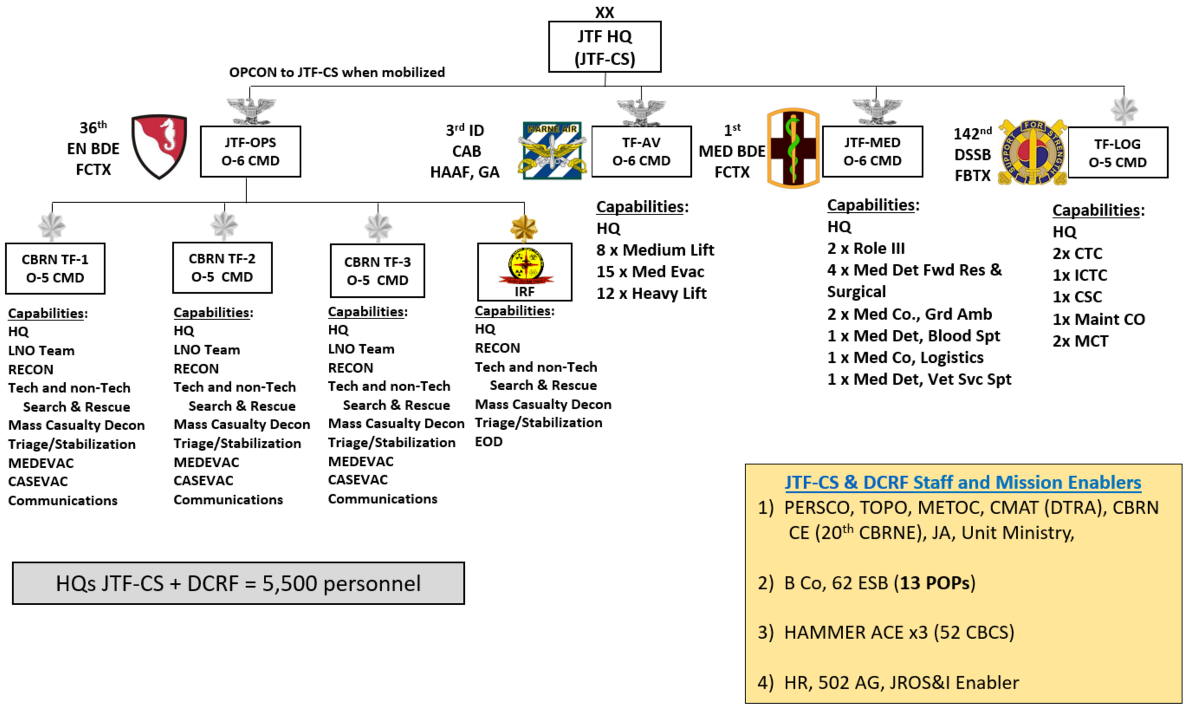


Figure 2. Mission Year 2022 JTF-CS Task Organization

DCRF tasks may have little resemblance to their unit's METL. Regardless, each BN TF must come together to provide six core capabilities as outlined in Contingency Plan (CONPLAN) 3500: Mission Command and Communications, CBRN Identification and Detection, Urban Search and Rescue, Mass Casualty and Non-Casualty Decontamination, Medical Triage, and Stabilization, and Air and Ground Evacuation.

THE RUGGED BRIGADE LEADS MISSION YEAR 2022

The Train Up Year

FORSCOM tasked the 36th Engineer Brigade headquarters element as the TF-OPS sourcing unit for DCRF Mission Year 2022 (MY22). Beginning in June 2021, the Rugged Brigade received a series of in-briefs that began the MY22 train-up year. From June 2021 to May 2022, the Rugged Brigade conducted internal leader development classes, hosted mobile training team visits from JTF-CS, initiated regular touch points with the TF-OPS down trace battalions and companies, and executed a series of train-up exercises in preparation for the joint multi-echelon collective training validation exercise.

Mission Validation

Before officially assuming the mission on 01 June of the assigned mission year, units must validate their training at the Muscatatuck Urban Training Center (MUTC) near Camp Atterbury, Indiana, in the GUARDIAN RESPONSE exercise The ARNORTH Civil Support Training Activity (CSTA) observes, coaches, trains, and validates each unit at GUARDIAN RESPONSE and sources hundreds of other contractors and role players for the exercise. MUTC is home to top-tier urban training facilities that can replicate various realistic response scenarios, including, among many others, a train crash, underground tunnel networks, a flooded neighborhood, a prison, a church, a hospital, certified rubble piles, and the capability to create rubble roads where hundreds of cars are placed on a route to be cleared by the TF-OPS ECC enabler. GUARDIAN RESPONSE is the only DCRF exercise encompassing the entire JTF-CS formation, allowing units to test their response mission systems, processes, and procedures. The Rugged Brigade took the opportunity to test inherited operating procedures and pave the way for new and enhanced response techniques and procedures for various aspects of the response force during their GUARDIAN RESPONSE validation exercise in May of 2022.

The Mission Year

Once validated at GUARDIAN RESPONSE, the Rugged Brigade officially assumed the DCRF mission, and the associated 24-hour Prepare To Deploy Order (PTDO). From 01 June 2022 to 31 May 2023, the Rugged Brigade led monthly status update briefs and regular task force touchpoints. The brigade continued conducting leader development sessions on DCRF topics and maintained contact with higher, adjacent, and subordinate units. Mission planning conferences hosted by JTF-CS enable mentoring relationships between the units currently on mission and those preparing to assume the mission. The conferences covered critical topics like the "N hour" deployment sequence, operation synchronization, and DCRF equipment use, storage, and handover planning factors. They also allow for key leader face-to-face engagements at the battalion, brigade, and division levels, ensuring adequate knowledge sharing and management between all pertinent stakeholders.

Developing Joint Service TTPs

The 62nd "Hammer" Engineer Battalion of the 36th Engineer Brigade was sourced as Battalion Task Force 1 for the DCRF mission year 2022. During DETERMINED RESPONSE in December of 2022, the Hammer Battalion developed new joint service tactics, techniques, and procedures (TTPs) by commanding and controlling an unprecedented relief operation between CBIRF and a battalion task force. The process included eight deliberate steps: an Initial link up, an operations

Below: U.S. Marine Corps Lance Cpl. Ethan Renteria, a decontamination Marine assigned to the Chemical Biological Incident Response Force (CBIRF), Bravo Company, assists a U.S. Army soldier with the 172nd Chemical, Biological, Radiological, Nuclear (CBRN) Company with providing emergency medical care to a simulated casualty during Exercise Sudden Response at Fort Cavazos, Texas, Dec. 12, 2022. (U.S. Marine Corps photo by Staff Sgt. Jacqueline A. Clifford)

overview and debrief, a key leader terrain walk, new unit area occupation, new operator equipment familiarization, gradual force integration, process management handover, and operator exfiltration by the previous unit. This type of operation is advantageous in a scenario where CBIRF establishes initial operations in a new response site and reaches the point of needing relief to maintain sufficient patient throughput. In preparation, the Hammer Battalion conducted multiple terrain model rehearsals with all stakeholders and refined tactical command procedures to include connections between the civilian Incident Commander and staff, the MCD command team, the CBIRF commander, the US&R teams, the GPF commander, the medical treatment and evacuation commander. To command and control such a complex and multi-faceted formation, the 62nd Engineer Battalion TAC embedded a team of liaisons with each major component of the operation. Having occupied an operationally advantageous area, the battalion TAC could receive and process information quickly, track operational status through execution checklists, and report progress to higher echelons. With up to six liaisons employed at once, tactical-level feedback was rapid, enabling operational decision-making to be flexible and effective.

Lessons Learned

The keys to success for the Rugged Brigade during the DCRF mission year 2022 include the implication of a joint LSCO and DSCA training glide path, effective knowledge management, and consistent stakeholder management (See the 36E DSCA and LSCO Training Glide Path). Each unit within the TF-OPS formation has competing requirements and commanders with differing priorities. However, every unit must still conduct DCRF training, validation, and sustainment activities. The Rugged Brigade implemented a joint glide path that trained Soldiers and leaders in LSCO and DSCA operations simultaneously where possible, preparing for Warfighter 23-04 as the culminating LSCO training event, while also staying ready to respond in support of DSCA operations. Incorporating clear training objectives for both lines of effort will maximize valuable multi-echelon collective training exercises. Planning efforts, communication across the formation, and knowledge management systems will all be more effective through aligning the right human and material resources to the DCRF line of effort. Each unit will undergo heavy turnover during the two-year assignment, but keeping the same trusted agents, liaisons, and lead planners will make a substantial difference in mission success.

ENGINEERS ARE APT TO LEADING JOINT FORCES

Engineers have always been problem solvers on the battlefield and remain the most versatile and diverse branch within the Department of Defense across the spectrum of military applications. Evidence of engineers' impact on warfare can be found throughout history and remains overtly significant in LSCO and DSCA operations. The Engineer Regiment will continue to answer the nation's call, whether to shape the modern battlefield's ever-changing operational environment or to lead joint task forces in response to a disaster on the home front. The Engineer Soldier has no choice but to fill any job, tackle any required task, and continue singing "*Essayons*, whether in war or peace ... *Essayons*, we serve America and the US Army Corps of Engineers." ■

CAPT. BRENT M. STOUT

currently serves as the Commander of the 104th Engineer Construction Company located at Fort Cavazos, Texas. He served as the lead planner, lead trusted agent, and lead liaison for the 36th Engineer Brigade (TF-OPS) during the 2022 DCRF train up year (01 June 2021 to 31 May 2022), and as the 62nd Engineer Battalion (DCRF BN TF 1) Plans Chief during DCRF Mission Year 2022 (01 June 2022 to 31 May 2023). Capt. Stout has a degree in Mechanical Engineering from the United States Military Academy at West Point and holds an advanced degree in Engineering Management from Missouri University of Science & Technology. He earned a graduate certificate in nuclear weapons effects, policy, and proliferation from the Air Force Institute of Technology in September of 2022.

COMBAT PERFORMANCE DECREMENT

DR. BEHZAD SALIMI

INTRODUCTION

At USANCA, among other missions, we attempt to understand and mitigate the degree of casualties, while improving the effectiveness of Army combat forces in the aftermath of a nuclear explosion. We attempt to use the best and the latest (and sometimes age-old legacy) computational resources to model, explore, and explain a new or better understanding of the effects of nuclear weapons on the battlefield. We use several computer programs (in software jargon–codes) created and maintained with support from Defense Threat Reduction Agency (DTRA), and also specialized software developed by this author for rapid environment phenomenology and effects analysis. Furthermore, we continually strive to push all our computational capabilities to and beyond their limit as we try to understand the scope of the problems and to find ideas and methods to improve the existing modeling capabilities.

One such code supported by DTRA is Health Effects from Nuclear and Radiological Environments (HENRE). This code, in its current state, takes only the nuclear radiation dose as input, with a few additional parameters to bound the calculations by the user preference. The input dose must be supplied by the user as arbitrary choice or from running other specialized codes that compute nuclear explosive environments. HENRE provides substantial detail on health effects of radiation, including many documentations, which the interested reader may obtain directly from DTRA.

The objective of this paper is to discuss the results of performance decrement computations in three hypothetical scenarios, not to present numerical values as facts, but to stimulate thoughts for further analysis and discussions. The numerical values presented in this paper are for overall analysis and discussions only.

As computer programs evolve, improve, or update onto newer platforms, it is normal to expect some change in numerical results, but the trend should be the same unless an error is discovered or a major update to the mathematical models (or data) is introduced by later research.

COMPUTATION SCENARIO

In the event of a nuclear explosion close enough to the Earth's surface to cause significant blast, thermal and nuclear radiation effects, imagine two concentric circular regions directly below the detonation point, which is commonly called ground zero or GZ. See Figure 1.

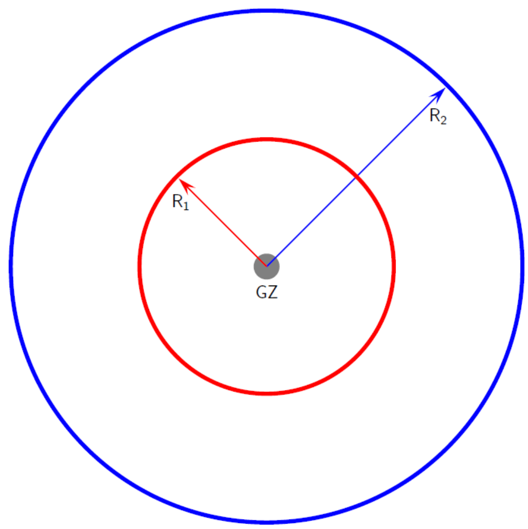


Figure 1. Affected zones beyond GZ.

Realistically, the radii of these circles are not fixed numbers, but an approximate range of hundreds of meters depending on the explosive power of the weapon in kilotons (kt) and its height of burst (HOB). For convenience, let us consider the boundary of these two circular regions represented by definite mathematical values R1 and R2, where R1 < R2 (R1 less than R2). We assert that the region inside R1 experiences total destruction by one or combined effects of nuclear explosion. In this region, we would consider all forces are destroyed or disabled, therefore combat ineffective. We also assert that the region beyond R2 experiences little or no damage or destruction except possible flash blindness or retinal burn, which are important but beyond the scope of this paper. Keeping this exception in mind, we consider forces positioned beyond R2 to be fully combat effective.

The paramount question in this scenario is, therefore, the effectiveness of the forces in the region bounded by R1 and R2, where we would expect a range of partial effectiveness. The term effectiveness is a relative figure that depends on many factors including the condition of individuals as well as the technical and physical demands of the tasks to be performed. For example, for a given injury, performance reduction by 50% has very different meaning (and outcome) for a task required by a rifleman and a task required by a helicopter pilot. HENRE has built-in mathematical models, based on both research and data, to estimate the effect of radiation on performance of certain functions generally ubiquitous in Army activities. For example, load, aim, fire an M-16 rifle; perform duties of a mobile gunner; equipment driver or operator.

We used a code developed by this author to generate a representative table of total dose versus horizontal range for a given weapon yield. The basic front-end wrapper for HENRE runs only one input value to generate one output, which is cumbersome and impractical to run a large number of computations for scoping analysis. With the support of DTRA, the developers of HENRE provided an automation tool (script) and a special version of the code to allow running many calculations in a very short time (minutes or seconds). We used this special version to run all the computations in this article.

SCOPE OF MODELING AND ANALYSIS

We selected a subset of HENRE's built-in task models to compute the range (in kilometers) at which a given performance decrement (PD) occurs. We selected three different weapon yields for this brief study. To simplify and demonstrate the results of the computations, we selected three performance levels of 25%, 50%, and 75% for simple, quantitative analysis of performance decrement in various selected task models. Also for simplicity, we did not include any specific radiation protection factors associated with the posture in different activities. Therefore, these results may be biased toward worst case scenario of total absorbed effective dose.

The following figures show the results of performance decrement computations for three different weapon yield scenarios. These figures can be useful in analysis of nominal variations in performance decrement of several different specific operations on the battlefield under radiation from a nuclear weapon attack.

Figure 2 shows the change in performance versus horizontal range for a notional 5 kt weapon.

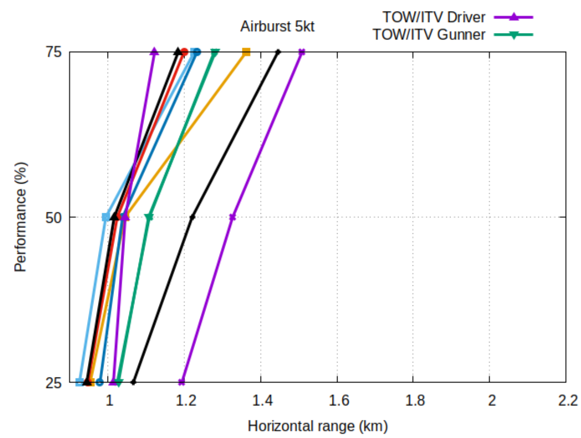


Figure 2. Performance vs. range, 5 kt scenario.

Figure 3 shows the change in performance versus horizontal range for a notional 20 kt weapon.

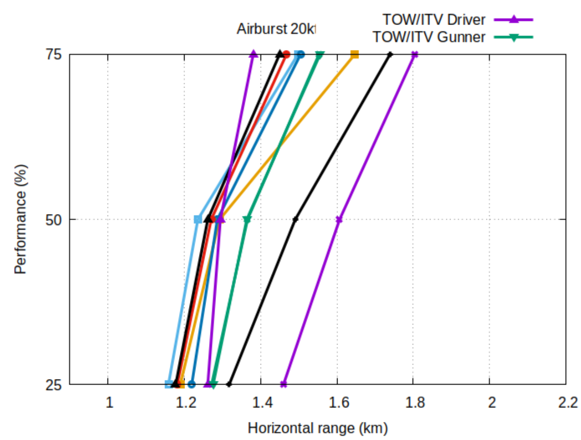


Figure 3. Performance vs. range, 20 kt scenario.

Figure 4 shows the change in performance versus horizontal range for a notional 50 kt weapon.

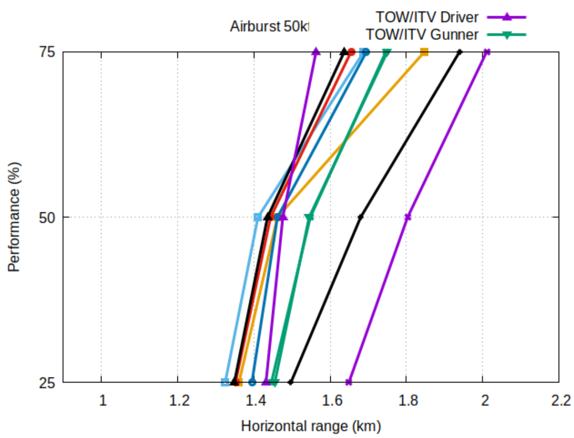


Figure 4. Performance vs. range, 50 kt scenario.

The prompt phenomenology of actual weapons depends on the weapon type and yield. Therefore, the information contained in these calculations and plots are for overall comparison and scoping analysis.

CONCLUSION

HENRE is a useful software for analysis of performance decrement and several other health effects after exposure to ionizing (nuclear) radiation due to nuclear weapon's output. One could argue, from the results of this simple study, that on the battlefield:

1) Performance decrement varies depending on different personnel postures.

2) Activities in the open are at higher risk of performance decrement.

3) Distance to the same performance (decrement) level increases proportionally to the increase in weapon yield.

According to these computations, distance from GZ has a significant effect on radiation-induced performance decrement as one would expect. Moreover, these computations demonstrate the trend in performance decrement are consistent with expected change in weapon yield, specific task, and personnel posture. The consequences of reduced performance in the region between R1 and R2 must be interpreted according to each specific task. For example, even with minor performance decrement, equipment drivers might drive off-road causing a crash, or feel disoriented, ultimately causing delays in delivery of ammunition, food, or medical supplies. We would expect riflemen and other weapon operators to load and fire their weapons more slowly. In both of these scenarios our forces would be more exposed and more vulnerable to enemy fire, therefore we expect higher casualties because of reduced performance of combat troops and their support personnel.

HENRE computations, accounting for combined injuries caused by radiation, may indicate a larger number of casualties than predicted with other tools, within the prompt and delayed radiation effects in the immediate nuclear detonation region. The increased or unanticipated casualties will have an operational impact on mission accomplishment and the associated increased need for medical and logistical support. These effects could stress resources with potential impact on various operations. While these arguments are expected from basic physics principles, HENRE computations can provide a framework for a quantitative perspective on the magnitude of the risk levels and the scale of the consequences of radiation exposure on the battlefield, in addition to blast and thermal effects. ■

DR. BEHZAD SALIMI

is a Nuclear Effects Analyst and weapons effects modeler at USANCA, at Fort Belvoir. He has a B.S. in Mechanical Engineering from the UT Austin, a M.S. in Nuclear Engineering from the University of Illinois, and a Ph.D. in Nuclear Engineering from the University of Illinois. His email address is behzad.salimi.civ@army.mil.

A UNIQUE SOLUTION TO NUCLEAR REACTOR PARAMETER CENTRALIZATION:

STREAMLINING THE SEARCH AND ANALYSIS OF PROLIFERATION ASSISTING REACTORS

CADET AARON CALHOUN & CADET MATTHEW ECKERT

ABSTRACT

To improve current methods of nuclear reactor parameter analysis research a new system of citation and information centralization is proposed. The tool would include long-form summaries of nuclear reactors, a holistic database of nuclear reactor characteristics, associated scoring / filtering tools, and the ability of users to compile and update reactor-specific citations in an open-sourced platform. The alterations and additions to the database would be confined within the Department of Energy, Department of Defense, or partner laboratories. Moreover, the proposal of this inter-agency database would serve to minimize the time needed to summarize and analyze potential proliferation assisting reactors, particularly when source information is limited. The Nuclear Reactor Directory Project would be an open-source inter-agency tool capable of minimizing preliminary research time while remaining accountable to the broader expert community.

INTRODUCTION

The current state of nuclear reactor research is decentralized. This fact is particularly true for generation IV and Chinese-developed reactors. Varying formats for parameter communication combined with infrequent updates from parent developers often makes current methods of information collection and analysis tedious and inaccurate. However, projects like The International Atomic Energy Agency's (IAEA) Advanced Reactors Information System (ARIS) and Power Reactor Information System (PRIS) or The World Nuclear Association's (WNA) Reactor Database attempt to resolve some of these issues.[1, 2, 3]

The most recent of these databases comes in the form of the IAEA's ARIS database. With the stated mission of "foster[ing] information exchange and collaborative research in the area of advanced nuclear reactor technologies." It provides users with an executive summary database of advanced reactors and a corresponding overview from historical IAEA reports. While capable of summarizing reactors in both long-form IAEA reports and in shorter in-page database rows, ARIS is unable to provide users with external citations which, in cases where reactors are under development, can be critical in the search for current reactor specifications. Moreover, ARIS is susceptible to irregular publication and information reporting due to the internal publication requirements needed for citation referencing. That is, reactors categorized as "Under Design" by ARIS, like ABWR-II, VBER-300, and all VVER reactors, can remain untouched in technical and parameter reporting for more than a decade because of the IAEA's limited publications.[1]

In their 2023 report, Ana Getaldić and Dr. Marija Surić Mihić summarize the primary function of the IAEA's database features and capabilities with an emphasis on nuclear and radiological data.[3] The summary report broadly serves to reinforce the authority and accuracy of the IAEA's databases, it also demonstrates the IAEA's limited tools for researchers looking to find technical design or parameter information of reactors that are not generation-IV or research focused. As such, the IAEA is unable to provide users with the web-page-to-user export features needed for multi-platform user analysis research. More specifically, users are unable to download design specifications in formats other than in the Portable Document Format (PDF).

PRIS and WNA's reactor database pose their own limitations. The central focus of these databases is on the summarization and categorization of power plants– not the nuclear reactors themselves. These databases largely focus on providing national governments and international agencies with the information needed to readily understand the features and capabilities of different power plants. Outside of peripheral information relating to the reactors employed by a given power plant, the two databases are limited in their descriptions and technical reports of the reactors themselves. Both databases provide little information regarding reactor specifications outside of its use at a given plant- their focus is power plant analysis, not reactors themselves.[4] A database for nuclear power plants cannot replace a centralize and comprehensive database of nuclear reactors.

Long term, the establishment of a new form of parameter centralization could also serve as a preliminary step in identifying civilian-counter proliferation gap in development. This gap, as outlined by Dr. Man-Sung Yim and Jun Li, can be found in the inhibiting effect nuclear weapons programs have on the development of domestic nuclear energy programs. Understanding the limitations and challenges of individual reactors, according to their country of implementation, would enable counter-proliferation researchers to better identify the national energy programs that are inadvertently limited by weapons development. Both identifying what reactors are being utilized and how those reactors are advancing within national energy programs will promote a more holistic analysis of a given reactor. If proliferation assisting reactors are to be found and studied by researchers and, eventually, the impacted public at large, then a larger emphasis is need on the formatting, accessibility, and resourcing of nuclear reactor parameter information.[5]

Current reactor information systems are limited in four primary ways:

1) Updating reactor parameters irregularly.

2) Providing citations external to the parent organization.

3) Creating systems capable of quantitatively comparing reactor characteristics and developments.

4) Exporting reactor parameter characteristics to user in multiple formats.

The proposed solution of this paper aims to resolve these issues through an expert driven open-sourced database of nuclear parameters. Obtaining and analyzing information on the reactors of national nuclear programs should not be limited by a given country's willingness to participate as is the case of the IAEA's Country Nuclear Power Profiles (CNPP) program – a complete understanding of all potential proliferation supporting reactors is necessary for comprehensive proliferation research.[6]

DIRECTORY ATTRIBUTES & FEATURES

Reactor-Specific Summaries

The Nuclear Reactor Directory Project (NRDP) is comprised of two primary user interfaces: (1) reactor-specific summaries and (2) the over-arching database and directory. The dual platform enables analysis of both specific reactors and broader trends within reactor sub-groups. The NRDP provides a framework for experts to understand and summarize the analysis of peer researchers and and conduct comparitive analysis of nuclear reactors.

A proposed outlook for a reactor-specific summary page, like those created by the IAEA, would primarily provide the user with an executive overview of the reactor, a reference of primary citations, varying export formats, and relevant technical diagrams in one location. With the ability to download all information stated on the page, users would be able to conduct independent analysis without the need for the web page.

Moreover, reactor summary pages serve as the primary point for information validation. Summary information with accompanying citations enables users to directly validate information from primary sources. When information is inaccurate or out-of-date, primary source

Search...

Home Login Register

Reactor	Plant or SMNR	Generation	Operational Status	Type	Primary Coolant	Primary Moderator	Primary Company/Group	Country	Thermodynamic Cycle	Decade of First Use	Operational Life	Thermal Output (MWt)
EGP-6	SMNR	X	operational	RBMK	light water	graphite	Institute of Physics and Power Engineering	Russia	TBD	1970	50	29
KLT-40S	SMNR	X	operational	PWR	light water	light water	OKBM Afrikantov	Russia	Rankine	2010	37.5	300
RITM-200	SMNR	X	operational	PWR	light water	light water	OKBM Afrikantov	Russia	Rankine	2010	40	175
TMSR-LF1	SMNR	X	in-construction	MSR	molten salt	graphite	China National Nuclear Coporation	China	TBD	2020	20	10
BREAST-OD-300	SMNR	X	in-construction	LFR	lead	X	Atomenergoprom	Russia	Rankine	2020	30	700
CAREM	SMNR	X	in-construction	PWR	light water	light water	CNEA	Argentina	TBD	2020	60	100
ACP100	SMNR	X	in-construction	PWR	light water	light water	China National Nuclear Coporation	China	TBD	2020	60	385
MMR	SMNR	X	licensing	MSR	molten salt	graphite	Ultra Safe Nuclear Corp.	Canada	TBD	2020	20	15
BWRX-300	SMNR	X	licensing	ABWR	light water	light water	GE Hitachi Nuclear Energy	U.S.	TBD	2020	60	900
NuScale	SMNR	X	licensing	PWR	light water	light water	NuScale Power Inc.	U.S.	Rankine	2020	60	160

Figure 1: Partial example from current prototype of NRDP summary database. This primary page is designed to be capable of exporting summary Data Frames of reactor parameters, conducting preliminary filtering, and enabling users to complete direct searches of the database for reactors or their composing characteristics. All reactors shown in the database are correspondingly hyperlinked to reactor-specific informational pages.

alterations by any user with access is possible with an accompanied citation reference. The utility of the database, then, is directly the result of its open-sourced structure.

Database Features & Scoring Analysis

The second main feature, the over-arching database, allows users to find reactors with shared characteristics and quantitatively compare listed parameters based on individualized needs. Similar, to the reactor-specific pages, export file variety would remain central to the page. The ability to filter the database for reactors with similar characteristics means that export files can be easily limited to only the information necessary to the user. As seen in Figure 1, reactor summary rows will correspondingly be linked to reactor-specific page which can also be found through a directory search engine.

Built into the database page is a comparative analysis tool that aims to quantify how "similar" a reactor is with an external set of user desired specifications – it is a method for finding the reactor(s) best suited for the needs of the user.

One method for quantitative comparative analysis of nuclear reactors parameters comes from weighting desired user specifications. To do this we categorized reactor parameters as describing either qualitative or quantitative characteristics. Qualitative characteristics, generally, include those specifications that do not exist on an explicit numerical spectrum – a reactor either uses molten salt or it does not, the coolant is either heavy water or it is not. These binary categorizations, while not directly capable of capturing potential relationships between qualitative characteristics, enables our system to easily integrate all forms of categorical parameters into a system of numerical analysis. Quantitative characteristics include all parameters that can be described by continuous numerical values – that is characteristics like "reactor generation" of "3" would not be considered quantitative.

To compare these characteristics the users are first asked to select the set of characteristics they wish to analyze, assign a proportional weight to each characteristic (W), and input the desired value they find ideal. All characteristic weights are normalized to find a scaling score factor (W_i) - this is accomplished by dividing individual characteristics weights by the sum of all characteristic weights (W_n).

$$W_i = \frac{W}{W_n} \quad (1)$$

The normalized score is then assigned to each characteristic regardless of qualitative or quantitative categorization. Once complete, each parameter of every reactor is compared with those specified by the user. For those categorized as qualitative a simple binary analysis is conducted where the same characteristic is given a percent deviation score (d) of 0 while those with parameters different from those desired by the user are given a score of 1.

For quantitative characteristics, the absolute difference between the user-desired parameter (v_d) and the value from a reactor of interest (v_r) is found. The difference is then divided by the user-desired parameter to determine the absolute percent deviation (d).

$$d = \frac{|v_d - v_r|}{v_d} \quad (2)$$

Once the difference values are found from a given reactor, the values are then used to assign a similarity sub-score (S) out of 100 to each reactor characteristic.

$$S = (1 - d) \cdot W_i \cdot 100 \quad (3)$$

The summation of all sub-scores (S_i) are used to assign each reactor a total score for comparison (S_n).

$$S_n = \sum_{i=1}^{n} S_i \quad (4)$$

Reactor scores are then ranked and presented to the user. Parameter sub-scores for each analyzed characteristic are correspondingly listed for all reactors.

Currently, a desktop-based Graphical User Interface (GUI) version of the analysis methods described has been prototyped. Input and output interfaces for the prototype can be found in Appendix A and Appendix B respectively. Providing users with the underlying python code and alternative interface could provide users with increased flexibility during research.

FUTURE WORK & LIMITATIONS

The current focus of future work aims to increase partnerships with existing laboratories and research institutions within the counter-proliferation and nuclear engineering fields to improve web-design, expand features, and generate new tools.

Institutional support and ownership would also enable the project to develop with a governing body of proliferation expertise and discretion. Agencies like the National Nuclear Security Administration (NNSA) have, in many cases, the reach to promote the platform and the technical expertise needed to resolve issues of reactor information exchange from both intellectual property and national security perspectives. Systems of accountability for information exchange will need to be established before the project can be implemented. Who should be empowered to make reactor specific edits and what information is available to various groups of researchers is not within our current capacity – higher governing bodies are needed.

A final challenge is acceptance and use. Currently, 40 reactors and their corresponding parameters have been catalogued. The success of NRDP is heavily dependent on the ability of the directory to gain wider adoption. Broader use of the NRDP is dependent on user time investment which, indirectly, is the result of user perceived utility. Further research into a larger baseline of reactor information, in addition to the 40 reactors, could serve to create the foundation of utility desired by initial users. Likewise, the refinement of the desktop analysis tool could serve to meet researchers in a setting preferable for their needs.

CONCLUSION

The creation of a central platform for nuclear reactor research could serve to reduce redundancies and improve short comings in current methods of reactor parameter research. Enabling partner laboratories with shared research aims to readily exchange information collection reduces total time spend on preliminary information centralization and could serve as a common space for increasing inter-laboratory research opportunities.

Research on novel or unique reactors conducted at one laboratory would no longer need to be unnecessarily repeated and the export of parameter information could be easily conducted across various formats and file types. With an orientation towards user-utility, the NRDP aims to create a standardized structure of reactor parameter information exchange while also remaining accountable to the broader technical field through open-sourced alterations. ■

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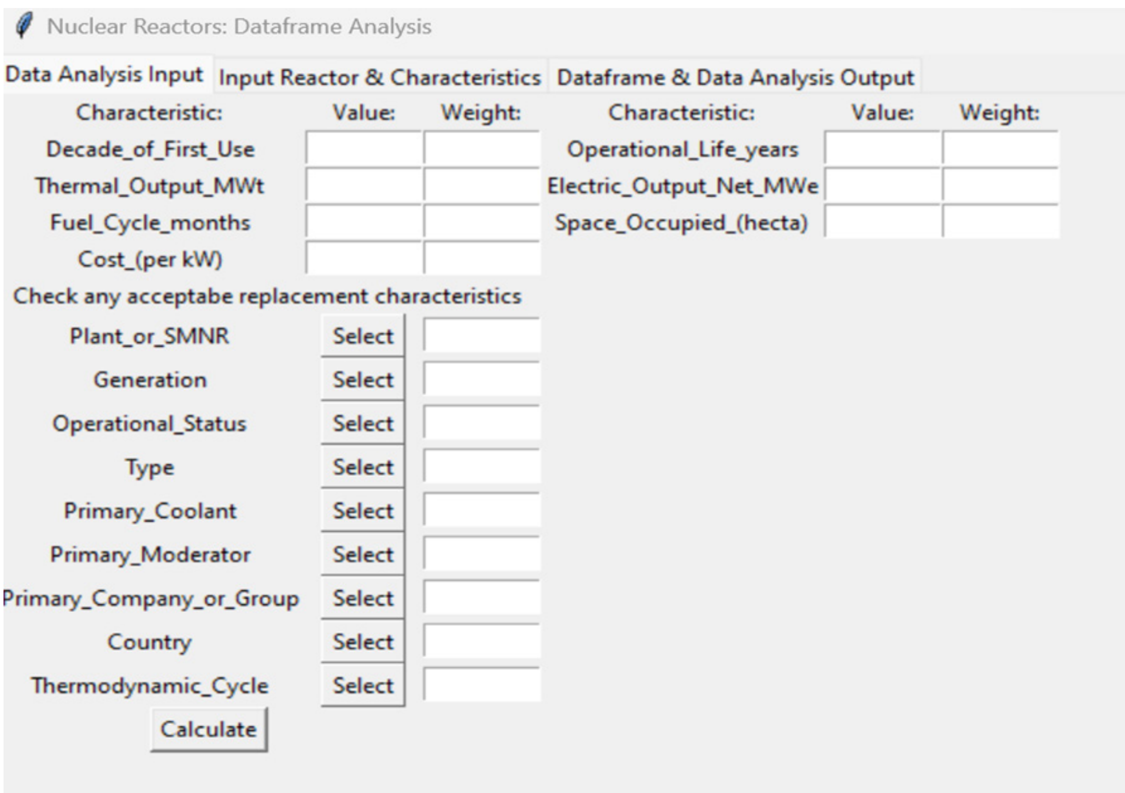
CADET AARON CALHOUN

is the Cadet Battalion Executive Officer at the United States Military Academy, in West Point, New York. He is working toward a B.S. in Nuclear Engineering from the United States Military Academy. His email address is aaron.calhoun@westpoint.edu.

CADET MATTHEW ECKERT

is the Cadet-in-Charge of the Cadet Competitive Cyber Team (C3T) at the United States Military Academy, in West Point, New York. He is working towards a B.S. in Physics from the United States Military Academy. His email address is matthew.eckert@westpoint.edu.

APPENDICES



Appendix A: GUI input example of qualitative and quantitative characteristics. Separate input and selection methods are shown. Relative weight input methods remain the same for both parameters categories.

Reactor		Operational_Life_years	Thermal_Output_MWt	Electric_Output_Net_MWe	Fuel_Cycle_months	Space_Occupied_(hecta)	Total Scores (w/ Weight)
EGP-6		6.25	6.25	6.25	6.25	6.25	100.0
KLT-40S		4.167	0.604	0.982	6.25	6.25	68.129
RITM-200		4.688	1.036	1.375	6.25	6.25	69.474
TMSR-LF1		0.0	0.0	0.0	6.25	6.25	49.845
BREAST-OD-300		2.083	0.259	0.229	6.25	6.25	52.417
CAREM		5.208	1.813	2.546	6.25	6.25	59.412
ACP100		5.208	0.471	0.55	6.25	6.25	56.074
MMR	• • •	0.0	0.417	0.0	6.25	6.25	50.262
BWRX-300		5.208	0.201	0.229	6.25	6.25	55.484
NuScale		5.208	1.133	1.528	6.25	6.25	57.714
SMART		5.208	0.549	0.687	6.25	6.25	56.29
VBER-300		5.208	0.198	0.212	6.25	6.25	61.713
APR-1400		5.208	0.046	0.047	6.25	6.25	48.927
ACPR-100		5.208	0.062	0.065	6.25	6.25	48.961
Hualong One		5.208	0.059	0.06	6.25	6.25	48.923
ABWR-II		6.25	0.037	0.042	6.25	6.25	43.829

Appendix B: Partial example of GUI output expressing sub-scores for each reactor under every parameter and total normalized score. Comparison input reactor used was the EGP-6.

REFERENCES

1. IAEA.org. 2023. Advanced Reactors Information System (ARIS) | IAEA. [online] Available at: https://aris.iaea.org.
2. IAEA.org. 2023. Research Reactor Database (RRDB) | IAEA. [online] Available at: https://www.iaea.org/resources/databases/research-reactor-database-rrdb.
3. Getaldić, Ana. et al. (2023). Nuclear and Radiological Data Available in the International Atomic Energy Agency (IAEA). Rudarsko-geološko-naftni zbornik. Available at: https://www.researchgate.net/publication/351245680_STUDY_OF_PHYSICAL_PARAMETERS_BASED_ON_ACPR100_REACTOR_CORE.
4. World-nuclear.org. 2023. Reactor Database | World Nuclear Association. [online] Available at: https://www.world-nuclear.org/information-library/facts-and-figures/reactor-database.aspx.
5. Yim, Man-Sung & Li, Jun. (2013). Examining relationship between nuclear proliferation and civilian nuclear power development. Progress in Nuclear Energy. Available at: https://www.sciencedirect.com/science/article/pii/S0149197013000504.
6. Iaea.org. 2023. IAEA Publishes 2023 Country Nuclear Power Profiles with New Web Platform| IAEA. [online] Available at: https://www.iaea.org/newscenter/news/iaea-publishes-2023-country-nuclear-power-profiles-with-new-web-platform.

A NEFARIOUS APPLICATION FOR COMMERCIAL MICROCAPSULES

MAJ. REBECCA M. REDDING

This essay identifies the ease of transitioning from legitimate microcapsule manufacturing applications to weaponization and the complex challenges microcapsules pose for current detection and decontamination. Microcapsule engineering is a process where microcapsules are designed for use in many different biological and non-biological systems for many purposes. Commercial cargo microcapsules are pervasive in countless consumer goods like shampoo and medications. They are designed to contain a substance such as liquid fragrance oil until the outer shell desiccates, allowing its release.[1,2] This process began in 1953 with dye encapsulation for copy paper[3] and has progressed extensively over the last 70 years. In this paper, the human body is the biological system referenced, which contains two systems where adsorbed (particle adhesion to a surface) and absorbed (particle transfer into a material) microcapsules are designed to target. Absorbed microcapsules are transported through the body's internal system, while adsorbed microcapsules remain external to the body, typically on the skin or hair. Manufacturers use microcapsules in numerous industrial and consumer applications for legitimate and productive purposes; however, they could be considered dual-use for militarily significant applications, including as a delivery means for chemical or biological agents.

For example, a commercially engineered microcapsule intended for bodily absorption is a drug-filled microcapsule coated in polyethylene glycol that can evade the human immune system, allowing it to maneuver through the body to its designed end location[4] This microcapsule type is an excellent means for drug delivery directly to an organ within the body without the potential of destruction by the immune system. This type of microcapsule coating design continues to be developed and improved significantly in recent years.[5] Virtually no barriers exist to alter the intended course of these microcapsules, even if they are filled with a chemical or biological agent. Commercially, microcapsules are already used for insecticide encapsulation and utilization as a means of delivery within agricultural settings to destroy specific harmful insects.[6] Should one choose to target a human population, it would be an undetectable type of agent that is dramatically more difficult to decontaminate than current delivery systems like aerosolized agents. With the internal absorption of a chemical or biological agent, treatment is only possible if the agent is known. Non-traditional hazards are even more challenging to detect and identify with current sensor designs.[7] It is important to note that the Chemical and Biological Weapons Conventions prohibit these hazard types.[8] Few medical antidotes exist even with proper and rapid detection and identification. Additionally, short treatment timeframes can increase the potential for mass casualty events.

Another example is of an adsorbed commercial microcapsule coated in a cationic copolymer called acrylamide-acrylamidopropyltrimonium copolymer, often used in soaps and shampoos. The cationic copolymer keeps the microcapsule tethered in place under aggressive fluid flow in the presence of a surfactant or soap. This polymer is regularly used as a raw ingredient in today's cosmetics with the intent of a delayed fragrance release. An example would be continuing to smell shampoo fragrance after rinsing in the shower. For clarification, the polymer-attached capsule does not remain on the human body indefinitely but desiccates or dehydrates. This results in the microcapsule rupturing and releasing the cargo, allowing its microscopic pieces to be rinsed off in an upcoming shower. A second microcapsule engineering example is manipulating the capsule surface to achieve this long-lasting effect, like flower pollen attaching to an animal's fur.[9] These long-lasting capsules are a preference for manufacturers but can also be filled with a chemical or biological agent, which is then intended for delayed release with the capsule and polymer desiccation. Adhered and encapsulated microcapsules filled with insecticides carried by insects like bees back to their nest have increased efficacy and induce much higher casualty rates.[10] Unfortunately, transitioning from insects to humans for this delivery system is not difficult as microcapsules can be specifically engineered for this purpose.

As previously mentioned, microcapsules can be engineered with specific diameter, volume, encapsulating material, and deposited amount to ensure the delivered agent would be toxic to humans. Microcapsules can be formulated in many sizes but are anywhere from nanometer range up to 50 microns.[11] The spherical volume of a 20-micrometer diameter microcapsule, for example, is 4,188 cubic micrometers.[12] According to the Center for Disease Control Medical Management Guidelines for Nerve Agents, the general population limit for an eight-hour work shift is 0.000003 milligrams/cubic meter[13] or 3.0×10^{-21} micrograms/cubic micrometer. Although this may seem insignificant, there can be thousands of microcapsules deposited onto a human body at any given time, which can easily exceed the threshold dose. Not only can the microcapsule size and deposited number be manipulated, but the encapsulating material as well. Typically, the material would be a natural protein for internal absorption, whereas adsorbed microcapsules can be made from a plastic polymer.[14,15]

The current military procedure is a thorough decontamination process. The Occupational Safety and Health Administration gives three decontamination methods: removing contaminants by physical or chemical means, physically removing contaminants, or inactivating contaminants.[16] According to the Army Technical Procedures, troop or personnel physical decontamination is conducted with soap and water.[17] This works for traditional agents and delivery methods but is ineffective against microcapsules since they are purposely engineered to remain adhered despite using soap and water. The microcapsules could be engineered to be adsorbed or tethered to human hair and skin even after fluid flow. For human exposure, there are only specific ways decontamination is possible. Decontaminates like bleach and heat treatment would not be applicable. Progress continues to be made in other areas, like inactivating compounds using engineered polymers.[18] This is only useful if the engineered polymer can penetrate the inside of the adhered microcapsule to deactivate the chemical or biological agent. Another possible solution is to increase the water flow pressure to dislodge the adhered polymer and microcapsule attachment. However, commercial microcapsules are designed to adhere despite applying the highest water pressures people can withstand.[19] Another method within the Army Technical Procedure guidelines involves physically removing gross contamination caused by microcapsules. This method is virtually impossible since they are microscopic and cannot be physically removed by brushing them off the body. Without a doubt, microcapsule engineering is a future problem for military decontamination procedures, especially concerning the difficulty of detection. As previously stated, the current detection equipment is not designed for emerging chemical and biological threats, so it would be difficult to determine whether decontamination would be necessary and whether it would even work.

This paper is an adaptation of my graduate thesis, where the copolymer was attached to different material microcapsules to maintain deposition on the human body. Although the research is intended for legitimate commercial applications, creative thinking led to my developing this thought piece. Designing a chemical or biological warfare agent that is delivered to the human body through a microcapsule system is not an extended leap from encapsulating insecticides to producing casualty effects in an operating environment. Although these types of weapons have been technically banned, that does not make them less of a threat, and the current detection and decontamination procedures need to be modernized to mitigate the threat. ■

MAJ. REBECCA M. REDDING

is a Student at the United States Army Command and General Staff College, located at Fort Belvoir, VA. She has a B.S. in Chemical Engineering from the United States Military Academy, a M.S. in Chemical Engineering from the Johns Hopkins University, and a Graduate Certificate in Nuclear Weapons Effects, Policy, and Proliferation from the Air Force Institute of Technology. She was previously assigned as a U.S. Army CBRN Officer and is currently a U.S. Army Nuclear and CWMD Officer. Her email address is rebecca.m.redding2.mil@army.mil.

ENDNOTES

1. Redding, Rebecca. *Understanding Size Dependence of Colloidal Deposition in the Presence of a Polymer-Surfactant Complex.* Johns Hopkins University Thesis Submission 2023.

2. Jumai'an, E.; Garcia, E.; Herrera-Alonso, M.; Bevan, M.A. "Specific Ion Effects on Adsorbed Zwitterionic Copolymers." *Macromolecules* 2020, 53, 9769-9778.

3. Green, B. K.; Schleicher, L. Manifold record material, US Patent 2730456; 10 January 1956.

4. Jumai'an, "Specific Ion Effects," 53.

5. Jumai'an, "Specific Ion Effects," 53.

6. Wang, R.; Liu, S.; Sun, F.; Yu, X.; Liu, X.; Li, B.; Mu, W.; Zhang, D.; Liu, F. Balance the rapid release of insecticide microcapsules using double-layer shielding effect when the foliar application. Chemical Engineering Journal 2023, 455, 140899.

7. Headquarters, Department of the Army. *Chemical, Biological, Radiological, and Nuclear Platoons*. Army Techniques Procedures, ATP 3-11.74. 2021.

8. Headquarters, Department of the Army. *Chemical, Biological, Radiological, and Nuclear Platoons*.

9. Jerri, H.A.; Torres-Diaz, I.; Zhang, L.; Impellizzeri, N.; Benczédi, D.; Bevan, M. A. "Surface Morphology-Enhanced Delivery of Bioinspired Eco-Friendly Microcapsules." *ACS Applied Material & Interfaces 2022*, 14 (36), 41499-41507.

10. Barker, R.J.; Lehner, Y.; Kunzmann, M.R. *Pesticides and Honey Bees: The Danger of Microencapsulated Formulations*. U.S. Department of Agriculture, Science and Education Administration, Bee Research Laboratory, Tucson 1979, 34c, 153-156.

11. Perinelli, D.R.; Palmieri, G.F.; Cespi, M.; Bonacucina, G. "Encapsulation of Flavours and Fragrances into Polymeric Capsules and Cyclodextrins Inclusion Complexes: An Update." *Molecules* 2020, 25 (24) 5878.

12. Redding, *Understanding Size Dependence.*

13. "Nerve Agents (GA, GB, GD, VX)." *Centers for Disease Control and Prevention*, 12 Jan. 2017, www.cdc.gov/TSP/MMG/MMGDetails.aspx?mmgid=523&toxid=93.

14. Jumai'an, "Specific Ion Effects," 53.

15. Jerri, H.A.; Torres-Diaz, I.; Zhang, L.; Impellizzeri, N.; Benczédi, D.; Bevan, M. A. "Surface Morphology-Enhanced Delivery of Bioinspired Eco-Friendly Microcapsules." *ACS Applied Material & Interfaces* 2022, 14 (36), 41499-41507.

16. "Hazardous Waste - Decontamination." *Occupational Safety and Health Administration*, www.osha.gov/hazardous-waste/decontamination. Accessed 12 Sept. 2023.

17. Headquarters, Department of the Army. *Chemical, Biological, Radiological, and Nuclear Platoons*.

18. Amitai, G.; Murata, H.; Andersen, J.D.; Koepsel, R.R.; Russell, A.J. Decontamination of chemical and biological warfare agents with a single multi-functional material. *Biomaterials* 2010, 31, 4417-4425.

19. Redding, *Understanding Size Dependence.*

JOURNAL ARTICLE WATCH

DR. JEFFREY ROLFES

In this issue, the CWMD Journal will introduce a new section spotlighting policy and scientific research of interest to the countering weapons of mass destruction (WMD) community. The importance of staying up to date on new research in this area cannot be overstated. Advancements in biological, chemical, nuclear, and policy research have far-reaching implications for global security and the well-being of nations. This section aims to provide our readers with a comprehensive overview of the latest breakthroughs, emerging technologies, and policy developments with relevance to countering WMDs. From cutting-edge research on nonproliferation strategies to innovative detection methods, we will explore the diverse facets of this critical field. Read on for in-depth analysis of ongoing research and thought-provoking pieces that shed light on the challenges and opportunities related to countering WMDs.

THE COMPLEXITIES OF CHINA'S CHANGING NUCLEAR POSTURE

SUMMARY OF RESEARCH:

China's strategic community is expressing heightened concerns about its external security environment, primarily due to evolving dynamics in its relationship with the United States. These concerns arise from a complex entangled security dilemma characterized by three key pathways: 1) China's perception that the U.S. is lowering the threshold for using nuclear weapons to compensate for conventional weaknesses in East Asia, 2) worries about the U.S.'s development of advanced conventional capabilities that undermine China's secure second-strike capability, and 3) China's efforts to employ advanced conventional weapons to defeat U.S. missile defenses. Despite these concerns, there is little evidence that China is shifting away from its strategy of assured retaliation, though changes in its approach to securing its nuclear deterrent may emerge over time. This entangled security dilemma is impacting U.S.-China relations, influencing nuclear threat perceptions, and exacerbating the security dilemma.

WHY IT MATTERS TO CWMD:

The evolving U.S.-China security dynamic, as described in the passage, has significant implications for global security. The entangled security dilemma between these two major powers increases the risk of arms race pressures, particularly in the nuclear realm. China's efforts to bolster its nuclear capabilities, combined with its concerns about U.S. military developments, could lead to a potentially destabilizing nuclear competition. This not only affects regional security but also has broader consequences for international arms control efforts.

Moreover, the passage underscores the challenges of engaging China in nuclear arms control. China's suspicions about U.S. capabilities and the entangled security dilemma make it unlikely that China would agree to arms control measures solely focused on nuclear capabilities. The inclusion of conventional capabilities further complicates negotiations. As a result, the world may witness an arms race between the U.S. and China, fueled by the entangled security dilemma and shifting military balances in the Asia-Pacific region. This could have profound ramifications for global stability and arms control efforts in the future.

REFERENCE:

Henrik Stålhane Hiim, M. Taylor Fravel, Magnus Langset Trøan; The Dynamics of an Entangled Security Dilemma: China's Changing Nuclear Posture. International Security 2023; 47 (4): 147–187. Doi: https://doi.org/10.1162/isec_a_00457.

Opposite: Hardtack I-Oak (J58-348-1)LA-UR-06-1068 (Los Alamos National Laboratory)

ISOTOPE ^{28}O UNIQUE PROPERTIES DEFY NUCLEAR THEORY

SUMMARY OF RESEARCH:

Researchers from 37 institutions, led by the Tokyo Institute of Technology, conducted a groundbreaking study on the rare isotope oxygen-28 (28O). They aimed to determine whether this isotope, which has a unique configuration of 20 neutrons and 8 protons, making it "doubly magic," could be bound by the strong nuclear force in spite of its high neutron count. Scientists at Japan's Radioactive Isotope Beam Factory observed the radioactive decay of 28O into 24O, finding that it was just barely unbound and unable to hold on to its neutrons long enough to form a stable nucleus. Complementing these experiments, advanced simulations conducted on Oak Ridge National Laboratory's Summit supercomputer confirmed with 98% probability that 28O is not a bound nucleus. This research delves into the behavior of rare isotopes, challenging traditional nuclear models, and paves the way for further exploration of the outer regions of the chart of nuclides, contributing to our understanding of exotic matter and the strong nuclear force.

WHY IT MATTERS TO CWMD:

The impact of this research extends to the field of nuclear physics, where it opens new avenues for understanding how nuclei behave under extreme conditions. Using cutting-edge computational techniques, like emulator algorithms, the study answers fundamental questions about the behavior of rare isotopes and demonstrates the potential of supercomputing in describing exotic matter from first principles. Furthermore, this research supports the work of the DOE's Facility for Rare Isotope Beams, offering insights that may lead to revisions or amendments to current nuclear models and expanding our knowledge of extreme nuclear structures where traditional models no longer apply.

REFERENCE:

Kondo, Y., Achouri, N.L., Falou, H.A. et al. First observation of 28O. Nature 620, 965–970 (2023). https://doi.org/10.1038/s41586-023-06352-6.

FIRST DEMONSTRATION OF A SELF-HEALING METAL

SUMMARY OF RESEARCH:

Researchers from Sandia National Laboratories and Texas A&M University have made a groundbreaking discovery regarding the self-healing ability of metals at the nanoscale. The study, published in the journal Nature, reveals that metals possess an intrinsic capacity to repair fatigue damage, a phenomenon previously believed to be impossible in metals. Fatigue damage caused by repeated stress or motion leads to microscopic cracks that can ultimately result in the failure of mechanical devices, costing billions of dollars annually. The research demonstrates that under certain conditions, metals can naturally heal these nanoscale fractures, challenging traditional materials science theories and opening new possibilities for materials engineering.

WHY IT MATTERS TO CWMD:

This discovery has profound implications for the resilience of the force facing the threat of WMD. It could potentially lead to the development of more durable and reliable materials, thus improving materiel survivability. Specifically, this discovery may lead to advances where the micro fractures and crystal defects from radiation damage can be spontaneously corrected. While there are still many unknowns and challenges to address before this self-healing property can be harnessed in practical applications, the finding represents a significant advancement in materials science and offers exciting opportunities for innovation in engineering and manufacturing.

REFERENCE:

Barr, C.M., Duong, T., Bufford, D.C. et al. Autonomous healing of fatigue cracks via cold welding. Nature 620, 552–556 (2023). https://doi.org/10.1038/s41586-023-06223-0.

NOVEL CORROSION PROCESS DISCOVERED IN MOLTEN SALT REACTORS

SUMMARY OF RESEARCH:

Researchers from multiple institutions, including Penn State, MIT, and Lawrence Berkeley National Laboratory, have made a significant discovery related to the corrosion of metals. They utilized advanced techniques such as 4D scanning transmission electron microscopy to study the corrosion process at a microscopic scale. What they found was a unique corrosion phenomenon they likened to "wormholes." In this process, molten salt selectively removes atoms from the metal during corrosion, creating one-dimensional "wormholes" along two-dimensional defects in the metal's structure, called grain boundaries. The researchers' findings have not only revealed a novel mechanism of corrosion but also suggested the potential for intentionally designing such structures for advanced materials, pointing to applications in various engineering systems.

WHY IT MATTERS TO CWMD:

This research has important implications for understanding and controlling corrosion, a common cause of material degradation in various industries. By gaining insights into how molten salt infiltrates specific metals and forms these one-dimensional pathways, researchers can work toward developing more resistant materials and predicting material failure more accurately. The ability to control or suppress this corrosion phenomenon is critical for the safety and longevity of advanced engineering systems, making this discovery a significant step forward in materials science and engineering.

REFERENCE:

Yang, Y., Zhou, W., Yin, S. et al. One dimensional wormhole corrosion in metals. Nat Commun 14, 988 (2023). https://doi.org/10.1038/s41467-023-36588-9.

CHEMICAL WARFARE SENSOR DESIGNED AND TESTED

SUMMARY OF RESEARCH:

Scientists at Rutgers laboratories have designed a synthetic protein that binds to the VX nerve agent, a chemical compound used in chemical warfare. The protein was created to generate a signal that could be coupled to a device, making it a biosensor for chemical weapons. The protein was tested against VX and underwent a dramatic shape change, burying VX in the cavity designed by the researchers. This shape change is the signal that could be coupled to a sensor device. The protein can detect VX at levels a thousand times more sensitive than current technologies without producing false positives.

WHY IT MATTERS TO CWMD:

This research opens another door for the development of biosensors, therapeutics, and diagnostics with applications in detecting and mitigating toxic nerve agents like VX. The designed protein could serve as a recognition element in various protein biosensor platforms, greatly enhancing sensitivity and specificity in detecting harmful substances. This innovation has the potential to improve safety and security measures against chemical warfare agents and other toxic compounds.

REFERENCE:

James J. McCann, Douglas H. Pike, Mia C. Brown, David T. Crouse, Vikas Nanda, Ronald L. Koder. Computational design of a sensitive, selective phase-changing sensor protein for the VX nerve agent. Science Advances, 2022; 8 (27) DOI: 10.1126/sciadv.abh3421.

ANALYZING BACTERIOPHAGES FOR ANTIBIOTIC TREATMENTS

SUMMARY OF RESEARCH:

This study delves into the world of bacteriophages (phages), viruses that infect bacteria. Phages employ various mechanisms to ultimately cause the destruction (lysis) of their bacterial hosts, a crucial step in their life cycle. While double-stranded DNA (dsDNA) phages rely on multiple proteins for host lysis, single-stranded RNA (ssRNA) phages and lytic single-stranded DNA (ssDNA) phages have a unique approach. They use a single gene, referred to as Sgl (single-gene lysis), to induce host lysis. These Sgls are responsible for triggering the autolysis of the host bacteria. The study focuses on understanding the molecular targets of these Sgls, especially those of ssRNA phages. It employs a high-throughput genetic screening method to identify host suppressors that interact with diverse Sgls. One key discovery is that the Sgl of the PP7 phage, which infects Pseudomonas aeruginosa, targets MurJ, a protein responsible for lipid II export, similar to the Sgl of coliphage M. Interestingly, these two Sgls, despite being unrelated and having opposite membrane topology predictions, both converge on the same target, highlighting a case of convergent evolution. The research extends these genetic screens to other uncharacterized Sgls, revealing a common set of multicopy suppressors, suggesting that these Sgls may share the same or similar mechanisms for inducing host lysis. The findings also provide insights into the genetic and molecular interactions between phages and their bacterial hosts, shedding light on the mechanisms underlying bacterial lysis and potential targets for future therapeutic interventions.

WHY IT MATTERS TO CWMD:

These findings advance our understanding of how phages induce bacterial host lysis, a critical process in phage biology. By identifying the molecular targets of diverse Sgls, the study uncovers important insights into the mechanisms these viruses employ to disrupt bacterial cells. The discovery that Sgls from different phages, such as PP7 and coliphage M, target the same protein, MurJ, highlights the concept of convergent evolution in phage biology, where unrelated Sgls evolve to exploit the same vulnerability in their bacterial hosts. This knowledge could pave the way for the development of novel therapeutic strategies, such as phage-based therapies or antibiotics that target specific host proteins involved in the phage life cycle. Additionally, the high-throughput genetic screening method used in this study provides a valuable tool for identifying suppressors of toxic genes, not limited to phages, which could have broad applications in understanding and manipulating gene functions in various biological contexts. Overall, this research contributes to our understanding of phage-host interactions and potential uses of phages in biotechnology and medicine.

REFERENCE:

Benjamin A. Adler, Karthik Chamakura, Heloise Carion, Jonathan Krog, Adam M. Deutschbauer, Ry Young, Vivek K. Mutalik, Adam P. Arkin. Multicopy suppressor screens reveal convergent evolution of single-gene lysis proteins. Nature Chemical Biology, 2023; DOI: 10.1038/s41589-023-01269-7.

WASTEWATER ANALYSIS OF PATHOGENS

SUMMARY OF RESEARCH:

This study focuses on wastewater-based surveillance, a method that gained prominence during the COVID-19 pandemic as an efficient means of monitoring infectious diseases in large populations. Ohio pioneered this approach with its Ohio Coronavirus Wastewater Monitoring Network (OCWMN), initially utilizing quantitative PCR (qPCR) to track COVID-19 prevalence at over 67 sites across the state. As the pandemic progressed, OCWMN evolved to include genome sequencing of SARS-CoV-2 to identify concerning variants. With the decline of the COVID-19 pandemic, the potential of wastewater surveillance extends to monitoring other infectious diseases and outbreaks, reducing the burden on healthcare systems. However, current surveillance methods mainly rely on qPCR for individual pathogens, which presents challenges for scaling to monitor multiple pathogens.

WHY IT MATTERS TO CWMD:

This research explores various genomic methods, both targeted and untargeted, to enhance wastewater-based biosurveillance. The objective is to find efficient procedures for detecting and tracking infectious diseases, known pathogens, and emerging variants. Over six weeks, RNA extracts from OCWMN sites were analyzed, with total RNA sequencing conducted using the Illumina NextSeq and MinION platforms to identify pathogens. MinION's long-read technology aims to simplify variant identification in mixed populations, a common challenge with short Illumina reads. Additionally, the study assesses the compatibility of a targeted hybridization approach with wastewater RNA samples. These research efforts aim to improve the scalability and effectiveness of wastewater-based surveillance, providing a valuable epidemiological tool for monitoring and mitigating infectious diseases in communities, beyond just COVID-19, in the post-pandemic world.

REFERENCE:

Spurbeck, R. R., Catlin, L. A., Mukherjee, C., Smith, A. K., & Minard-Smith, A. (2023). Analysis of metatranscriptomic methods to enable wastewater-based biosurveillance of all infectious diseases. Frontiers in Public Health, 11, 1145275.

BACTERIAL DETECTION OF LAND MINES

SUMMARY OF RESEARCH:

Researchers in Israel have achieved a significant breakthrough in landmine detection by utilizing genetically engineered E. coli bacteria. They've developed pellet-sized biosensors containing E. coli that are dispersed over target areas to detect the chemical signature of buried explosives, becoming luminescent upon detection. A drone is then employed to photograph the luminescent biosensors, revealing the precise location of landmines. The genetically engineered E. coli used in this biosensor project self-terminate shortly after deployment, ensuring no human or environmental risk. This innovative approach marks a transformative step in landmine detection, offering a 7-fold lower DNT detection threshold, a 45-fold increased signal intensity, and a 40 % shorter response time compared to previous methods for detecting landmines using bacteria.

WHY IT MATTERS TO CWMD:

Currently, landmines pose a significant threat worldwide, and their detection and removal are dangerous and costly endeavors. The E. coli-based biosensors, combined with AI and synthetic biology, provide a revolutionary solution that can accurately locate unexploded ordnance from a safe distance. This technology has the potential to dramatically enhance landmine clearance efforts, making them more efficient and less hazardous. Furthermore, the biosensors' adaptability to detect various other substances like explosives, environmental toxins, and hazardous chemicals suggests broader applications, promising safer and more sustainable solutions to other humanitarian and environmental challenges beyond landmine detection.

REFERENCE:

David, L., Shpigel, E., Levin, I., Moshe, S., Zimmerman, L., Dadon-Simanowitz, S., ... & Belkin, S. (2023). Performance upgrade of a microbial explosives' sensor strain by screening a high throughput saturation library of a transcriptional regulator. Computational and Structural Biotechnology Journal, 21, 4252-4260.

RICIN DETECTION USING HPLC-MS

SUMMARY OF RESEARCH:

In this study, researchers developed a groundbreaking method for accurately quantifying ricin, a highly toxic protein toxin, in complex matrices using ultra-high-performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS). Traditional quantification methods faced challenges due to ricin's complex structure, specifically its interchain disulfide bonds, which hindered the production of suitable internal standards for precise measurements. The researchers overcame this hurdle by designing a novel protein standard absolute quantification (PSAQ) technique. They utilized recombinant mutant ricin (RMIS) as an internal standard, simplifying the process by creating a single-chain full-length sequence that linked the A-chain and B-chain. Extensive evaluations identified the most suitable protein IS, termed R1A, based on factors like digestion efficiency, LC-MS behavior, and antibody recognition function. By simultaneously detecting marker peptides from both chains, the team achieved accurate and absolute quantification of ricin in various complex samples, including milk, plasma, and river water.

WHY IT MATTERS TO CWMD:

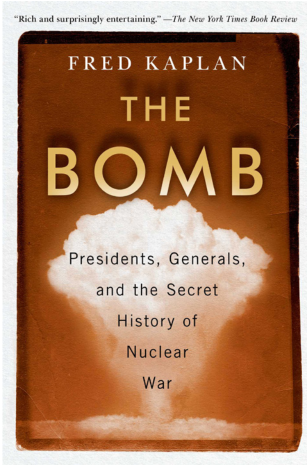
This research marks a significant advancement in the field of toxin analysis and detection. By introducing a novel PSAQ technique utilizing recombinant mutant ricin as an internal standard, researchers have overcome major challenges associated with the quantification of ricin in complex samples. This innovative approach not only enhances the accuracy and precision of ricin measurements but also demonstrates the potential for addressing similar challenges in quantifying other complex proteins or toxins. The impact of this study extends beyond ricin analysis, serving as a pioneering model for developing advanced protein quantification technologies, which are crucial not only for scientific research but also for practical applications in fields such as bioterrorism prevention and environmental monitoring.

REFERENCE:

Long-Hui Liang, Yang-De Ma, et al. A protein standard absolute quantification strategy for enhanced absolute quantification of ricin in complex matrices using in vitro synthesized mutant holoprotein as internal standard by ultra-high-performance liquid chromatography-tandem mass spectrometry, Journal of Chromatography A, Volume 1708, 2023, 464373, ISSN 0021-9673, https://doi.org/10.1016/j.chroma.2023.464373.

DR. JEFFREY ROLFES

is the Operational Survivability Lead at the USANCA, in Fort Belvoir. He has a B.S. in Chemistry, Biology, and History from Newman University and a Ph.D. in Radiochemistry from the University of Nevada, Las Vegas. He was previously assigned as a Nuclear Scientist at the Defense Threat Reduction Agency.



BOOK REVIEW:

THE BOMB: PRESIDENTS, GENERALS, AND THE SECRET HISTORY OF NUCLEAR WAR

BY: FRED KAPLAN

Simon & Schuster Paperbacks, New York, 2020, 384 pages

MAJ.(P) JAMES C. BOWEN

"Look. At the end of the war, if there are two Americans and one Russian, we win!"[1]

– General Thomas Power, Strategic Air Command (SAC) Commander in 1957.

SUMMARY

In Fred Kaplan's "The Bomb", Kaplan dissects relationships between world political and military leaders through the lens of nuclear deterrence strategy. From the first use of a nuclear weapon during World War II to the Donald Trump Presidency, Kaplan examines every deterrence strategy, nuclear employment and non-proliferation treaty, and foreign policy in detail. "The Bomb" documents the perspectives and conversations of people involved, revealing very little of Kaplan's opinion on the subject, and reads like a documentary. Through hundreds of declassified conversations, documents, policies, and war plans, "The Bomb" turns over every proverbial rock attempting to uncover motives of people when dealing with the unlocked destructive power of nuclear weapons.

Starting with military and political leaders who faced the atrocities of World War II and subsequently faced the looming threat of communism, military leadership instituted nuclear weapons use doctrine and policy that were calculated and ruthless. Kaplan delves into volumes of military conversations showing the insouciant views of military leadership discussing acceptable casualties, in the millions, during nuclear war. Alongside employment strategy and casualty assessments, Kaplan investigates policies and declassified transcripts to tell the story of Generals and Admirals pursuing deterrence theories based on their service's equities and desire to maintain control of nuclear weapons. This pursuit of equity in nuclear capabilities established the nuclear triad: the original Air Force delivery to allow for call-back authority and precision strikes, the forming of the nuclear Navy to allow for stealth and a survivable second-strike option, and the Intercontinental Ballistic Missile founding to enable prompt strikes and establishing the "nuclear sponge" for adversaries. Increases and decreases of the nuclear stockpile, establishment and decreases of nuclear weapons by service, and organizational restructuring to move strategic war planning out of Washington D.C. are all discussed. Nuclear policy through the Cold War parallels historical events like the Korean, Vietnam, and Russian-Afghanistan Wars, and Kaplan elaborates on United-States and Soviet policies, treaties, and actions (such as the Cuban Missile Crisis) surrounding those conflicts relating to nuclear weapons.

After the Cold War, Kaplan discusses denuclearization and the strategies and policies implemented to maintain strategic deterrence with fewer delivery systems. Military and political leadership continued to debate the tenebrous validity of winning a nuclear war and if the United States should institute a "no first-strike policy" regarding nuclear weapons. In addition to nuclear employment doctrine, "The Bomb" discusses the rise of rogue threats beyond the original three nuclear powers, The United States, Russia, and the United Kingdom, and how treaties like the Non-Proliferation Treaty attempt to and fail at curtailing new state actors. He ends the book examining modern presidential policies starting with President Clinton instituting the Nuclear Posture Review (which establishes United States nuclear policy, strategy, and posture), and looks at the contrast between President Obama's attempts to minimize nuclear use against President Trump using nuclear weapons as a bargaining chip in strategic policy.

APPLICATION TO COUNTERING WEAPONS OF MASS DESTRUCTION (CWMD)

"Let's stipulate that this is all insane. But…"[2] – President Barack Obama.

It is important for policy makers and military leaders to understand the origins of doctrine and policies they implement. Kaplan does a phenomenal job of outlining the history of strategic deterrence policy and in doing so gives excellent examples of constructive and destructive political-military relations. Additionally, "The Bomb" gives a historical account of the reasoning behind developing the different legs of the Triad and how nuclear warfighting was previously integrated into conventional warfare. As the Army is writing doctrine integrating conventional and nuclear operations, there is a need to understand the scope of warfare that may include nuclear effects on the battlefield. This is not a concept as the Army possessed nuclear weapons on the battlefield until 1991, and there was little distinction between conventional and nuclear operations from a planning perspective.

Outside of conventional-nuclear integration, "The Bomb" looks at the greater scope of the CWMD problem, and how political-military integration attempts to counter WMD. Military doctrine focuses on the military response to nuclear effects and what a military response looks like. This perspective provides one of many tools for the Executive Branch of government to use in CWMD. Outside of military doctrine, it's important for officers to understand other governmental tools at their disposal, and Kaplan outlines many strategies the United States government attempted to use in preventing the proliferation of nuclear weapons.

I recommend "The Bomb" to anyone with an interest in military history, political-military relationships, or professionals who deal with nuclear topics, strategic deterrence, or international policy. As an aside, Kaplan examines how international treaties and governmental policies drive military allocations and budgeting, and how they shift between Presidential administrations. Specific to military readers, this book reviews historical topics which could benefit anyone serving at a component command or higher who might coordinate across the interagency regarding Countering WMD or nuclear employment. ■

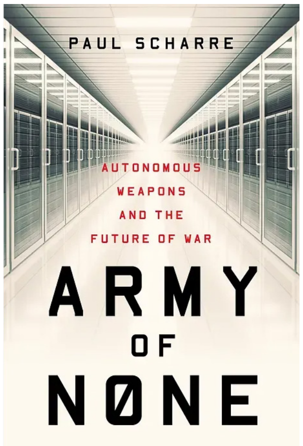
MAJ.(P) JAMES C. BOWEN

is the CWMD Advisor Course Manager at the United States Army Nuclear and CWMD Agency, HQDA G3/5/7 at Fort Belvoir, Virginia. He has a B.S in Physics from the United States Military Academy and a M.S. in Physics from the Naval Postgraduate School. He was previously assigned as a Deputy Team Chief for a Nuclear Disablement Team at the 20th CBRNE Command.

REFERENCES:

1. "The Bomb, Book by Fred Kaplan." Simon & Schuster, 2023, https://www.simonandschuster.com/books/The-Bomb/Fred-Kaplan/9781982107307. [Accessed 07 September, 2023].

2. Kaplan, Fred M. "The Bomb. Presidents, Generals, and the Secret History of Nuclear War." New York, Simon & Schuster Paperbacks, 2020. Page 243-244.



BOOK REVIEW:

ARMY OF NONE: AUTONOMOUS WEAPONS AND THE FUTURE OF WAR

BY: PAUL SCHARRE

W.W. Norton & Company, New York, 2018, 448 pages

DR. ALEXIA GORDON

In November 2022, OpenAI released ChatGPT to the public and brought artificial intelligence (AI) into the public consciousness, generating reactions that ranged from joy and awe at the possible benefits offered by the technology to existential dread at the potential harms. In 2018, four years before the world-at-large worried about AI algorithms hallucinating, chatbots declaring obsessive love for users, and lawyers offering judges AI-generated fictitious legal citations, Paul Scharre wrote *Army of None: Autonomous Weapons and the Future of War*, a non-fiction book that examines the "rise of artificial intelligence" and the way it will "transform warfare."[1] In twenty-one chapters plus an Introduction, Conclusion, and Afterword, Paul Scharre discusses the concept of machine autonomy (vs. automatic and automated), the development of autonomous weapons, the role humans play (or do not play) in the "Weapon System OODA Loop," policies and laws (or the lack thereof) regulating the development and use of autonomous weapons, and the risks, benefits, and consequences of incorporating increasingly sophisticated AI into autonomous weapon systems.[2]

Army of None is written for a general audience, a recommended read for those interested in autonomous weapon development as well as government policy. While some knowledge of AI or robotics would be helpful in reading Scharre's book, such knowledge is not necessary to understand his argument or themes. Scharre uses anecdotes and analogies to make complex military concepts relatable to a non-specialist reader. The book is divided into six parts with titles that nod to popular culture, like "Robopocalypse Now," "Building the Terminator," and "Averting Armageddon." The chapters bear titles like "Garage Bots: DIY Killer Robots," "Bot vs. Bot: An Arms Race in Speed," and "Centaur Warfighters: Humans + Machines" which pay further homage to pop culture while making it apparent what each chapter is about. Illustrations throughout the book amplify Scharre's points. Photographs mid-book show several examples of unmanned weapon systems. With fifty-four pages of notes, the book is well-annotated. A list of abbreviations and an index are also included.

Despite being written in an accessible, almost conversational style (the story of his battles with his Roomba and his Nest thermostat are amusing. The repetitive analogies to the *Terminator* movies, less so.), Army of None is not a lightweight book, nor is it a love letter to AI. Scharre examines some of the controversies surrounding AI and autonomous weapons and devotes much of the book to the downside of weapons that can kill without the "ability to understand the consequences of their actions" or the "ability to step back from the brink of war."[3] He cautions, "The future is coming, and we aren't ready…Decisions made in the coming years will have a long-lasting impact on human society as we see the emergence of a new digital order."[4] However, Scharre does not leave readers without hope. He recommends a way to avoid the direst predictions regarding AI and autonomous weapons. He states, "Human societies have cooperated time and again to restrain the worst excesses in war, to place some actions or means of killing out of bounds…This restraint—the conscious choice to pull back…is what is needed today."[5]

Scharre is the Executive Vice President and Director of Studies at the Center for a New American Security (CNAS), a non-profit, bipartisan national security and defense research and policy institute. In September 2023, *Time* magazine named him one of the 100 most influential people in AI.[6] Prior to joining CNAS, Sharre worked as a Department of Defense (DOD) policy analyst where he led the group that drafted the 2012 DOD Directive 3000.09, “Autonomy in Weapons Systems.”[7] He is a former U.S. Army Ranger and veteran of Iraq and Afghanistan. *Army of None* won the Colby Award, which “recognizes a first book-length work of fiction, nonfiction, or poetry that has made a major contribution to the understanding of military history, intelligence operations, or international affairs,” in 2019.[8] In 2023, Scharre published *Four Battlegrounds: Power in the Age of Artificial Intelligence.* ■

DR. ALEXIA GORDON

is a Medical & Health Scientist at the U.S. Army Nuclear and Countering Weapons of Mass Destruction Agency (USANCA) at Fort Belvoir, VA. She has a B.A. in Psychology from Vassar College, an M.A. in National Security and Strategic Studies from the U.S. Naval War College, and an M.D. from Drexel University College of Medicine. She was previously assigned as a Special Assistant to the Deputy Commanding General of Operations, U.S. Army Space and Missile Defense Command (SMDC), a Western Sector Medical Officer, U.S. Medical Entrance Processing Command (USMEPCOM), and a J-7 Branch Chief, USMEPCOM. Her email address is alexia.l.gordon.civ@army.mil.

NOTES:

1. “What are AI Hallucinations?” IBM, accessed 3 October 2023, https://www.ibm.com/topics/ai-hallucinations; Mary Papenfuss, “Creepy Microsoft Bing Chatbot Urges Tech Columnist To Leave His Wife,” *Huffpost*, 16 February 2023, https://www.huffpost.com/entry/kevin-roose-ai-chatbot_n_63eeb367e4b0063ccb2bcc45; Sara Merken, “New York Lawyers Sanctioned for Using Fake ChatGPT Cases in Legal Brief,” *Reuters*, 26 June 2023, https://www.reuters.com/legal/new-york-lawyers-sanctioned-using-fake-chatgpt-cases-legal-brief-2023-06-22/; Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York: W.W. Norton & Company, 2018), 5.

2. OODA: Observe, Orient, Decide, Act. The loop consists of searching for targets (observe), detecting targets (orient), deciding to engage targets (decide), and engaging the targets (act). A fully autonomous weapon system does not include a human in this decision loop. Scharre, 43.

3. Scharre, 318.

4. Scharre, 364.

5. Scharre, 262.

6. Sam Jacobs, “How We Chose the TIME100 Most Influential People in AI,” *Time*, September 7, 2023, https://time.com/6311323/how-we-chose-time100-ai/ (accessed October 3, 2023).

7. Will Henshall, “Paul Scharre,” *Time*, September 7, 2023, https://time.com/collection/time100-ai/6307703/paul-scharre/ (accessed October 3, 2023); Scharre, 7.

8. “Colby Award,” Norwich University, accessed 3 October 2023, https://www.norwich.edu/campus-resources/research-centers-institutes/peace-war-center/colby-award.

REFERENCES:

Henshall, Will. “Paul Scharre.” Time. September 7, 2023. https://time.com/collection/time100-ai/6307703/paul-scharre/ (accessed October 3, 2023).

IBM. “What are AI Hallucinations?” Accessed 3 October 2023. https://www.ibm.com/topics/ai-hallucinations.

Jacobs, Sam. “How We Chose the TIME100 Most Influential People in AI.” Time. September 7, 2023. https://time.com/6311323/how-we-chose-time100-ai/ (accessed October 3, 2023).

Merken, Sara. “New York Lawyers Sanctioned for Using Fake ChatGPT Cases in Legal Brief.” Reuters, 26 June 2023. https://www.reuters.com/legal/new-york-lawyers-sanctioned-using-fake-chatgpt-cases-legal-brief-2023-06-22/.

Papenfuss, Mary. “Creepy Microsoft Bing Chatbot Urges Tech Columnist to Leave His Wife.” Huffpost, 16 February 2023. https://www.huffpost.com/entry/kevin-roose-ai-chatbot_n_63eeb367e4b0063ccb2bcc45.

Scharre, Paul. Army of None: Autonomous Weapons and the Future of War. New York: W.W. Norton & Company, 2018.

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Rear Cover: The 71st Chemical Company conducted a chemical contamination exercise at Bellows Air Force Training Area on Oct. 18, 2021. The exercise was in preparation for the company's upcoming deployment. (U.S. Army Photo by Sgt. Kyler L. Chatman)

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