Combating WMD JOURNAL
U.S. Army Nuclear and Combating WMD Agency
Issue 10 Summer/Fall 2013

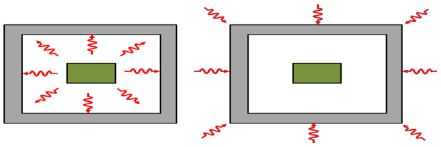
Photo: Joint Combating Weapons of Mass Destruction Planning Course 2013

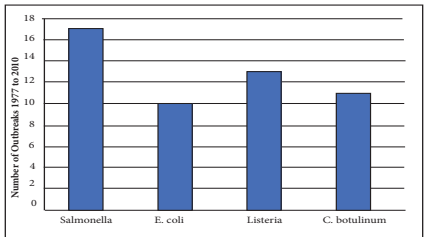
Inside the Journal

FROM THE DIRECTOR

COMBATING WMD

SCIENCE and TECHNOLOGY





CONFERENCE/TRAINING

BIOGRAPHY
MR. DANIEL M. KLIPPSTEIN

Mr. Dan Klippstein assumed his current position in March 2013. He serves as Deputy Director of Army Strategy, Plans and Policy Directorate where he develops the Department of the Army strategic policies and plans to influence National and Defense strategies and to generate Army development of major activities and programs.

Concurrently, he serves as the Director of the US Army Nuclear and Combating WMD Agency (USANCA). USANCA is a Department of the Army Field Operating Agency charged to provide nuclear and combating Weapons of Mass Destruction planning, execution and CBRN effects expertise in direct support of the Geographic Combatant Commands, the Defense Threat Reduction Agency, and the Army Operational Commands requirements.

Combating WMD JOURNAL
U.S. Army Nuclear and CWMD Agency

Published by the
United States Army Nuclear and CWMD Agency
(USANCA)

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Distribution: U.S. Army organizations and activities with CBRN-related missions, to include all combat and materiel developers and units with chemical and nuclear surety programs, and FA52 officers. The Secretary of the Army has determined that the publication of this periodical is necessary in the transaction of the public business as required by law.

Article Submission: We welcome articles from all U.S. Government agencies and academia involved with CBRN matters. Articles are reviewed and must be approved by the Combating WMD Journal Editorial Board prior to publication. Submit articles in Microsoft Word without automatic features, include photographs, graphs, tables, etc. as separate files, please call or email us for complete details. The editor retains the right to edit and select which submissions to print.

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DIRECTOR NOTES

MR. DANIEL M. KLIPPSTEIN
From the Director (October 2013 – Present)

Welcome to another exciting edition of the Combating Weapons of Mass Destruction (WMD) Journal. I am Daniel M. Klippstein, the new SES-Director for USANCA and Deputy Director for Plans and Policy, Office of the Deputy Chief of Staff, G-3/5/7. As part of my duties as Director of USANCA, I am also the Army Proponent for the Functional Area 52 (FA52), Nuclear and Counterproliferation. I will briefly address a few key points related to my role as Director of USANCA and as the Army FA52 Proponent.

Seven years ago my predecessor, Mr. Peter Bechtel, started to transform USANCA and this journal to "improve the Army's role in the efforts to Combat Weapons of Mass Destruction." He expanded this G-3/5/7 Field Operating Agency's roles and missions across the spectrum of combating WMD and nuclear operations, helping in decision support and filling gaps. Mr. Bechtel also continued supporting USANCA's enduring and leading role in nuclear weapons effects and survivability expertise for the Army. Today, I see USANCA as a key enabler and leader to bring nuclear and combating WMD expertise forward to the land component commander. Furthermore, I envision USANCA as a vital element for synchronizing countering WMD activities within the ARSTAF, and for enhancing coordination with major Army elements above Corps level, with the Joint Staff and the Interagency.

In the last issue of the Combating WMD Journal, COL Ariel Cuadrado, Acting Director of USANCA at the time, discussed how recent strategic guidance is influencing the Army to refocus from a COIN-centric position to a broader mission spectrum requiring new capabilities, especially on countering WMD. COL Cuadrado provided an update on the impact of critical Army documents describing Army capabilities required for the future on the Army's countering WMD activities. I would like to briefly address additional recent developments along the Army countering WMD activities and nuclear operations.

Clearly, as a result of recent strategic guidance the Army is taking a new look at the countering WMD mission and conducting operations in a nuclear environment. The Army is assessing what new capabilities are required across DOTMLPF, and how the Army's institutional strategies should evolve to better support military strategies in such wide and dynamic mission areas as countering WMD, and regional deterrence and nuclear operations. It is imperative that institutional strategies align with military strategies. For example, if countering WMD operations are primarily assigned to the Unified Land Component within a Geographical Combatant Command (GCC) and the Army leads the Unified Land Component within the Joint Force, the Army should develop a CWMD strategy to harmonize countering WMD activities within the Army. Likely, such institutional strategy harmonizing countering WMD in the Army will serve as the bases for the military strategy at the Joint Force level.

The Army has done well equipping and preparing for CBRN defense and continues to make progress in multiple areas that need additional improvement. However, countering WMD is a much broader problem: CBRN defense does not equate to countering WMD. Interdiction of CBRN materials of concern, WMD Elimination, Consequence Management (domestically and in support of our international allies), among others, are critical parts of the countering WMD mission space. In the past the Army saw CBRN and WMD challenges as an environment to fight through. We now recognize that countering WMD is more than that one perspective and that countering WMD missions, before and after WMD use, occurs in the Army's land domain. As such, the Army has a role in each of these countering WMD tasks and its General Purpose Forces can supplement and augment Specialized CBRN Forces and Special Operations Forces to increase their effectiveness and efficiency as an "economy of force" function. Therefore the Army is reviewing its capabilities in these mission areas and, where appropriate, planning and training to expand our countering WMD support to the Joint Force.

Shortly after the publication of the previous issue of the Combating WMD Journal, Mr. Peter Bechtel, Director of the Capabilities Integration Directorate (DAMO-CI) in HQDA G-3/5/7, conducted the first-ever Army Countering WMD Capabilities Portfolio Review (CPR). After a very intense few months, the CPR was completed and findings presented to the Vice Chief of Staff of the Army, GEN Campbell, on 19 September 2013. We will report on the findings and implications of the Army countering WMD CPR in a future Combating WMD Journal edition.

Since the Cold War, not only have we lost valuable knowledge in nuclear operations, but the ability to train and educate the force for effective operations in a potential nuclear conflict is very limited. Current thinking in DoD is that the potential for a regional conflict to escalate to nuclear weapons use is greater than ever, and we are assessing gaps in the Army's ability to operate on a nuclear battlefield as part of the Joint Force. The need for the Joint Force, especially the Unified Land Component, to effectively operate in a nuclear environment is being highlighted in many of the Presidential, Office of the Secre-

tary of Defense (OSD) and Joint policy level documents and working groups. While the Army does not deliver nuclear weapons, the GCC and assigned Army forces will own the effects of a nuclear weapon used in their battlespace.

Relevant considerations for the Army and the Unified Land Forces include the recognition within the DoD of the importance to modernize and maintain a robust Nuclear Command, Control and Communications (NC3) system if the Joint Force is to succeed in a nuclear environment. Back on 26 August 2012, an Information Memorandum from the Deputy Secretary of Defense, SUBJECT: (U) NC3 DMAG, announced that he recently reinvigorated the "Senior National Security Presidential Directive-28 Oversight Committee (SNOC) and established the National Leadership Command Capability Executive Management Board" to provide strategic oversight of NC3 as DoD moved forward to address problems in that area. Earlier this year, on 13 February 2013, a memorandum from OSD, SUBJECT: (U) NC2 Support to Future Nuclear Posture Requirements, provided guidance on a working group that includes the Joint Staff, the Services (including the Army) and other appropriate participants of the NC3 community to address specific issues highlighted in the 2012 Deputy Secretary of Defense memorandum. USANCA has been representing and advancing Army equities in this working group to ensure that any future investments and changes affecting NC3 will take into account the role and contributions of the Army as leader of the Unified Land Component and a major element of the joint Force's ability to survive and succeed in operations in a nuclear environment.

Before closing this note, let me briefly explain how I see my role as the Army FA52 Proponent. Active oversight and managing the proponency for the Army FA52 requires me to effectively perform three main functions. First, I ensure that we acquire sufficient and qualified manpower to meet current and future Army requirements for FA52 officers. Secondly, I provide the vision for and allocate adequate resources to develop FA52 officers to meet the Combating WMD needs of the Army, DoD and the Interagency. Finally, I provide SES-GO level oversight for the coordination of force development actions related to FA52. Of course, I perform these duties with the support of a talented team of professionals in USANCA, especially the steady support from the FA52 Proponent Manager, Mr. Robert Beimler; do not hesitate in contacting Mr. Beimler on any FA52 Proponency questions you may have.

By the time the next issue of the Combating WMD Journal is published, much more progress in the areas discussed above will have taken place and we should be able to provide you an update. I look forward to continue working with you to shape the Army's role in countering WMD and operations in a nuclear environment for years to come.

"Reorganizing the Domestic EOD and CBRN Forces for Success"

"A Solution in Search of a Problem?"

Michael D. Evans
Colonel, US Army

Introduction: The United States (US) has seen a significant evolution in our perception and understanding of the Weapons of Mass Destruction (WMD) threat to the homeland since September 2001. The national uncertainty and rage following the al Qaeda (AQ) attacks on September 11, 2001 have given way to a more pragmatic view of WMD domestic threat. This has no doubt been shaped by 13 years of overseas military operations in Afghanistan and Iraq. While there, the best trained and equipped US military forces have been consumed in a fight against extremists who used inexpensive; relatively low technology improvised explosive devices (IED) with great effect. The American people are not apathetic regarding the WMD threat; however they are no longer overwrought about it. One of the origins of this attitude change is likely the increasingly effective capability of federal and state officials since the 911 attacks. These programs include a significant response and consequence management capability which is increasingly interoperable via the National Incident Management System (NIMS).

The US Army's 20th CBRNE Command was activated in October 2004 to serve as the force provider for all Army general purpose force WMD capabilities, specialized chemical, biological radiological and nuclear (CBRN) forces. At the time, the US Army was adding force structure in order to fight two wars. The headquarters mission has evolved over time to provide a full time Army focus on combatting Weapons of Mass Destruction, combatting the IED threat and providing a staff-cadre of trained subject matter experts to plug into a Joint Task Force for WMD-Elimination (JTF-E) under either a Joint Task Force or a Geographic Combatant Command.[1] Much of this change was driven by 2006 Quadrennial Defense Review (QDR) that assigned a JTF-Elimination mission to the 20th CBRNE HQ.

An EOD Team Leader after rendering safe an IED, Iraq 2004. (non-attributable photo)

As the geostrategic landscape has evolved, so has the Army's WMD-Elimination (WMD-E) construct. The justification for Operation Iraqi Freedom, to a great extent rested on preemption of a hostile regime's WMD capability. The Geo-Strategic Landscape in 2004 indicated possible requirements to eliminate other national WMD capabilities such as Libya, Syria and North Korea. However, in Libya and Syria, minimal use of technical enablers were used to support operations that to a great extent were outsourced to contractors, other nations and the Organization for the Prohibition of Chemical Weapons (OPCW). The WMD-Elimination mission was reassigned from the 20th CBRNE to US Strategic Command (USSTRATCOM) in 2010. The strategic landscape has changed, calling into question the CBRN sense of urgency.

The All Hazard Brigade: The 20th CBRNE has drafted an initiative that proposes to form an "All Hazard Brigade" (AHB) construct from the merger of the Army's two EOD brigade level commands with the 48th Chemical Brigade. The AHB construct aims to task organize, the two functional commands into a single organization that would provide a fully "integrated CBRNE capability" to Combatant Commanders through provision of a CBRNE Coordination Element (CCE) and alignment of the AHBs with the three US based Corps headquarters.[2] What is not clear is the "integrated CBRNE capability" that the initiative intends to address.

The proposal to create "All Hazard Brigades" appears premature at this time, as there has been no combatant command operational requirement or validated "integrated CBRNE" capability gap identified or characterized. Additionally, while additional research is required, it appears to miss the mark in terms of providing the optimal mix of forces to address the demonstrated terrorism threat.

EOD and CBRNE definition and doctrine contrast, by Colonel Leo Bradley, Department of Defense Explosive Safety Board (DDESB).

Currently the 20th CBRNE has received US Forces Command (FORSCOM) endorsement and the proposal is under consideration at the Department of the Army Headquarters. The CBRNE command continues to analyse the proposal and has initiated a proof of concept process at the National Training Center (NTC). The proof of concept experiments provide elements of the 20th CBRNE staff and a rotational Brigade Combat Team (BCT) to replicate a notional JTF-E mission set, allowing a "CBRNE Battalion" to employ EOD and CBRN forces in simulated missions such as Joint Special Operations Task Force CBRNE Reconnaissance, WMD interdiction as well as conventional WMD Consequence Management (CM), WMD Site Exploitation, CBRNE packaging, and Munitions and IEDs.[3] The Army Capabilities Integration Center (ARCIC) has been requested to observe and presumably provide metrics. The lessons learned from the proof of concept will be a data point in the detailed analysis being conducted by the 20th CBRNE staff. However, the ongoing evaluations have had no involvement of the institutional Army to date.

Force development is shaped by many variables, the most prominent is often budget and the anticipated threat environment. The US economy will not support redundant force structure and the scale of structure cuts remain undetermined. The Army has reduced it's manpower significantly, down from 570,000 and may be required to go below 440,000 if the budget landscape does not improve. The Total Army Analysis (TAA) process will be significant in shaping the Army and 20th CBRNE structure for the future. Ideally reductions are matters of capacity vice capability and it is justification to consider creative reorganization of the current EOD and CBRN forces in order to optimize force mixture. Historical data as well as several unclassified assessments provide a useful perspective of the potential IED and CBRN threats, particularly to the homeland.

What is the CBRN Threat? The preponderance of scholarly domestic security journals and think-tanks agree that for the foreseeable future that predominant US terrorism threat is conventional explosives used in IEDs. It is not IEDs incorporating CBRN or a WMD. There is empirical data that document that domestic terrorism has not involved a significant CBRN aspect. The US has never been effectively targeted with a CBRN weapon and there have been only two CBRN events of consequence in the US since 2000.[4] With the exception of the 1984 poisoning of a restaurant salad bar in Oregon by local cult members and the 2001 anthrax via envelope attack, which tragically killed five people, there is no history.[5] Despite Osama bin Laden's well publicized 1998 statement that "Acquiring [WMD] for the defense of Muslims is a religious duty."

Al Qaeda's well financed efforts to develop or procure WMD throughout the late 1990s and early 2001 is well documented, however with the exception of toxins and poisons, the program failed to produce CBRN material. It wasn't for a lack of intent or trying. The AQ efforts took place unconstrained in Taliban controlled Afghanistan and in some part, assisted by elements of the Pakistan government. Yet in this permissive environment, with state expertise, they were unable to produce a CBRN capability.[6] There have been no instances of large scale CBRN attacks and certainly none that rise to the status of the oft-overused moniker WMD.

There are several theories that may explain why the US has not experienced an effective CBRN related attack. Those submitted by Dr James Forest, Professor and Director of the Center for Security Research and Technologies at the University of Massachusetts Lowell, parallel my personal observations and experience. As an EOD officer with 19 years experience, several years working national WMD issues, it's my assessment that Dr Forest's model passes the "practitioner's assessment". He organizes them into Practical and Strategic Constraints. Practical constraints are

Washington Army National Guard EOD Team supporting state and local bomb squads in Operation Raven Challenge.

limitations in a terrorist group's ability to build a reliable weapon that will function as it is designed. CBRN material is difficult to procure, hazardous to handle and weapon design is more complex. As a result, the weapons is more inclined to not detonate when planned. These variables increase the chances that planners and the design team will be detected and captured. The prohibitive cost, increased risk and inability to test the weapon all contribute to the likelihood of an unsuccessful attack.[7] Essentially, pursuit of a CBRN weapon violates the Keep It Simple Stupid (KISS) principle and increases the odds of mission failure.

Strategic constraint theory posits that senior leaders of terrorist organizations undergo similar rational actor analysis as nation-states when considering pursuit of major weapons programs. Extremist group leaders consider the cost-benefit ratios, development costs, and weapon acquisition timelines in their decision making. Additionally, use of a CBRN weapon may undermine the group's legitimacy or provoke global response that the group is unwilling to risk.

> For most terrorist groups, their strategic deliberations have steered them away from CBRN weapons. In fact, many scholars have observed that there are very few strategic benefits a terrorist group could derive from using a CBRN weapon, particularly compared to other, more conventional kinds of weapons.
>
> ~ Dr James Forest

It is not my intent to imply that there is not a validated CBRN threat. That is not the case, as demonstrated by the fact that between 2001 and 2013 at least 15 people in the continental US attempted to acquire poisons and biological agents.[8] The scale of the demonstrated threat remains low as a result of the complexity of developing an IED's CBRN filler or the expense of procuring the toxic agents (financially as well as risk). The balance between the potential consequences, WMD attack probability and possibility are the persistent challenge for security officials and force planners.

The Domestic IED Threat: Despite the fact that experts do not agree on the exact scale of the future domestic IED threat, they are consistent in their opinion that it is increasing. They agree that increased availability of IED technology, internet based manuals, and materials contributes to a future security environment with an IED component. There is also a domestic trend away from Islamic extremist attacks with an increasing number of homegrown "non-jihadist" individuals or groups who have either been interdicted or simply failed to produce a viable weapon.[9] The number of law enforcement interdictions is indicative of increased effectiveness of the US security infrastructure. It may also indicate ineptitude on the part of the terrorist cell,[10] many of which are simply small disaffected groups, effectively with no tradecraft.

How will AQ's revised business model affect homeland security? Prior to the US and NATO campaigns in Afghanistan, the group was centrally managed. However with effective US and allied counter-terror programs, senior leaders either killed or in hiding, the terrorist group has adopted a franchise program. The central ideology or "Big Picture" radiates from AQ central leaders, with promising entrepreneurial believers free to act independently.

A second uncharacterized variable is how events in North Africa and the middle-east could impact future domestic security. The conclusion of the US military role in Iraq, decreasing Afghanistan operations and the ebb and flow of Islamic fighters across North Africa and Syria could provide a pool of trained and motivated bomb-makers.

Doctrinal Friction: The documents provided by the 20th CBRNE indicate a number of misunderstandings that may present challenges to the initiative. The most prominent appears to be a misunderstanding of the CBRN and EOD capabilities and missions. In reference to WMD (only one of the EOD missions) the two functions are on the same operational continuum. Simply, EOD's role falls in the Crisis Resolution or "left of Boom", phase. This includes IED / WMD render safe, collection or facilitation of technical intelligence, identification of the bomb-maker and illuminating the network. The CBRN capability is further along the same continuum, "right of boom" in Consequence Management (CM). This includes decontamination, hazard sampling, packaging of rendered safe hazardous material (CBRN related IED filler) and escort to final disposition. The EOD function, in accordance with DoD directives and US doctrine is the only element of the military that chartered, trained, equipped and allowed to conduct render safe of US, foreign ordnance and IEDs.

The distinction between Crisis Resolution and Consequence Management is significant as the National Response Framework (NRF) designates the FBI as the lead federal agency for counterterrorism and FEMA the lead federal agency for Consequence Management. During a large domestic event, the EOD and CBRN functions will be reporting through different agencies (admittedly all within NIMS). The EOD and CBRN Commanders have completely different and technically unique missions.[11]

Justification: Several of the presentations provided as well as teleconference discussion relates that the intent of the AHB proposal is to provide "integrated CBRNE capability". It is not clear, what exactly that is. The term CBRNE is recognized only in the Army and is not accepted in either Joint or NATO doctrine. Likewise, it is not clear at what level or command that a lack of integration exists. The EOD force is integrated in planning and operations from the theater level down to maneuver battalion. The US forces in Iraq and Afghanistan were both supported by a theater level CIED Task Force and each subordinate division had an aligned EOD battalion with companies in direct support to the brigade combat teams. During my most recent two deployments, there were no high priority missions that lacked integrated EOD support. [12]

There are no indications that the AHB capability is an operational requirement, beyond that articulated by the 20th CBRNE and subsequently validated by Forces Command. Research and questions submitted to the 20th CBRNE staff and NORTHCOM provided no indication of Geographic Combatant Command support. Throughout 11 years

of operations in Afghanistan and Iraq, there have been numerous requests for additional EOD forces, staff expertise and command and control organizations. This "demand signal" came in the form of Combatant Command validated, Requests for Forces (RFF). Additionally, there has been no Training and Doctrine Command (TRADOC) validated gap identified or validated.

Of concern, is the impact of this experiment on the Army's current ability to Counter IED and provide EOD forces to a joint force commander (JFC). The two capabilities are highly technical, commanded by EOD and CBRN officers for good reason. Mingling the two unique functional capabilities risks diminishing the effectiveness of both, providing the joint force commander a reduced capability.

Conclusion: The proposal to merge the two functional brigade commands into the AHB, risks a reduction of the Combatant Command's preferred capability. Use of the phrase "integrated CBRNE capability" does not add clarity. It diminishes understanding, confusing what was previously a clear concept with well-understood roles and missions. The case has not been made for how the AHB construct will increase the maneuver commander's warfighting effectiveness or provide an increased capability to counter domestic terrorism threats.

There may be a value added to the proposal once the specific tactical tasks are explained. For instance, it is confusing to refer to CBRN forces in an emergency response Defense Support to Civil Authority (DSCA) role. The EOD DSCA mission is directed in DODD 3025.21 and codified in Army Regulation 75-15. Perhaps, if the structure were modified to place a CBRN company into an alignment with each of the existing EOD Groups it would provide a structure organized to combat the most likely threat, while balancing the force in preparation for the TAA. The Army has in recent years, intentionally reduced the size and mission of the CBRN force. This reflects the evolving operational environment and reduced requirement for CBRN capabilities. While these changes were appropriate, there is a need for a tactical level CBRN capability in tomorrow's force structure.

The historical as well as most likely future domestic threat is a homegrown or possibly Islamic extremist threat using IEDs. The Army has effectively polished the EOD capability in two wars and is postured to sustain the well established homeland defense role as well. The capability is codified and integrated with DOD, Army Maneuver and Defense Support to Civil Authorities (DSCA) requirements. This initiative risks dilution of the joint force commander's ability to counter the IED threat and is not sufficiently justified.

"These operations are being prepared and you will see them in your heartland when they are ready."
~ Osama bin Laden

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BIOGRAPHY

Colonel Mike Evans is an Ordnance Corps / EOD officer with experience at the tactical and operational levels in Afghanistan, Iraq and other contingency operations. His last assignment was serving as the ISAF Joint Command (IJC) Counter-IED, Branch Chief in Kabul, Afghanistan. Colonel Evans is currentlya student at the US Naval War College. His email address is michael.d.evans@usnwc.edu

Why a 15 Minute Biological Detection System?

LTC Doug Lewis
Air Force Institute of Technology

The biological defense community needs to take a hard look at the requirements and assumptions we use to develop our biological sensors. Today the point sensors currently deployed or in development can offer at best "near real time" detection. This translates into approximately 10-20 minutes from the time an agent passes over the device until an alarm is issued. Why are we working to develop detection hardware which in reality contributes little to no advantage to an operational environment? Should the DOD resist fielding (in the near term) "near real time" detection systems, and instead field slower (but much more sensitive and selective) sensors in the interim while re-engaging basic research to find a truly real –time biological detection capability?[1]

I ask this question as it has emerged from research I conducted which examined the historical relationship between biological weapons and chemical weapons. I found that a chemical frame of reference has exerted a historical bias on development of biological defensive programs. I argue this bias has resulted in reduced biological detection capability by imposing chemical standards on the entirely different problem of biological detection. The use of chemical standards for biological problems has resulted in biological detection hardware which in reality contributes little to no actionable information, has relatively low sensitivity and suffers from high false alarm rates. I argue that a 15 minute detection timeline cannot be supported from a cost benefit analysis.

The obvious question one may ask is, do you advocate intentionally exposing our forces to a biological attack? Should we not field the fastest biological detectors possible? It is not that we should intentionally expose anyone to a threat that can be realistically detected and avoided. However with the current technology it is not possible to field an operational biological sensor that will actually significantly reduce the impact of a biological attack.

The root of this argument is grounded in the difference of chemical agents and biological agents. Chemical agents are just that, chemicals. They can exist as gas, liquid or solid. Chemical agents act as single molecules, directly attacking the body and causing symptoms based upon the total exposure. Biological agents, on the other hand, are complex bacteria or viruses. While small, they are orders of magnitude larger than chemical agents. They can only exist in a solid state, and can be found in the natural environment. They are living organisms able to reproduce within the host. It is the presence of the living agent within the body which causes incapacitation or death. These and other differing fundamental characteristics make detection of chemical agents arguably easier and faster than biological agents.[2]

However, for my argument I will focus on two significant differences; time to act and medical countermeasures.

The relative time span between exposure and symptoms is a significant difference between chemical agents and biological agents. Chemical nerve, blood and choking agents begin to affect the body within seconds to minutes of exposure.[3] These physiological reactions are drastic and obvious to other personnel within the vicinity. We are all trained to look for the signs of a nerve agent attack (pinpoint pupils, salivation, convulsions etc.) and know to take immediate protective action if we observe or hear of nearby personnel exhibiting these symptoms. In this manner, whether we like it or not, we are all walking chemical sensors, only slightly better paid than the proverbial canaries used to detect toxic gases.

The availability of post exposure medical treatments is the other significant difference. While antidotes do exist for chemical agents there is a narrow timeframe between exposure and death where the antidote is effective. However, with a biological agent there is a period of days where medical intervention can blunt a biological attack. For biological agents, vaccination is also a valid preventative strategy and can be administered as a defensive measure prior to an attack. Therefore, given a realistic advanced warning, the medical community can negate the effects of many potential biological attacks.[4]

From the viewpoint of a chemical detection hardware developer, the rapid onset of symptoms places an upper limit on acceptable detector response time. A proposed chemical sensor that takes 5-15 minutes to sample, integrate and report a detection of a physiologically significant level of agent concentration is operationally useless and would never be funded. Such a chemical sensor would only alarm after those in the exposed area are already suffering the effects, or have taken protective action by observing symptoms in nearby personnel. Therefore most currently fielded chemical sensors alarm within seconds to one minute of exposure to a chemical agent.

Biological weapons, on the other hand, do not act immediately. Depending upon the particular agent, symptoms will take days to weeks to manifest themselves after an attack. However, while the effects may not be apparent for days, the actual exposure and infection event will happen as fast as with a chemical weapon (a few lungfulls of air, depending on the concentration of the agent).

The delayed onset of symptoms may give a biological detection hardware developer a false sense of security when developing detection hardware. As the infected individuals will not be dropping dead within minutes it is possible to develop sensors that alert in the 5-15 minute time range, which is days prior to the appearance of overt symptoms. This may make us feel good because in theory the base can take protective action to avoid exposure to the agent and we will be warned of the presence of a biological agent well before the effects of the attack become apparent in the victims. However, I argue that such a sensor is operationally useless.

The best answer for biological detection is to detect the hazard in time for personnel to avoid exposure through protective masks or movement. One approach to this problem is standoff detection, where a detector would identify an agent several kilometers away. This is an immensely challenging problem, one the military has been working for 60 years and has yet to field an operational sensor. As standoff detection is not currently an option, we rely upon point sensors which sample, detect and alert based the ambient atmosphere at their location.

Point detectors have their own temporal and hardware issues. Currently, antibody binding offers the most rapid detection available in fielded detectors. However this method requires relatively large amounts of agent, (often many times greater than the infectious dose) for the detection reaction. Therefore the detector may not actually detect unless a collection and concentration step is added to the process, which adds time, hardware costs, reagent costs and complexity to the issue. These detectors also face a significant cross-reaction problem with naturally occurring (and generally benign) environmental bacteria and viruses. When all the detection steps are added together the best fielded point detectors require 10's of minutes to alarm and are still subject to high false positive rates.[5]

Why is such a sensor operationally questionable? To keep the math simple assume that a biological attack takes place on a day with 6mph winds and the detector response time is 10 min. This means that the leading edge of the biological cloud will be one mile past the detector before an alarm is sounded and personnel take protective actions.[6] The picture below shows Kunsan AB in South Korea, and the arrows represent one mile. Depending upon the wind direction and origin of attack, in this scenario a ten minute response time provides no protection for a significant portion of the base population.

Figure 1 - KUNSAN AB, ROK; red arrows are 1 mile in length

Therefore, when we employ a sensor with a 15 min response time (and a high false alarm rate) what have we actually accomplished? In most attack scenarios, a significant population of a fixed site instillation will be infected prior to the first alerts going out. While at the same time our drive to reduce reaction time produces sensors with such high false alarm rates they may be turned off or ignored, where they offer zero protection whatsoever. However, our community spends vast amounts of money and effort to produce sensors that operate within these sets of parameters.

One way to improve the protection offered to a site would be to place the sensors some distance upwind of the population, trading distance for time and allowing an alert before the cloud reaches personnel. This strategy would only work at some remote sites with the luxury of large uninhabited standoff distances. For other bases there is effectively zero standoff distance between the perimeter and civilian structures. Again taking Kunsan AB as an example there are civilian farms and buildings that border the fence line of the base, any one of which could be used to mount a covert attack. A second issue with a forward deployed remote sensor site is security for the sensor and the threat to technicians which would have to periodically service the sensor.

What is the alternative to a "near real time" point sensor strategy? The medical community, as well as civilian agencies have adopted a "detect to treat option." The JBAIDS and Biowatch sensor programs both rely upon Polymerase Chain Reaction (PCR) detection of DNA sequences associated with biological agents. The most common collection strategy is to use a dry filter unit to collect particulates from the air, then to test the filters for the presence of biological agents. However any sampling technique such as a swab or environmental sample can serve as a DNA source.

By employing these systems, there is no intent to issue a warning in time to take protective measures. The PCR analysis itself takes from 30-60 minutes, and the filters may only be changed/ tested once every 24 hours or longer.

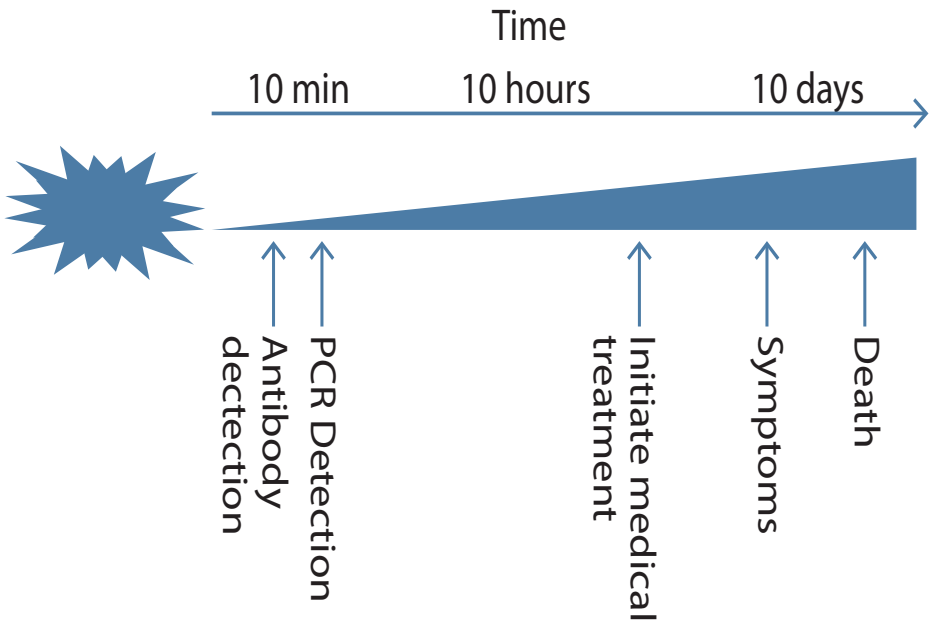


Figure 2 - Notional Biological Attack Timeline.

So why would one intentionally accept such a long detection time and accept exposure of a target population? While these detection strategies are significantly longer than current antibody based detection, they are significantly more sensitive and selective. Theoretically a PCR based detection system can detect one organism per sample. Additionally it is possible to develop assays which are much less prone to environmental contamination and false positives. In this strategy the significant increase in sensitivity and significant reduction in false alarms outweighs the increase in time to alarm.

The reason an extended detection/ warning cycle is acceptable is the availability of medical countermeasures to many potential biological agents. As long as there is a medical countermeasure available, there is little difference between a 15 minute alarm vs. a 6 hour alarm, as long as medical countermeasures are initiated in time to protect the population.[7] However, the sensitivity and selectivity of a PCR based detection provides medical providers with greater actionable information regarding the nature of the attack.

Circling back to the original questions posed by this article, what advantage does a 15 minute, or even a 5 minute detector have over a 1 hour detector? Especially considering the significant false alarm rates (and resulting operational considerations) associated with the shorter time periods. Should we reassess why we have established certain arbitrary time requirements for biological sensors? To truly help protect the population the sensor must provide warning in time for personnel to take protective measures and avoid infection. I would argue that even a 5 minute response time is unlikely to do that (with a 6 mph wind this is still ½ mile of cloud travel).

What is an acceptable response time? Future requirements should be worked backwards from a realistic time/distance calculation and should serve as hard requirements that must be met in order for the sensor to actually offer any protection, and therefore be considered for fielding. A biological detection standard that in fact alerts in time to protect a significant number of a site's population will resemble current chemical alarm standards which require alarms within seconds of exposure. Such a standard is extremely difficult and I would argue not possible (for a deployable system operating in a field environment) with today's biological detection technology.

Therefore we are left with two possible sensor strategies, which have already been discussed. We can accept a longer timescale (such as the PCR based methods), trading any hope at avoidance for increased sensitivity and selectivity while leveraging medical countermeasures. This strategy is already in place in the civilian biodefense communities. In this case the adequate detection capability currently exists, and the emphasis of our future biodefense efforts will need to be focused on increasing our medical capabilities through vaccines and drugs.

The other option is to truly deploy a detect to protect system, a capability we do not currently have the technical capabilities to employ operationally in the field. Such an approach will require a fundamental shift in what we consider an acceptable response time. As I have already stated, a truly protective biological response standard will resemble currently employed chemical response standards. Achieving such a standard is incredibly challenging, and will require a significant amount of 6.1 (basic) technological research.[8] This will also require discipline within the defense community not to advance potential technologies until they clearly demonstrate the ability to meet these rigorous detection timelines.

How, then should the U.S. approach biological detection? We currently have the ability to mitigate many potential biological attacks using sensitive detection combined with medical treatment. However, exclusively relying upon this slow detection plus treatment strategy would require a fundamental change in our approach to biodefense. We would have to knowingly accept the reality that our forces will be exposed to any biological attack, while also accepting we are (temporarily) abandoning our "detect to protect" premise. This change in strategy would be difficult to accept and even more difficult to sell to the forces and our leaders. However, until we truly have a real-time biological detection capability we are by default accepting a detection/ medical treatment defensive posture. Acknowledging such a strategy may be difficult and uncomfortable, but can focus resources and improve our defensive capabilities. Only when we have identified and operationally validated

detection hardware capable of alerting a significant portion of a base in time to avoid the attack should can we return to an avoidance based defensive strategy.

ENDNOTES

1. The opinions expressed in this article are solely those of the author. No endorsement by any Government or DOD agency is implied.

2. For this article I will exclude biological toxins from this discussion, and focus on biological agents of bacterial or viral nature. While biological in nature, toxins act more like chemical agents than biological agents in regards to how they affect they body.

3. The mustard agents take longer (hours) but are still significantly faster than biological agents.

4. The U.S. does not possess medical countermeasures against every possible biological agent. For agents where medical countermeasures do not exist defense will rely upon detection/protection, or the development of vaccines or drugs.

5. For an undertsnding of the difficutly facing current arosol detection systems see: Jensen, J. Effects of Atmospheric Background Aerosols on Biological Agent Detectors. US Air Force (2007)

6. This is the best case response, which does not take into account possible delays due to human decisions, or the need for confirmatory evidence.
7. This time frame will vary depending upon the agent, but initiation of countermeasures within 24-48 hours of exposure is desired.

8. It is also possible to develop a research strategy which focuses on unique detection requirements for different biological agents. All agents are not created equal in regards to their time to act, infectious dose, lethality and susceptibility to medical countermeasures. We can de-aggregate the detection requirements so that we can focus on protection where we have little to no medical capability, while relying on detect to treat for agents which are well countered with currently available medical countermeasure. Such a focused approach would allow researchers to optimize detection to specific agents, perhaps buying additional warning time not available to a multi agent detection strategy.

BIOGRAPHY

LTC Doug Lewis is currently an Assistant Professor of Biodefense Science at the Air Force Institute of Technology, in Wright Patterson Air Force Base, OH. He has a B.S. in Biology from the US Air Force Academy, a M.S. in Genetics from the Pennsylvania State University, and a Ph.D. in Biodefense from George Mason University. He has previously been assigned to C-WMD missions at DTRA, Air Staff, the United Kingdom and DIA. His email address is douglas.lewis@afit.edu.

Biotoxins Used As Warfare Agents – Part 3

John S. Nordin, PhD
AristaTek, Inc.

Review: What kind of Biotoxins Might Be Used as Warfare Agents?

A 'biotoxin" is a poison produced by living organisms including certain bacteria, plants, algae, fungi, protozoa, reptiles, fish, mollusks, and insects. Over 400 biotoxins have been identified and many more exist in nature. Roughly about 15 or 20 of these usually appear on various lists published by governmental agencies as having potential for use as warfare agents. Two natural biotoxins are classified as "Schedule 1 Chemical Warfare Agents" under the United Nations agreement on biological weapons, e.g. the Chemical Weapons Convention in 1993 and earlier agreements. These are saxitoxin and ricin.

On June 12, 2002, President George W. Bush signed into law the Public Health and Safety Act of 2002 (PL 107-188), which requires that the Department of Health and Human Services maintain a list of biological agents and toxins, which pose a severe treat to public safety. The list of biotoxins, as it appears in the August 23, 2002 Federal Resister, (see also 42 CFR Part 72, Appendix A) is as follows:

- Abrin
- Botulinum neurotoxins
- Clostridium perfringens epsilon toxin
- Conotoxins
- Diacetoxyscirpenol
- Ricin
- Saxitoxin
- Shigatoxin and Shiga-like toxins
- Staphylococcal enterotoxins
- Tetrodotoxin
- T-2 toxin

Several of these listed above represent classes of several individual biotoxins of varying potency. The Centers for Disease Control and Prevention Website (http://www.bt.cdc.gov/agent/biotoxins/) also lists the following biotoxins which do not appear as a specific listing in the Public Health and Safety Act of 2002:

Brevetoxin
Colchicne
Digitalis
Nicotine
Strychnine
Trichothecene

Figure 1 Live Conus geographus, one of the most deadly cone snails, venomous tube visible. Photo from National Geographic website, Kerry Matz photographer.

We will look at conotoxins, tetrodotoxin and related toxins, T-2 toxin, and trichothecene myotoxins including diacetoxyscirpenol in this paper.

Conotoxins

Conotoxins are neurotoxins derived from marine cone snails of the genus Conus that occur in the Indian-Pacific Oceans especially off the coast of Australia. Cone snails do not occur naturally off the coast of the United States (Hawaii an exception) or Europe. The conotoxins are in the toxin sacs of these predatory snails. The snails use their venom to immobilize and kill fish, shellfish, and marine worms. Conotoxins are a complex group of chemicals made up of typically 12 to 40 amino acid residues forming compact peptide molecules of which over 2000 different variant combinations are known. There are probably over 50,000 different conotoxins in existence from perhaps 500 different species of cone snails. Any cone snail species can inject a mix of many different conotoxins.

The Conus geographus mollusk illustrated can grow up to 10 cm in length; a typical attack takes place in milliseconds with a 70% fatality rate to humans.

Images of this and other cone shells can be found on the Internet.

Human deaths have occurred naturally when divers and fishermen have accidentally stepped on a cone snail, or in the process of harvesting the snails. The shells are very attractive, and some shells are worth a small fortune to collectors. About 30 deaths have been docu-

Classification	Biological Activity
Alpha-Conotoxins	Inhibits nicotinic acetylcholine receptors at nerves and muscles. The result is paralysis.
Mu-Conotoxins	Inhibits voltage-graded sodium channels in muscles. The mechanism is similar to that of saxitoxin produced from red tide algae and discussed in an earlier PEAC Newsletter.
Delta-Conotoxins	Inhibits the inactivation of voltage dependent sodium channels ("delta" slows the inactivation of the sodium channel, "mu" inhibits the sodium channel.)
Omega-Conotoxins	Affects the calcium channels associated with nerve impulse transmission at the neuromuscular junction. Calcium channels are related to sensitivity to pain.
Kappa-Conotoxins	Inhibits voltage-graded potassium channels, resulting in tremors.
Conantonkins	Blocks nerve impulses that use glutamic acid rather than acetylcholine as the neurotransmitter.

Table 1 Biological Activity of Conotoxins

mented and studied. There are probably a lot more deaths that have not been studied or reported. Deaths occur by injection of the venom if the snails are handled or stepped upon, but the venom is also toxic by ingestion of the mollusk.

Conotoxins are classified into six different broad classifications based on their biological activity (Table 1).

The extreme toxicity results from several different classes of conotoxins acting synergistically by different mechanisms. Some of the toxins by themselves are not lethal but produce tremors or deaden pain. Some alpha-conotoxins by themselves are lethal by injection at 0.025 mg/kg or even 0.01 mg/kg of body weight, from mouse injection tests. No information is available in the public domain on toxicity by inhalation [from http://www.cbwinfo.com/Biological/Toxins/Conotox.html].

On a molecular scale, conotoxins differ from other biotoxins in that they are relatively small, compact peptides made up of 12 to 40 amino acids held tightly together by disulfide bonds. The disulfide bonding network as well as the order of the specific amino acids and how they are configured determine the specifically of conotoxins.

Non Fatal Case (full recovery)

- Burning pain
- Swollen arm and pain
- Local numbness spreading rapidly to involve the entire body, with some cardiac and respiratory distress
- Progressive weakness, loss of coordination, drooping eyelids, shallow breathing
- Headache, nausea, stomach cramps, shortness of breath

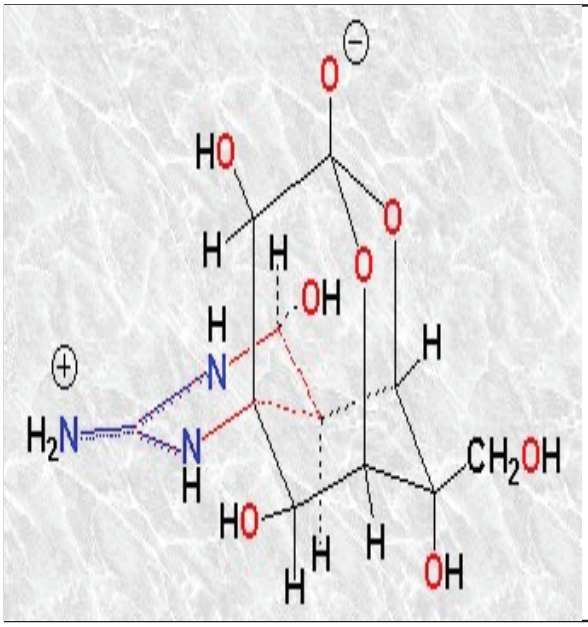
Fatal Cases

- Numbness without pain (some species produce severe pain and spreading numbness)
- Lips become stiff
- Blurred vision
- Paralysis
- Coma
- These symptoms occur almost immediately upon injection
- Death occurs as the result of respiratory and/or cardiovascular collapse.

Clinical symptoms (based on interviews by H. Flecher in 1935 of people "stung" by Cone snails and published in the Medical Journal of Australia, and later interviews) include

There are severe logistics for a potential terrorist to grow and harvest cone snails for their toxins. Our search using the Internet failed to uncover any use of Conotoxins as a terrorist weapon. There is an interview report on Soviet research using smallpox virus to produce toxic small peptide chains similar to "conotoxins" [see Journal of Homeland Security Website, http://www.homelandsecurity.org/newjournal/Interviews/displayInterview2.asp?interview=3].

The potential threat of terrorist use is there because Conotoxins are being studied as a source of potential drugs for treating neurological diseases. In addition, the amino acid sequence forming the peptide chain of several conotoxins have been determined, and synthetic combinations of specific conotoxins have been artificially produced. Patents for producing selected conotoxins or using them for drugs are published in the open literature. The introduction of genes into bacteria, which can be grown to produce the toxins is feasible. The possibil-



Tetrodotoxin

Molecular formula: C11H17N3O4
CAS Number: 4368-28-9
Molecular Weight: 319.3
Synonym: TTX
Lethal dose (from mouse injection test) is 8 micrograms per kilogram of body weight.
Lethal oral dose (mouse) is 334 micrograms per kilogram of body weight.
Note that tetrodotoxin is a non-protein.

Figure 2 Chemical Formula of Tetrodotoxin Chemist's representation of Tetrodotoxin molecule, from http://www.chm.bris.ac.uk/motm/ttx/ttx.htm.

ity of laboratory theft or someone with the necessary technology and equipment to manufacture the toxins is real.

As an example of medical use, clinical trials are underway in Australia using a conotoxin Vc1.1 (drug called ACV1) derived from Conus victoriae to treat neuropathic pain in the treatment of sciatica, shingles, and diabetic neuropathy. The ACV1 also appears to accelerate the recovery of injured nerves and tissues [see B.G. Livett et al, "Therapeutic applications of conotoxins that target the neuronal nicotinic acetylcholine receptor" Toxicon Vol 48(7) 2006. pp 810-829, abstract available on Internet]. Additional examples on the use of LMW Toxins for development of drugs to treat diseases and neurological conditions is at the website, http://www.bentham.org/cpps/contabs/cpps6-3.htm. A synthetic version derived from omega-conotoxin M VII A has found an application in the analgesic drug ziconotide (Prialt®).

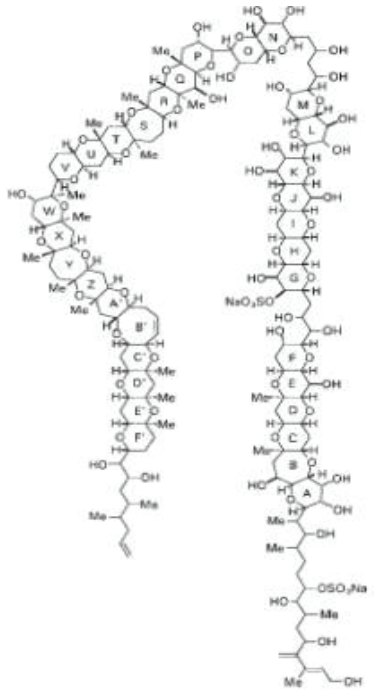
The CDC has issued guidelines on the safe handling on biotoxins including Conotoxins, which can be viewed at http://www.cdc.gov/OD/OHS/biosfty/bmbl5/sections/SectionVIIIG-ToxinAgents.pdf.

Additional Reading on Conotoxins: BioScience, Vol. 47, No. 3 (Mar., 1997), pp. 131-134

Tetrodotoxin is another of what the U.S. Center for Disease Control (CDC) classifies as a "Selected Low Molecular Weight (LMW) toxin. Poisoning usually occurs as the result of eating certain marine fish, in particular organ parts where the toxin is concentrated. Cooking does not destroy the toxin.

Test animals injected (1 to 10 micrograms per kg of body weight) with the toxin develop a rapid onset of excitability, muscle spasm, and respiratory distress. Death may occur within 10 to 15 minutes from respiratory paralysis. Humans ingesting seafood containing tetrodotoxin show similar signs of toxicity, typically preceded by numbness of lips, the face, and extremities. Other symptoms include sweating, weakness, tremor, incoordination, cyanosis, hypotension, nausea, vomiting, diarrhea, and abdominal pain. Cardiac arrhythmias may proceed complete respiratory failure and cardiovascular collapse. The person although paralyzed may be conscious until just before death. Death usually occurs within 4 to 6 hours after ingestion with a range of 20 minutes to 6 hours. The toxin works by inhibiting the sodium channel at the nerves and muscles. [information from CDC website and Wikipedia].

Tetrodotoxin poisoning is usually associated from eating pufferfish. The toxin does not come from the fish itself but is produced by certain bacteria, notably Pseudoalteromonas tetraodonis, and other bacterial species (e.g. Vibrio alginolyticus). Pufferfish grown in a laboratory free from the bacteria do not produce tetrodotoxin unless they



Chemist's representation of Maitotoxin (from J. Chandrasekar, Resonance, May 1996, pages 68-70, Me is an abbreviation for CH3)

Maitotoxin

Molecular Formula: C164H256O68S2Na2
CAS Number: 59392-53-9
Molecular Weight: 3422

This molecule holds the record of being the largest natural and most lethal non-protein, non-peptide product made in nature yet discovered.

The lethal dose is (from mouse injection tests) is 50 nanograms per kilogram of body weight.

The toxin is produced by the red tide algae Gambierdiscus toxicus, but human poisoning is associated with eating tropical reef fish which are contaminated with the red tide algae. The condition is called "Ciguatera Fish Poisoning".

Paralysis and death may occur upon ingestion. Recovery time among survivors may take weeks, months, or even years.

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Figure 3. Chemical Formula of Maitotoxin

are fed food containing the bacteria. The highest concentration of tetrodotoxin in pufferfish is in the ovaries, liver, intestines, and skin; these body parts must be removed before the fish is prepared for eating. The muscular flesh of the pufferfish is considered free of the toxin. Nevertheless, in Japan where pufferfish [Fugu, as it is called in Japan, which is also the genus name for several species of pufferfish] is considered a delicacy, from 1974 through 1983 there were 646 reported cases of pufferfish poisoning with 179 fatalities. Sushi chefs who wish to prepare pufferfish [Fugu] must be licensed by the Japanese government. A technical article on tetrodotoxin paralytic poisoning is available (Ahasen et al, Singapore Med Journal) 45(2) (2004)) at http://www.sma.org.sg/smj/4502/4502a2.pdf. Photos of different pufferfish species are available at http://saltaquarium.about.com/od/porcupinepufferphotos/Porcupine_Pufferfish_Photos.htm.

Tetrodotoxin is also produced by the bacteria inhabiting other marine and some terrestrial animals. The list of animals include the blue-ringed octopus, triggerfish, goby, anglefish, parrot fish, ocean sunfish, porcupine fish, seastars, starfish, certain species of crabs, flatworms, sea squirts, several marine snails, ribbon worms, arrow worms, some poisonous frogs, and some salamanders. The blue-ringed octopus uses tetrodotoxin as venom for injecting its prey (the venom contains both the bacteria and toxin). With all the different kinds of bacteria inhabiting different hosts, one would expect different kinds of tetrodotoxin. There are different biotoxins produced by different bacteria, but the name "tetrodotoxin" is reserved for just one molecule. Other toxins have been given different names, such as anhydrotetrodotoxin, palytoxin, maitotoxin, etc. Two of them (palytoxin and maitotoxin) have potencies 100 times that of tetrodotoxin. Palytoxin has been isolated from small marine organisms of the genus Palythoa. Maitotoxin has been found in certain fishes associated with ciguatera poisoning.

Tetrodotoxin has been blamed for "zombie" poisons in Haiti [see W.H. Anderson, "Tetrodotoxin and the zombie phenomenon", Journal of Ethnopharmacology vol 23 (1) pages 121-126 (1988)].

Tetrodotoxin can be synthesized. The papers are in the open literature. [e.g. Kishi, Y. et. Al., Journal of American Chemical Society, vol 94, 1972]. For a general survey of methods of tetrodotoxin synthesis (2004) see http://www.princeton.edu/~orggroup/supergroup_pdf/SuperGroupMeetingJune2nd.pdf.

Tetrodotoxin in many respects is similar to Saxitoxin. The toxicity is about the same. Both are sodium ion channel blockers. The difference is saxitoxin poisoning occurs through eating shellfish and tetrodoxin poisoning usually occurs through eating fin-type fish, in particular pufferfish. Cooking does not destroy the toxins. Both poisons can be artificially synthesized. Both have the same potential to be mass produced and used as a terrorist weapon, to be disseminated as an aerosol or in food.

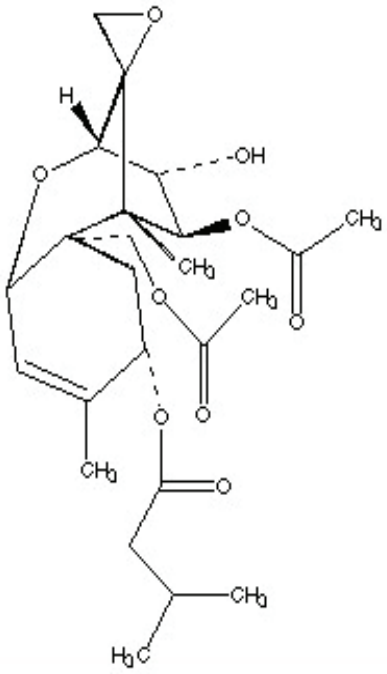
T-2 toxin

T-2 Toxin is one of several trichothecene myotoxins which occur naturally in moldy grains (grains infected with Fusarium mold). The CDC also classifies it as a "Selected Low Molecular Weight (LMW) Toxin". The CDC also implements T-2 toxin as a potential biological warfare agent [based on a report, Wannemacher R, Wiener SL. Trichothecene mycotoxins. [In: Sidell FR, Takafuji, ET, Franz DR, editors. Medical aspects of chemical and biological warfare. Vol.6. Textbook of military medicine, part 1: warfare, weaponry, and the casualty. Washington, DC: Office of the Surgeon General at TMM Publications, Borden Institute, Walter Reed Army Medical Center; 1997. p. 655-76]

The manner in which T-2 Toxin inhibits protein synthesis has been studied by many researchers (see summary paper on Fusarium toxins published by the European Commission, in 2001; Fusarium is the name of the mold that produces the toxin), paper at http://ec.europa.eu/food/fs/sc/scf/out88_en.pdf. Specifically, T-2 toxin attacks a critical site on the ribosomal RNA. Ribosomes are the structures within the cell where proteins are made.

Toxicity Data for T-2 Toxin

A detailed summary on toxicity of T-2 Toxin and other trichothecene myotoxins



Chemist's representation of T-2 Toxin, from http://www.cbwinfo.com/Biological/Toxins/T2.html

T-2 Toxin

Molecular Formula: C24H34O9
CAS Number: 21259-20-1
Molecular Weight: 466.6
Synonyms: T 2 mycotoxin; Fusariotoxin T 2; Insariotoxin; Mycotoxin T-2; T-2

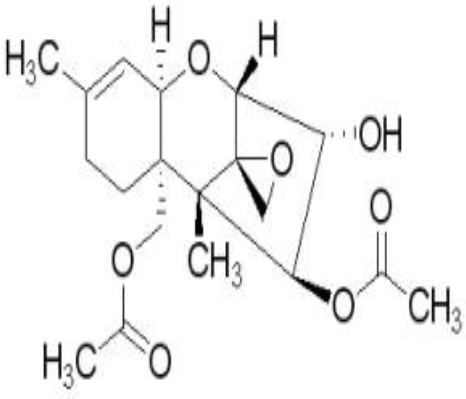
Related Compound: HT-2 Toxin, C¬22H32O8, CAS Number 64943-87-2, a metabolite of T-2 Toxin

T-2 Toxin is a powerful natural blister agent which works by inhibiting protein synthesis. About 50 nanograms of T-2 Toxin on skin produces the same blistering effect as 20 micrograms (=20,000 nanograms) of sulfur mustard

Figure 4 Chemist's Representation of T-2 Toxin

can be found by visiting the website, [website citation from Textbook of Military Medicine] http://www.cbwinfo.com/Biological/Toxins/TriToxicol.html. T-2 Toxin is toxic by inhalation, skin absorption, injection, and ingestion. The chemical is not as toxic by injection or ingestion compared with tetrodotoxin (mouse lethal dose, injection, LD50 = 1.6 to 3.8 mg/kilogram of body weight, a mouse weighs about 20 grams). By inhalation, LD50 (mouse) = 0.24 to 0.94 mg/kg.

Symptoms of Exposure for T-2 Toxin Symptoms for skin injury are similar to mustard gas but appear at about a 400 times lower dose. These symptoms include blistering of the skin and irritation of the eyes and throat. The dose required to produce blistering and eye damage is still well below the lethal dose. Inhalation toxicity is comparable to that of other blistering agents (Lewisite, Mustard). Symptoms of inhalation exposure include nasal discharge, throat pain, cough, shortness of breath, and chest pain; the victim spits blood as a result of pulmonary and bronchial hemorrhage. Severe poisoning results in prostration, weakness, jerky movement, shock, collapse, and death. Onset of symptoms occurs between seconds up to about 20 minutes of exposure. Treatment includes decontamination with soap and water.



Chemist's representation of diacetoxyscirpenol, from Sigma-Aldrich website, http://www.sigmaaldrich.com

There is potential for a terrorist to mass produce diacetoxyscirpenol by fermentation using a starch-rich grain or potatoes as a food source.

Diacetoxyscirpenol

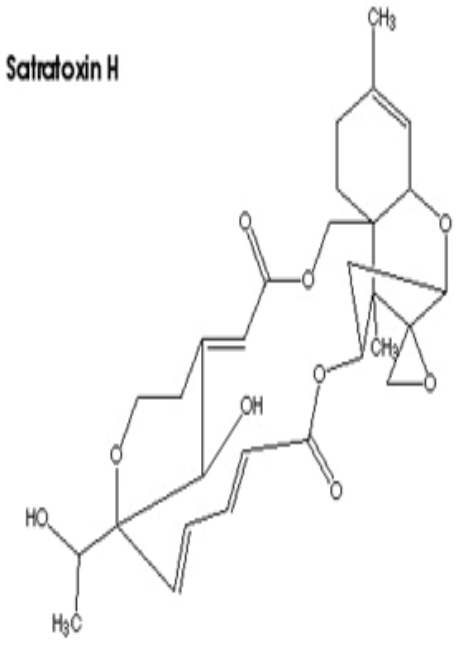
Chemical Formula: C19H26O7
CAS#: 2270-40-8
Molecular Weight: 366.4

Produced from molds of species Fasarium such as Fasarium sambucinum, F. moniliforme, equiseti, F. graninearum, etc., which can contaminate grains, potatoes, peas, soybeans, and is toxic if the food is consumed by people or livestock. Diacetoxyscirpenol also has been detected in crude building materials.

LD50 (mouse, intravenous injection)= 12 mg/kg. LD50 (rat, intravenous injection) = 1.3 mg/kg; LD50 (rat, oral) = 7.3 mg/kg, from http://www.cbwinfo.com/

Primarily a concern with livestock fed moldy food, with symptoms similar to the T-2 Toxin

Figure 5 Chemist's representation of Diacetoxyscirpenol



Chemist's representation of Saratoxin H, from http://www.cbwinfo.com/Biological/Toxins/Satra.html

Satratoxin H

Molecular Formula: C29H36O9
CAS Number: 53126-64-0
Molecular Weight: 528.6

Produced by mold Stachybotrys chartarum; the mold may contaminate water-damaged homes and other buildings (wallboard, fiberglass, cellulose products, etc.).

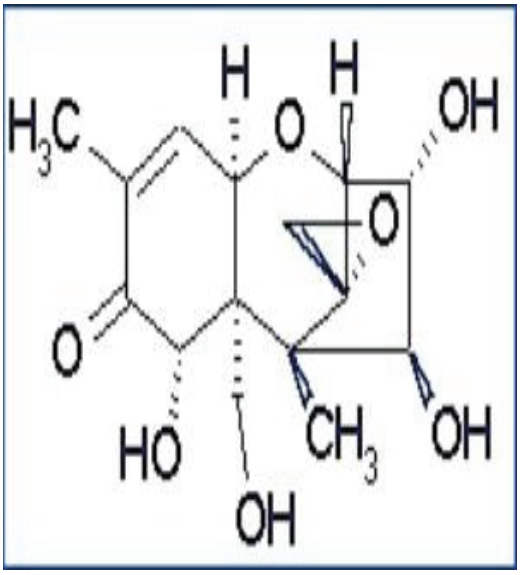
LD50 (mouse, injection) = 1.0 to 1.4 mg/kg.

If mold spores, fungal fragments, or toxin is inhaled, it can cause nosebleeds, chest pain, and pulmonary hemorrhage. Contact with skin may cause rash. May be fatal if ingested or inhaled in large quantity. A cause of infant deaths (pulmonary hemorrhage) by chronic exposure to mold spores in contaminated houses. Other symptoms headache, fatigue, elevated body temperature.

Figure 6 Chemist's Representation of Satratoxin H

If ingested as in contaminated grain products, symptoms appear between 8 and 12 hours. These include vomiting and internal hemorrhages in the alimentary track. The intestines, bone marrow, lymph nodes, spleen, and thymus are particularly affected. Severe poisoning results in prostration, weakness, jerky movement, shock, collapse, and death. Treatment includes supportive care including removal of ingested toxin with adsorbents such as superactivated charcoal. The term "alimentary toxic aleuka", or ATA, is used to describe the poisoning. Alimentary toxic aleuka occurred in the USSR during 1941-47 and again in 1952, 1953, and 1955 killing thousands of people; the ATA was traced to the people eating over-wintered wheat. Symptoms included vomiting, abdominal pain, diarrhea followed by leucopenia, bleeding from the nose and throat, depletion of the bone marrow, and fever. Extractions of the suspected wheat showed toxic dermal effects when applied to the skin of test animals. The ATA poisoning was not conclusively linked to T-2 Toxin, but the presence of Fusarium fungus species was established in the over-wintered wheat, and T-2 toxin and HT-2 toxin was found in later fungal cultures.

Other outbreaks of ATA occurred in China and India. In one Chinese location, 165 subjects became ill after consuming rice infected with two species of Fusarium. An ELISA assay of the suspected rice for T-2 Toxin showed a level of 180 to 420 micro-



Chemist's representation of Saratoxin H, from http://www.cbwinfo.com/Biological/Toxins/Satra.html .

Satratoxin H

Molecular Formula: C29H36O9
CAS Number: 53126-64-0
Molecular Weight: 528.6

Produced by mold Stachybotrys chartarum; the mold may contaminate water-damaged homes and other buildings (wallboard, fiberglass, cellulose products, etc.).

LD50 (mouse, injection) = 1.0 to 1.4 mg/kg.

If mold spores, fungal fragments, or toxin is inhaled, it can cause nosebleeds, chest pain, and pulmonary hemorrhage. Contact with skin may cause rash. May be fatal if ingested or inhaled in large quantity. A cause of infant deaths (pulmonary hemorrhage) by chronic exposure to mold spores in contaminated houses. Other symptoms headache, fatigue, elevated body temperature.

Figure 7 Chemist's Representation of Nivalenol

grams per kilogram of rice (see European Commission paper, cited earlier).

Potential for Terrorist Use

T-2 Toxin and other trichothecene myotoxins are relatively easy to manufacture. The Fusarium molds can be grown in large fermentation vessels using grains, barley, rice, maise, or corn as food. Fusarium molds are found in the soils in which the grain crops are grown, or the grain could be inoculated with a particular mold such as Fusarium sporotrichioides. The yield of T-2 toxin may be several grams per kilogram of grain material. The T-2 Toxin could be harvested and spread as an aerosol. The target might be people or agriculture (livestock, food crops).

The trichothecene myotoxins including T-2 Toxin are in general stable compounds which are not destroyed during processing or cooking of food, and they do not degrade at high temperatures (from Eriksen, G.S., 1998, cited in European Commission paper).

Diacetoxyscirpenol and other Trichothecene Myotoxins

There is a fairly long list of toxic chemicals produced from molds, which can affect grain products or the air quality in buildings. One of them, diacetoxyscirpenol, is on the Department of Health and Human Services list of biological agents and toxins, which pose a severe treat to public safety. Two other trichothecene myotoxins are also discussed below.

The same contaminated grain products may contain diacetoxyscirpenol, T-2 Toxin, and Nivalenol.

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BIOGRAPHY

Dr. Nordin received his PhD degree in biochemical engineering from the University of Minnesota and has worked with several engineering firms and with the not-for-profit Western Research Institute on environmental and public safety problems. He is currently a co-owner of AristaTek Inc

Monitoring and Surveillance of Biological Threats and Disease

Jon J. Calomiris, Ph. D.
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Challenges to monitoring for biological threats. U.S. biological defense programs began surging about two decades ago following the Persian Gulf War (August 1990 to February 1991) in response to concerns about potential use of weapons of mass destruction (WMD) by adversary nations and factions. One decade later, biological defense efforts intensified on the U.S. homeland as a consequence of the anthrax letter attacks (September to October 2001). Today, defense against deliberate offensive attacks involving release of biological threat materials remains a great challenge for the warfighter on the battlefield as well as the DoD in support of Federal departments and agencies responsible for homeland security. A significant component of biological defense is monitoring of critical and vulnerable areas for release of biological agents. As proactive defense, monitoring is intended to prevent or limit an attack by providing information of a release for timely engagement of operations to minimize casualties and spread of biological contamination. Monitoring can be continuous (24/7) or executed during periods of heightened alert.

On the battlefield, monitoring for a biological attack is crucial to ensure continuation of military operations. Surveillance for and rapid detection of a biological release would enable the warfighter to assume appropriate protective posture and continue operations in a contaminated environment. A biological attack on the battlefield would likely involve release of biological material to a wide-area exterior environment. Thus, a battlefield attack could involve aerosol dissemination of biological agents selected on the basis of (1) infectiousness or toxicity via inhalation and, perhaps, dermal contact and (2) stability in air and on surfaces upon deposition. Other agent selection factors could include (1) ability of enemy factions to produce large quantities of agent to cover wide-areas, (2) agent tolerance to decontamination, and (3) lack of effective countermeasures (vaccines and therapeutics). Because the basic conditions of a battlefield are somewhat predictable, effective defense strategies and countermeasures can be developed to prepare for and respond to a battlefield attack.

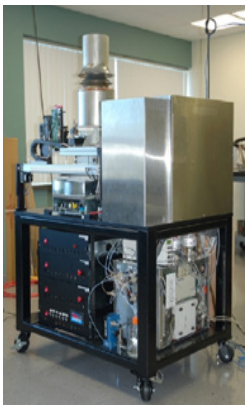
While a biological strike on a battlefield could seriously impact the warfighter and mission operations, the repercussions of an attack of the U.S. homeland could be devastating. Compared with battlefield defense, establishing homeland defense strategies is a great challenge due to the complexity and geographic immensity of the homeland as a target. An attack of the U.S. could involve release of biological agents at any of a variety of sites, including transportation hubs, buildings, food supplies, water systems, agricultural animal and plant resources, and special events with large masses of civilians. The impact would be compounded by multiple attacks set simultaneously or in succession. While a battlefield attack would likely involve aerosol release, the diversity of possible homeland attack sites broadens the means for agent release. In addition to air, attack of homeland sites could involve release of biological agents directly into liquid or solid materials or upon surfaces with the intent for massive exposure via inhalation, ingestion, or dermal contact. The diversity of possible attack routes broadens the variety of biological agents (among various bacteria, viruses, or toxins of biological origin) that could be selected for an attack. The potential impact of a homeland attack is also increased by greater liability of the civilians, as compared to the warfighter, due to lack of available protective measures such as vaccines, therapeutics, or protective gear.

This article provides an overview of available technologies and resources that support strategies for monitoring the battlefield or homeland for potential biological attacks. Discussion addresses recent national strategy that expands the role of biological defense. Rather than focus on typical attack scenarios such as the release of anthrax bacteria on the battlefield, the current policy calls for countering any biological

threat which includes essentially any disease-causing organism. In addition, surveillance must include, in additional to a deliberate biological attack, any naturally-occurring disease events or accidental releases. This new approach creates a greater challenge for biological defense as well as a greater need for effective surveillance capability. Essentially, we must "expect the unexpected."

Systems to monitor airborne release of biological threats. For DoD and Federal Government programs have established biological monitoring systems designed for airborne release of biological agents and pathogens at specific sites or environments. For the military, Joint Biological Point Detection System (JBPDS) units are deployed as fixed-site units or mobile units mounted in High Mobility Multi-purpose Wheeled Vehicles, integrated in Stryker Nuclear, Biological, and Chemical Reconnaissance Vehicles, and aboard Navy ships. JBPDS units can continuously (24/7) collect air samples and detect in about a minute a spike in airborne biological material that could indicate a possible attack release. The detection signal automatically activates the unit to collect an air sample for presumptive antibody-based identification of specific biological agents and pathogens. A positive presumptive test is confirmed by personnel collecting the sample and conducting DNA-based testing with the Joint Biological Agent Detection System (JBAIDS) which as a portable unit can simultaneously identify any of about 30 target biological agents and pathogens. JBAIDS is intended to be a component of the Joint Warning and Reporting Network (JWARN), a computer-based system designed to collect and analyze CBRN data and sensor information in the field for C2 decision makers.

As a Federal Government program led by the Department of Homeland Security, BioWatch is a network of biological samplers stationed as fixed-units at priority sites, such as transportation hubs



(airports and rail stations), throughout the U.S. in over 30 urban areas. In addition, BioWatch samplers can be transported to high-profile events involving large masses of people. As a 24/7 automated sampler, the BioWatch unit collects air for 24 hours to trap microbes on a filter. At the end of the daily sampling period, personnel (CDC and local public health laboratories) retrieve the filter and process the sample in an analytical laboratory to detect variety of target biological agents and pathogens on the basis on the microbes' DNA. While the BioWatch sampling and analytical processes are time consuming and labor intensive, results would provide highly reliable early spatial warning of a biological attack and forensic evidence on the basis of DNA signatures. Currently, the BioWatch program is advancing its detection technology by engineering BioWatch Gen3 to be a fully-automated unit that conducts the complete detection process from air sample collection to assays for biological agent and pathogen identification. BioWatch-based surveillance and response involves various organizations (DHS, CDC, EPA, FBI, and state and local governments) and is integrated in the Laboratory Response Network (described below) for rapid response to bioterrorism.

The biological threat and DoD role for biodefense are expanding. The responsibility of the DoD for biological defense is focused on military operations and missions. However, as stated above, the DoD also plays a supporting role in homeland defense for the Federal Government. This assistance could pose challenges to the military since biological attack scenarios of the homeland may be more complex and unpredictable than release of agents on the battlefield. In addition, the scope of DoD support is expanded by Presidential Policy Directive 2 (PPD-2) "National Strategy for Countering Biological Threats") (National Strategy). Released November 2009, PPD-2 broadens biological defense beyond concern for typical agents such as Bacillus anthracis, the microbe that causes anthrax. In addition, to recognize biological agents, the Directive expands the biological threat to encompass any pathogen that could have widespread or significant impact on the U.S. Pathogens of concern can include microbes that are known to cause disease as well as microbes that are newly discovered or emerging as human health threats. The scope of biological defense is widened by the range of potential exposure scenarios, which include, in addition to deliberate attacks, naturally-occurring disease events or harmful biological material accidently released from laboratories. And to load the responsibility further, the Directive extends beyond human disease by including agricultural diseases since wide-spread disease of animal or plant resources could impact the U.S. economy and stability.

Meeting the challenges imposed by PPD-2 calls for biological surveillance as comprehensive networks that go beyond deployment of JBAIDS or BioWatch units. Effective biological surveillance for human health would include (1) clinical facilities and personnel to receive and examine patients of exposed (with symptoms or those who believe that have been exposed or infected), (2) laboratory and diagnostic facilities to identify and verify disease and infectious agents, and (3) epidemiological capability to identify associations and trends as the basis "sleuth" cases and define outbreaks and epidemics. The health surveillance systems of the U. S. military

(Armed Forces Health Surveillance Center) and civilian sector (National Laboratory Response System) public health surveillance networks (described below) have successfully demonstrated their effectiveness for monitoring human diseases. While these networks are adept with common diseases such as seasonal influenza epidemics, the personnel must also be trained and prepared for biological attacks which may first noticed as unusual or atypical cases that appear in health clinics or emergency rooms.

Biological surveillance goes beyond monitoring for threats.

Monitoring the battlefield or the homeland for a biological agent attack as described above could provide near real-time detection for airborne release on a continuous basis. However, these monitors are limited to specific defined locations, such as the battlefield or transportation hubs, and are not suitable to cover vast geographic areas. Such an expansive detector network would be prohibited by cost and complexity of execution. In addition, the detection units are limited to airborne releases of designated biological agents and would likely not detect naturally-occurring or emerging pathogens. However, as a broader approach, monitoring large areas throughout the U.S. and globally is accomplished with public health surveillance systems. These established surveillance systems provide the resources that are instrumental to countering biological threats as addressed in PPD-2.

Public health surveillance is defined by the Centers for Disease Control and Preventive Medicine (CDC GUIDELINES) as "ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity (illness) and mortality (death) and to improve health." The health surveillance systems of the U. S. military (Armed Forces Health Surveillance Center) and civilian sector (National Laboratory Response System) (described below) have demonstrated their effectiveness for monitoring natural diseases. Each of the two networks possesses the basic components of public health surveillance, being (1) clinical facilities and personnel to receive and examine patients of exposed (with symptoms or those who believe that have been exposed or infected), (2) laboratory and diagnostic facilities to identify and verify disease and infectious agents, and (3) epidemiological capability to identify associations and trends as the basis "sleuth" cases and define outbreaks and epidemics. While these networks have proven their effectiveness with common disease events such as seasonal influenza epidemics, they need to also be effective for swift detection of unexpected and atypical biological threats such as those of a deliberate attack.

DoD surveillance of biological threats.

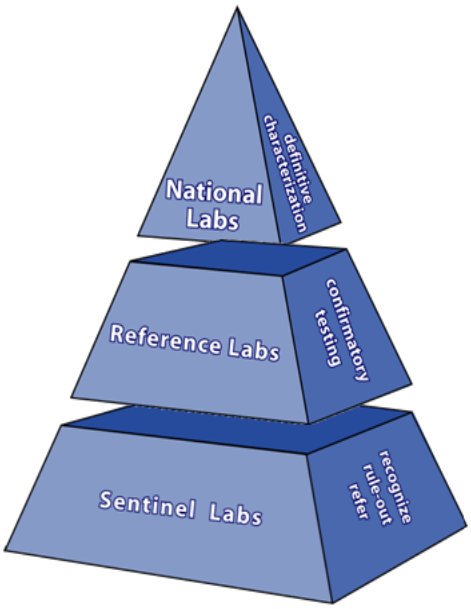
As a focal DoD resource, the Armed Forces Health Surveillance Center (AFHSC) was established in 2008 to unify the various DoD health surveillance resources as a single organization. The AFHSC mission is to serve as the central strategic epidemiologic resource for the U.S. Armed Forces. AFHSC includes basic divisions with specialized surveillance functions. As a central division of AFHSC, the Global Emerging Infections Surveillance and Response System (GEIS) was established as a result of a 1996 Presidential Decision Directive (NSTC-7) aimed to improve protection against emerging infectious disease threats of U.S. and global public health communities. To provide expertise in infectious disease surveillance, GEIS is organized with more than 35 partner laboratories located in every global region. CONUS DoD laboratories and centers include Walter Reed Institute of Research (Silver Spring, MD), Naval Medical Research Center (Silver Spring, MD), U.S. Army Public Health Command (Edgewood, MD), U.S. Air Force School of Aerospace Medicine (San Antonio, TX), and Naval Health Research Center (San Diego, CA). Non-DoD partners include CDC, NASA, and John Hopkins Applied Physics Laboratory. Global surveillance is supported by DoD laboratory centers in Hawaii, the Pacific, Korea, Germany, Egypt, Kenya, and Peru. GEIS surveillance programs focus on 5 categories of infectious disease, as respiratory infections (with emphasis on avian and pandemic influenza), gastrointestinal infections, febrile and vector-borne infections, antimicrobial drug resistance, and sexually transmitted infections. The power of GEIS for global surveillance was advanced in 2010 by integration of World Health Organization (WHO) International Health Regulations core capabilities into all GEIS surveillance activities.

The AFHSC Division of Epidemiology and Analysis (E&A) conducts comprehensive surveillance and analysis of health-related information. E&A receives requests for information, analyses, and research support through AFHSC service liaisons and other routes. A major analytical function is to provide baseline rates of disease and health-related conditions among all Services of the Armed Forces. Baseline tracking and surveillance efforts are utilized to assess pre- and post-deployment health status, acute respiratory disease, and vaccine status and immunization rates. E&A provides periodic surveillance reports and publications that can be obtained online (REPORTS AND PUBLICATIONS). The Medical Surveillance Monthly Report (MSMR) is the AFHSC publication of record, presenting the incidence, distribution, trends, and impact of illnesses and injuries among all active and reserve component members of each Service.

Surveillance of our Homeland with the Laboratory Response Network (LRN).

As a collaboration of many partners,

the LRN became operational in 1999 to address Presidential Decision Directive 39 (U.S. Policy on Counterterrorism). As an integrated network of strategically placed national and international laboratories, the LRN was created to improve the existing U.S. public health laboratory infrastructure's capability and capacity for rapid response to bioterrorism. The network consists of numerous organizations, including Federal (CDC, USDA, FDA, EPA, DOE, DHS, FBI, and DOJ), military, state and local public health, Association of Public Health Laboratories, and international (Canada, UK, and Australia). Each laboratory is fully equipped and capable of quickly responding to acts of biological terrorism, infectious diseases, or other public health threats and emergencies. In addition to public health laboratories, the LRN includes facilities for testing food, animals, water and other environmental materials that could be sites of naturally-occurring diseases or biological attacks.



The LRN is tiered as sentinel, reference, and national laboratories. As the foundation, the sentinel labs include thousands of hospital-based labs that have direct contact with patients for routine care. The sentinel labs are regarded as "first responders" since they are likely to be the first facilities that detect suspicious specimens from human victims of a covert biological attack. These labs comprise a network of various types of organizations that include the military, Federal agencies, state and local governments, and foreign. In addition to public health and clinical labs, the sentinel tier includes labs that conduct testing of environmental (water and air), food, veterinary, and agricultural samples. Sentinel laboratories during their routine diagnostic and testing services have the ability to recognize and rule-out potential samples of concern. However, since they are not able to conduct confirmatory test procedures, these labs refer and transfer suspicious samples to reference labs for additional testing.

As the second tier, reference labs can rapidly conduct confirmatory tests for the presence of biological threat agents. The reference labs are crucial to providing information that enables local authorities to quickly respond to emergencies. As are the sentinel labs, the reference labs are of diverse organizations and testing specialties. About 150 reference labs are located throughout the U.S. and Canada. All 50 states have the ability to process samples to identify Bacillus anthracis and other biological agents. While reference labs can process and analyze a great variety of samples, extensive or advanced testing of dangerous biological agents or pathogens requires samples to be transferred to a national laboratory.

When necessary as for response to a significant biological incident or situation, the national labs receive samples to provide "definitive characterization" of a biological agent or pathogen. These labs have established advanced technologies for characterizing specific biological agent strains and conducting forensic analyses. Of the three national labs (U.S. Army Medical Research Institute for Infectious Diseases [USAMRIID], Centers for Disease Control and Preventive Medicine [CDC], and Naval Medical Research Center), two labs (USAMRIID and CDC) possess unique facilities that provide capability to handle very dangerous or highly infectious biological agents such as the Ebola virus.

The effectiveness and value of the LRN was demonstrated during the 2001 anthrax letter attacks, the only fatal bioterrorism incident to occur in the U.S. The Bacillus anthracis pathogen was detected in LRN reference lab located in Florida. During the course of the investigation, LRN labs tested about 125,000 samples and conducted about 1 million separate tests.

Active information systems enabling near-real-time global surveillance. Monitoring for biological agent release as described above for the battlefield (JBAIDS) or homeland (BioWatch) provides near real-time surveillance for release on a continuous (24/7). However, these surveillance approaches are limited to specific geographic locations and require sophisticated instrumentation with substantial cost for operation and maintenance. To meet requirements for global surveillance of know biological agents as well as naturally-occurring pathogens (known and emerging) surveillance systems have been established.

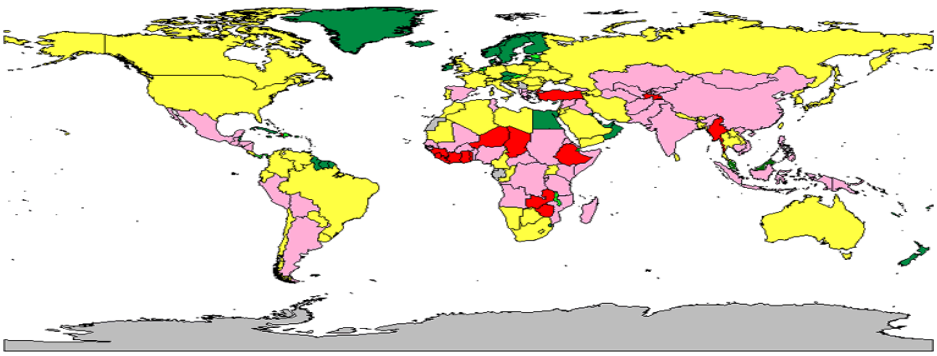
Tools for surveillance of disease and biological threats.

Program for Monitoring Emerging Diseases, commonly called ProMed-mail (ProMED-mail), provides electronic global surveillance of infectious diseases and toxin exposures. Established in 1994 and as a program of the International Society for Infectious Diseases since 1999, ProMED-mail reports data by email on a near real-time basis to more than 50,000 subscribers in over 185 countries. The resource provides multiple updates

daily on disease outbreaks with commentary by subject matter experts.

In addition to near real-time reporting, ProMed-mail's value for global surveillance is broadened by reporting diseases of animals and plants. Surveillance of emerging animal diseases is important since about 70 percent of emerging human diseases originate in animals. The broad surveillance approach supports efforts that not only monitor known diseases but also unexpected or not-yet-discovered pathogens as presented in PPD-2. In addition, since ProMed-mail reports disease associated with any type of exposure conditions or scenario, the surveillance system could quickly identify outbreaks resulting from deliberate biological attacks or accidental releases.

ProMED-mail is a valuable resource available without cost to the public (although donations are greatly appreciated) for a quick view of global disease. You may subscribe the ProMED-mail (ProMED-mail SUBSCRIBE) and receive automatic updates on global occurrence of disease. To meet your interests and support your mission, you can tailor your updates to focus on particular biological threats.

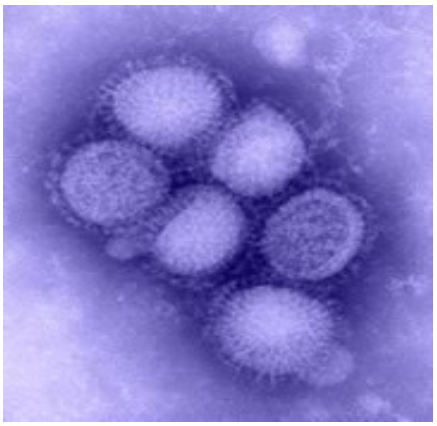


A valuable component of ProMED-mail for quick view of global disease are the interactive maps. Latest posts of disease incidents and outbreaks (ProMED-mail Latest Posts) are listed at the ProMED-Mail "Home" section is a valuable resource for geographic display of outbreaks. Included is the "HealthMap" (ProMED-mail HealthMap) as an interactive geographic display of current reported cases and outbreaks. Disease locations are indicated by pins that are color coded to indicate levels of disease as low (yellow), moderate (orange), or high (red). By placing the cursor on the pin of a location, you can identify the disease and details at that location. By selecting "Advanced Search" you can select from a lists of diseases and locations for a specified time period.

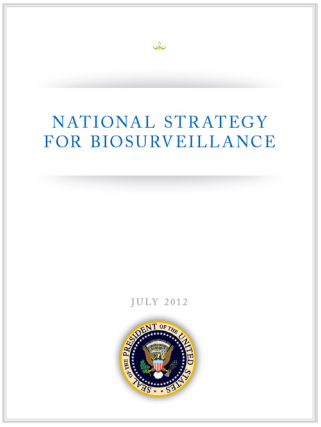
"Maps of Outbreaks" also includes maps created by other organizations to display specific diseases. The global map of "ANTHRAX (1994 to 2001)" (ProMED-mail ANTHRAX MAP) created by Louisiana State University School of Veterinary Medicine designates anthrax occurrence as epidemic, endemic, sporadic, free, and unknown by continent and country during the 1994-2001 period. The U. S. Geological Survey Disease Maps include vector-borne diseases such as West Nile Virus (USGS WEST NILE VIRUS), equine encephalitis viruses (USGS EEE VIRUS, USGS WEE VIRUS), and dengue fever (USGS DENGUE FEVER). The USGS maps provide detailed surveillance of each specific disease within counties or regions of each state.

Surveillance of influenza as an expected disease.

Surveillance resources, such as those of AFHSC, LRN, or ProMed-Mail, are likely to detect significant outbreaks of disease during routine monitoring. Expected or anticipated diseases, such as influenza, are also likely to be effectively chronicled by surveillance resources. Influenza typically strikes globally each year as an epidemic. As



an epidemic, the disease is usually adequately controlled by established medical and public health measures that include therapeutics and a vaccine developed for the specific virus strain. In addition, individuals with previous exposure to the same or similar virus strains may have immunity to the virus. However, occasionally influenza strikes with vengeance due to an unanticipated or atypical virus strain. This can result in a greater than usual number of illnesses and thus evolve into a pandemic. In addition, the pandemic can be caused by a strain that imposes more severe symptoms and a higher death rate. The potential global crisis from influenza is illustrated by the Influenza Pandemic of



1918 which caused 500 million illnesses (about 27 percent of the world population) and 50 to 100 million deaths (about 3 percent of the world population). However, as demonstrated with the H1N1 Influenza Pandemic of 2009, a pandemic can involve a virus that behaves as a typical influenza virus with respect to causing the typical flu symptoms and incidence of death. While many became ill globally, the severity of the disease was similar to that of typical seasonal influenza. Public access updates on surveillance of influenza in the U.S. and globally are provided by the CDC (CDC INFLUENZA SURVEILLANCE) and the World Health Organization (WHO INFLUENZA SURVEILLANCE).

National Strategy for Biosurveillance.

In JULY 2012, the White House released the National Strategy for Biosurveillance which addresses a GAO Report to Develop Biosurveillance Capability. The Strategy's expressed goal is to achieve "a well-integrated national biosurveillance enterprise that saves lives by providing essential information for better decision making at all levels." As the first-ever national strategy for biosurveillance, the Strategy calls for strengthening and integrating existing biosurveillance capabilities by following four guiding principles: (1) leveraging existing capabilities, (2) embracing an "All-of-Nation Approach," (3) adding value for all participants, and (4) maintaining a global health perspective. Core functions are to (1) scan and discern the environment, (2) identify and integrate essential information, (3) alert and inform decision makers, and (4) forecast and advise impacts. The broad scope of the Strategy establishes great challenges for DoD and many other organizations to function together to provide effective biosurveillance. To implement the Strategy, the AFHSC recently established the Division of Integrated Biosurveillance (DIB) with the goal to provide support to AFHSC to identify biosurveillance gaps, fill existing needs, and synchronize DoD biosurveillance efforts. In addition to working with the Geographic Combatant Commanders, National Center for Medical Intelligence, and other DoD medical personnel and organizations, the DIB will advance biosurveillance capabilities by working with federal agencies (including CDC and USDA) and a variety of international partners (WHO, NATO Center of Excellence for Military Medicine, International Committee of Military Medicine, and European Center for Disease Prevention and Control). Through partnerships, the DIB will consolidate biosurveillance information, augment NCMI products provided to the Combatant Commands, and provide "operational biosurveillance" support such as producing executive summaries of health-related situations for leadership.

BIOGRAPHY

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NUCLEAR ENGINEERING AT UTK

LTC Sam Willmon
U. S. Army Student Detachment
The Nuclear Engineering Program at the University of Tennessee, Knoxville

This article highlights the opportunities available to FA52's pursuing either the masters or doctoral program in nuclear engineering at the University of Tennessee, Knoxville (UTK). While the Air Force Institute of Technology (AFIT) remains the primary hub for FA52s at the masters level, opportunities exist for FA52s to attend civilian academic institutions as well. As our career field continues to engage in aspects of combating WMD from intelligence, planning, operational, policy, and R&D perspective, UTK offers FA52s an unparalleled academic experience particularly with respect to the width and breadth of the nuclear fuel cycle. First some preliminary points of interest:

- UTK is one of the top 10 rated graduate programs in nuclear engineering in the nation.
- The UTK campus in downtown Knoxville is 27 miles from the Oak Ridge National Laboratory and the Y-12 National Security Complex.
- UTK has an established relationship with DOD, DOE, and DHS entities in research areas of interest to the FA52 community.

Why pursue an advanced degree?

The most tangential reason for pursuing an advanced technical degree is because it's our job as FA52s. Revisit the purpose of our functional area from DA Pam 600-3: "Nuclear Operations and Counterproliferation officers are warfighters who provide the Army with a technically educated, operationally experienced and highly trained cadre specializing in all aspects of nuclear and combating WMD strategic and operational level planning and execution." On-the-job training tends to make up a large portion of the position-unique skills required by FA52s. The sporadic and short-duration training courses related to WMD or proliferation issues offered by a variety of organizations do not provide the level of technical detail required by FA52s. In fact, FA52s ought to be capable of teaching nearly all of the courses offered to the counterproliferation community. It is the academic setting afforded by ACS opportunities that uniquely allows FA52 officers to immerse themselves in the technical points of our craft and demonstrate both comprehension of the subject and the application of the science.

In our field, a masters degree in a WMD-related field ought to serve as a Go/No-Go criterion. Without a technical education that serves as the foundation of our career field, FA52s are no different from other equally capable staff officers in the U.S. Army. From this vantage point, the root question proposed herein centers on whether or not an FA52 ought to pursue a Ph.D. Given the limited number of Ph.D.-coded billets for FA52s, the answer is largely a personal one. A few things to consider include: Does obtaining a Ph.D. facilitate getting you where you want to go with your professional career, both while in the Army and in your post-Army life? Are you prepared (and your family) for a 3-year stint in grad-school? Does the timing line up with your career path? If the answer to these questions is "yes," then get to work chasing down the opportunities available.

School selection: In narrowing down the schools available to you, the first cut comes with the level of ACS funding available to you. Most FA52s (not funded by USMA) are limited to no-cost or low-cost schools (capped at $21k in FY13), such as AFIT, the Naval Post-graduate School, the National Defense Intelligence College, or civilian academic institutions that meet the requirements of the ACS program. In down-selecting the list of schools, the following four central questions should guide the development of your short list:

- What are you interested in studying at the PhD level with respect to nuclear engineering?

- Which schools have a faculty member (potential advisor) grounded in the topic of interest (ideally one who is established in the sub-field and not simply somewhere in the nuclear engineering field)? Your advisor is someone you are professionally hitching your cart to. Not only will their perspective shape your research, but also both how you approach the remainder of your professional career wrt nuclear engineering and how others will perceive your background.

- Which schools have the resources capable of supporting your topic of interest?

- Where would you prefer to go to school? Location is important not only with respect to school and resources available, but also in terms of taking care of your family while you're in school. While you're going to be focused on school - it's obviously important that the home front is squared away (from schools for the kids, a job for the spouse, medical care, housing, etc.).

Given the preceding list of things to bear in mind, why should UTK be on every FA52s short-list of schools to attend?

The UTNE Program at UTK

The nuclear engineering program at UTK has a long history of producing graduates who have gone on to work both in the civilian nuclear power industry as well as the federal government. Early collaboration in the post-World War II era between Oak Ridge, the Massachusetts Institute of Technology, the University of Tennessee, and the "Clinch College of Nuclear Knowledge" served foundation for academic programs in nuclear engineering. Notable alums of the initial academic program include ADM Rickover (father of the nuclear Navy) and ADM Watkins (Secretary of Energy 1989–1993). With President Eisenhower's Atoms for Peace initiatives seeking greater use of commercial applications of nuclear technologies, UTK founded its nuclear engineering department of in 1957 to support growing the academic demand. The leveling off of nuclear power industry and the decline of the Cold War in the 1980's had the tangible effect of nearly two decades of flat or negative growth in student enrollment in UTK's nuclear engineering program. In response to studies indicating the rapid decline of an experienced nuclear work-force, a variety of U.S. academic initiatives re-invigorated interest in the nuclear field. In the Fall of 2012, UTK's nuclear engineering department had 344 students enrolled (120 graduate and 224 undergraduate students)—nearly four times the size of the student body in 1998. In terms of graduation numbers, the department graduated 61 students (40 BS, 22 MS, and 10 PhDs) in 2011. The department currently has 13 tenure/tenure track, 20 research, and 25 adjunct faculty members. Primary research areas within the department include: nuclear fuels and materials, nuclear security issues, radiological sciences & health physics, nuclear instrumentation & control, reliability and safety, nuclear fuel cycles, and advanced modeling and simulation.

The academic requirements for a Masters of Science in nuclear engineering at UTK are as follows:

- 12 hours of graduate courses in nuclear engineering which must include at least two of the following: Transport Processes in Nuclear Engineering, Nuclear Systems Dynamics and Control, Radiation Protection, and Reactor Theory and Design;

- 6 hours of elective courses in mathematics, statistics, or another field related to nuclear engineering;

- 6 hours in either nuclear engineering or a related field; and,

- 6 hours of thesis work culminating in a written thesis*;

(* - While UTK's graduate program catalog lists three other options as available for the "culminating experience" in lieu of a thesis — none of the three alternatives are generally encouraged for full-time, resident graduate students.)

The academic requirements for a Ph.D. with a nuclear engineering major at UTK are as follows:

- A minimum of 48 hours beyond the bachelor's degree, exclusive of credit given for masters thesis work.

- A minimum of 24 hours in doctoral research (NE600);

- A minimum of 30 hours in nuclear engineering courses at the graduate level (including at least 6 hours of 600-level courses);

- A minimum of 12 hours in mathematics, statistics, or other courses related to nuclear engineering beyond nuclear engineering undergraduate requirements numbered 400 or above; and,

- A minimum of 6 hours in courses numbered 500 or above from a department other than nuclear engineering.

The Comprehensive exam: Prospective Ph.D. candidates must pass a comprehensive exam (often referred to as "comps," "quals," or "qualifier") administered by the nuclear engineering department once a year (in August). Candidates cannot begin their dissertation work (NE600) before passing the comprehensive exam. The written portion of the comprehensive exam is conducted over a 2-day period. The first day covers the fundamentals of nuclear engineering at the undergraduate level via 2x 1.5-hour exams. Day-1 questions tend to focus on radiological engineering and nuclear reactor theory. Day-2 consists of a 3-hour graduate specialty exam — each prospective candidate selects one of the following tracks for their exam: Transport processes in nuclear engineering, Nuclear systems dynamics and control, Radiological engineering, or Reactor theory and design, Shielding and radiation transport, or Nuclear fuels and materials. The second part of the comprehensive exam is completed with the successful oral defense of a written dissertation proposal. A PhD candidate must successfully defend, in an oral examination, all work presented for the degree (all course work and the dissertation).

UTNE Resources

The resources available to nuclear engineering graduate students at UTK resemble those one expects of a large university:

- Neutron and photon detection/characterization laboratories

- Heat transfer and fluid flow measurements laboratory

- Data acquisition and instrument characterization laboratory

- Prognostics, reliability and control laboratory

- PWR simulator (hardware and software)

- Radiochemistry and nuclear forensics laboratory

- A 30-node, multi-core Beowulf

computing cluster

In addition to the standard academic and research support infrastructure, UTK also houses/sponsors several centers of excellence relevant to the nuclear engineering community:

- Howard H. Baker Center for Public Policy,
- Institute for Nuclear Security,
- Reliability and Maintainability Center, and the
- Scintillation Materials Research Center

ORNL Resources

While attending UTK, graduate students in nuclear engineering have the opportunity to leverage resources at the Oak Ridge National Laboratory:
- 85 MW High Flux isotope Reactor (HFIR)
- Spallation neutron source (SNS) accelerator
- Nuclear safeguards laboratory
- Radiochemical Engineering Development Center (RDEC)
- Oak Ridge Electron Linear Accelerator
- Kraken (the world's most powerful university computer)
- ORNL Technical Testing and Analysis Center
- Radiation Safety Information Computational Center (DOE hub for nuclear codes, data and software modeling tools)

External research collaborators potentially available to UTK nuclear engineering graduate students include:
- Y-12 National Security Complex (to include the Y-12 Nuclear Detection and Sensor Testing Facility), and
- Oak Ridge Associated Universities (a consortium of major PhD-granting institutions)

Recommendations

As with all significant choices in life, information is essential to the decision-making progress. If you happen to be an FA52 and don't yet have your masters degree – stand on someone's desk until you get a slot. If you are toying with the idea of pursuing a Ph.D., talk to those currently in the ACS program or recent/former graduates and begin collecting the facts ASAP – regardless of your timeline. Timing and budget constraints can quickly out-weigh personal desires, no matter how hard our career-field management team works to meet the needs of the individual.

Any FA52 presented with the opportunity to attend a civilian academic graduate program ought to strongly consider UTK. The resources available to FA52s will attending UTK are unparalleled. If your topic area of interest relates to the fuel cycle (anywhere from the front end to the back end, less weaponization and not so heavy into weapons effects), then there is no better place to immerse yourself in the science of things than UTK. With a strong history on the reactor, fuels and health physics sides of the house, UTK is equally established in the fields of radiation detection, forensics, radiation transport, and nuclear security issues of interest to our community.

While fairly remote from DoD facilities and embedded support infrastructure, eastern Tennessee certainly offers a lot by way of education, health care, and recreation when it comes to family life. Aside from the cranial flogging, Knoxville is a great place to be stationed.

BIOGRAPHY

LTC Sam Willmon is a doctoral candidate at the University of Tennessee, Knoxville in the nuclear engineering program. He has a B.S. in Physics from the United States Military Academy and an M.S. in Nuclear Engineering from the Air Force Institute of Techmnology. His previous FA52 assignments have included duties as a plans officer, liaison officer, and intelligence officer. His email address is swillmon@utk.edu

Shielding

Shielding Theory Fundamentals
Dr. John M. Les
United States Army Nuclear and Combating Weapons of Mass Destruction Agency

Introduction

In order to prevent unwanted electromagnetic (EM) energy from coupling into sensitive electronic equipment, shielding is usually employed. The source of this energy may be intentional or unintentional in nature. An example of the former is the electromagnetic pulse (EMP) generated by the detonation of a nuclear weapon, or a high power microwave (HPM) generator used for offensive purposes. Unintentional sources include those related to the problems of electromagnetic interference and electromagnetic compatibility, or EMI/EMC for short, which deals with the EM interference or operability between electronic systems. The shield may come naturally as part of the system structure, such as the hull of a main battle tank, or the fuselage of an aircraft. The shield may also be designed or incorporated into a system to meet EMI/EMC requirements, such as the metallic case of a desktop computer. These basic concepts of shielding are illustrated in Figure 1.

Electromagnetic Sources

In shielding problems electromagnetic sources are broken into two general categories, near field and far field. For those familiar with electromagnetics this will not be surprising. Far field refers to sources far from the shield or observer, while near field refers to sources that are nearby. High altitude EMP (HEMP) illuminating a ground facility is one example of a far field problem and the low frequency testing of the shielding effectiveness of a facility using MIL-STD-188-125 is an example of a near field situation.

To help answer the question of what is far and near refer to Figure 2. This figure shows the magnitude of the wave impedance, which is simply the ratio of electric and magnetic fields, for an electric (Zwe) and magnetic (Zwm) field source. An electric source can be thought of as a small electric dipole antenna, while for a magnetic source it is a small loop antenna. In either case, the electromagnetic fields in the near field are complex, while in the far field, the electric and magnetic field makeup is much simpler since the fields are perpendicular to one another and lie within a plane, defining what is called a plane wave.

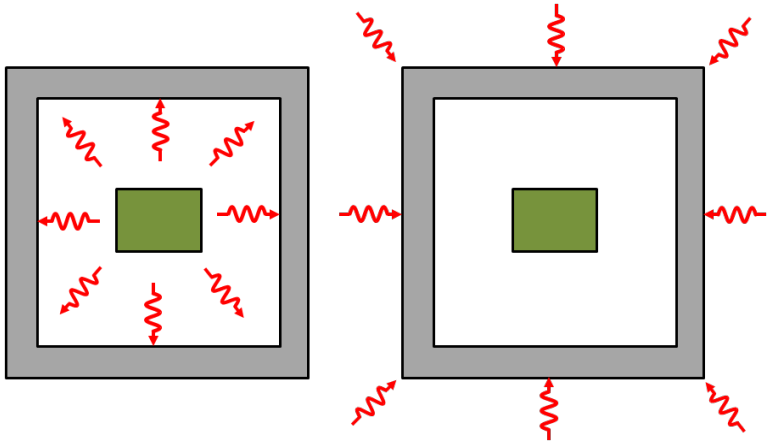

Figure 1(a) Shielding (Gray) used to Suppress Radiated EM Emissions from Electronics (Green), and (b) Reducing the Amount of EM Energy (Red) Coupling into an Electrical System.

One can see from Figure 3 that the transition to a plane wave from the near field begins approximately at the normalized distance of 1, or $r = \lambda_0/2\pi$, where the fields become equal in the asymptotic sense. The distance r therefore depends on the wavelength of the EM wave. For a wave of frequency of 1 MHz (cycles/sec), the wavelength is 300 meters, and for 300 MHz the wavelength is 1 meter.

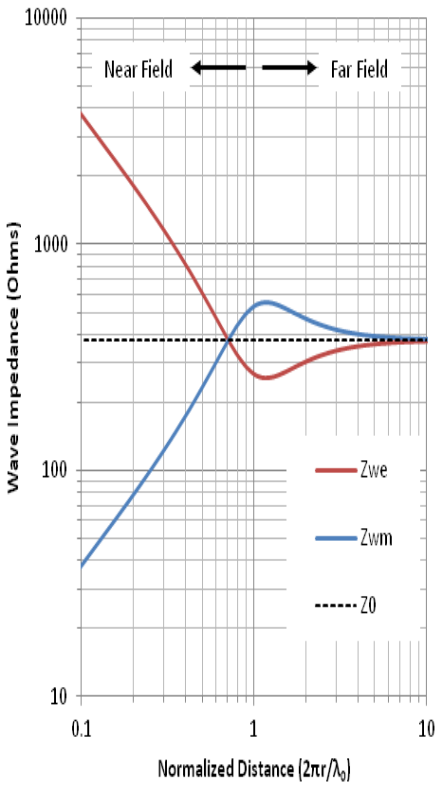

Figure 2 Magnitude of the Wave Impedance for Electric and Magnetic Sources versus Normalized Distance, Where r is the Actual Distance from the Source, and λ_0 is the Wavelength of the Wave in Free Space. Both Source Impedances Approach that of Free Space, Z0 = 377 Ohms (Dotted Line).

An electric field source can be characterized as high voltage and low current while a magnetic source can be described in the opposite sense as high current and low voltage. From Figure 2 one can see from the near field dependence, that an electric source is commonly known as a high impedance source and for the magnetic case, a low impedance source.

Shielding Effectiveness

In order to try and quantify a given material's ability to shield against unwanted electromagnetic energy the concept of shielding effectiveness was developed. Shielding effectiveness can be used to compare different materials in terms of their shielding capabilities. A simplified view of the shielding mechanism for a normally incident plane EM wave, denoted by Ei and Hi, on a slab of material of thickness t, is shown in Figure 3.

Note that Figure 3 assumes that the source of electromagnetic energy is far from the shield, a plane wave source, which is a good assumption for most types of EMP or offensive use of HPM problems. The infinite slab problem depicted in Figure 3 is a simplification of an actual shielding problem one may encounter due to geometrical considerations.

The model of shielding, as depicted in Figure 3, consists of three elements. The first is the reflection of the EM wave from the front and back surface of the shield, the second is multiple reflections inside the shield (region 2), and the third is the absorption of the wave. The absorption is represented by the smaller electromagnetic fields, $\mathbf{E}^s$ and $\mathbf{H}^s$, within the slab, and the transmitted wave is denoted by $\mathbf{E}^t$ and $\mathbf{H}^t$. The vector quantities, $\mathbf{E}$ and $\mathbf{H}$, are the electric and magnetic fields of the plane EM wave respectively.

From Figure 3 and the discussions above it would be reasonable to describe a material's ability to shield against EM energy as the ratio of the transmitted to incident fields. Given this, it is not surprising that the shielding effectiveness, SE, in decibels (dB), is defined as:

$$SE = -20\log_{10}|E^t/E^i| \text{ dB}$$

where the logarithmic argument is the ratio of the magnitudes of the electromagnetic field. With this definition a good EM shield, where the transmitted field is much smaller than the incident field, the SE will have a large positive value in decibels.

Because metals are commonly used as an EM shield due to their good conductive properties the discussion from here on will be restricted to metallic shields only. With the definition of shielding effectiveness and the model prescribed in Figure 3, the shielding effectiveness, in dB, for a metallic shield can be shown to be given by the simple form:

$$SE = R + A + M$$

where R, A, and M are all in decibels. R is the reflection loss from the front and backside of the shield, A is the absorption loss due to the shield, and M is the effect of multiple reflections within the shield. For an electrically thick metallic conductor, where the absorption loss is large (> 15 dB), or the physical thickness t is larger than the skin depth, δ, t/δ >> 1, the multiple reflection factor M can be ignored and we are left with:

$$SE = R + A$$

where,

$$R = 168 + 10\log_{10}(C/f) \text{ dB}$$

$$A = 8.6859(t/\delta) = 3.34t\sqrt{(Kf)} \text{ dB}$$

and C and K are constants for a given metal. Specifically C is the ratio of the relative conductivity, with respect to copper, to the relative (magnetic) permeability, with respect to free space, of the metallic shield; and the constant K is the product of the relative conductivity and permeability. In the expression for the absorption, A, t is the thickness of the shield (see Figure 3) in inches, and the skin depth δ also in inches is a measure of the depth of penetration of an EM wave in a metal. The variable f is the frequency of the incident EM wave in Hertz (Hz).

From the expressions for R and A, for an electrically thick metallic conductor, one can see that the shielding effectiveness due to reflection decreases as frequency increases, but absorption increases with frequency. This effect is quite apparent as shown in Figure 4, which shows the absorption, reflection, and their sum, the shielding effectiveness, for Copper ($C = K = 1$).

For electric and magnetic sources as described in the previous section, the expression for the reflection factor R is

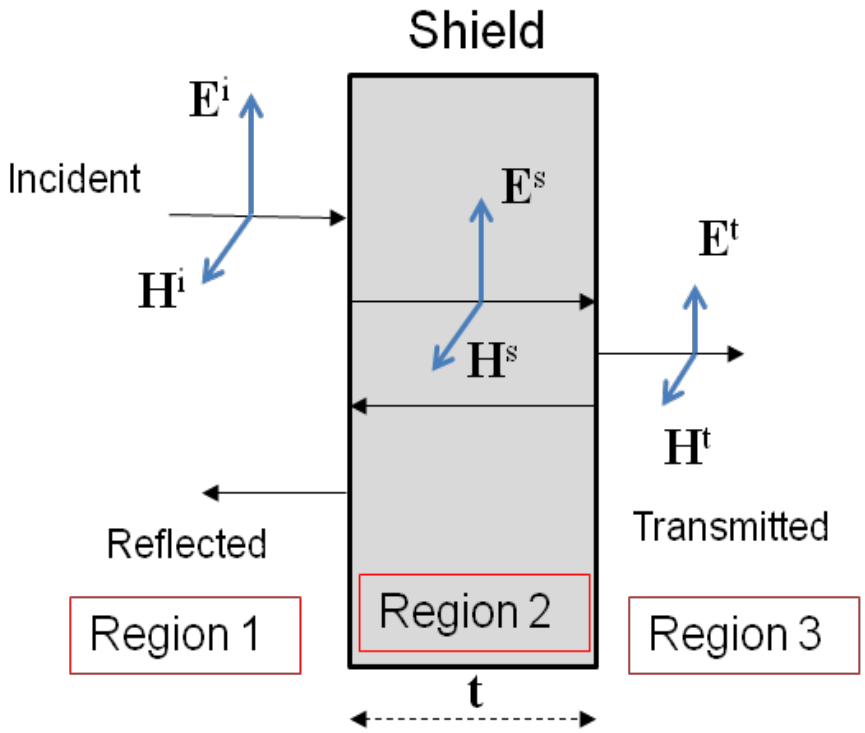

Figure 3 Region 1 - An EM Wave Incident on a Plane Slab of Material. Region 2 - EM Wave Inside the Shield, Including Transmitted and Multiple Reflected Waves. Region 3 - Transmitted Wave. The Material in Region 1 and 3 are Assumed to be the Same, Either Air or a Vacuum.

much more complicated than for the far field source, and is dependent on the distance between the source and shield. For further details the reader should consult the references at the end of this article.

Conclusions and Comments

Shielding effectiveness for a simple sheet of metal, with a normally incident plane EM wave, can be separated into three different components, reflection from the surface of the shield (front and back), absorption, and a contribution from multiple reflections within the shield. For shields that are electrically thick, in terms of absorption, or physical thickness with respect to skin depth, the multiple reflection coefficient M can be ignored. For higher frequencies absorption becomes the dominant factor in the shielding effectiveness of a metal, while reflection is more important at lower frequencies.

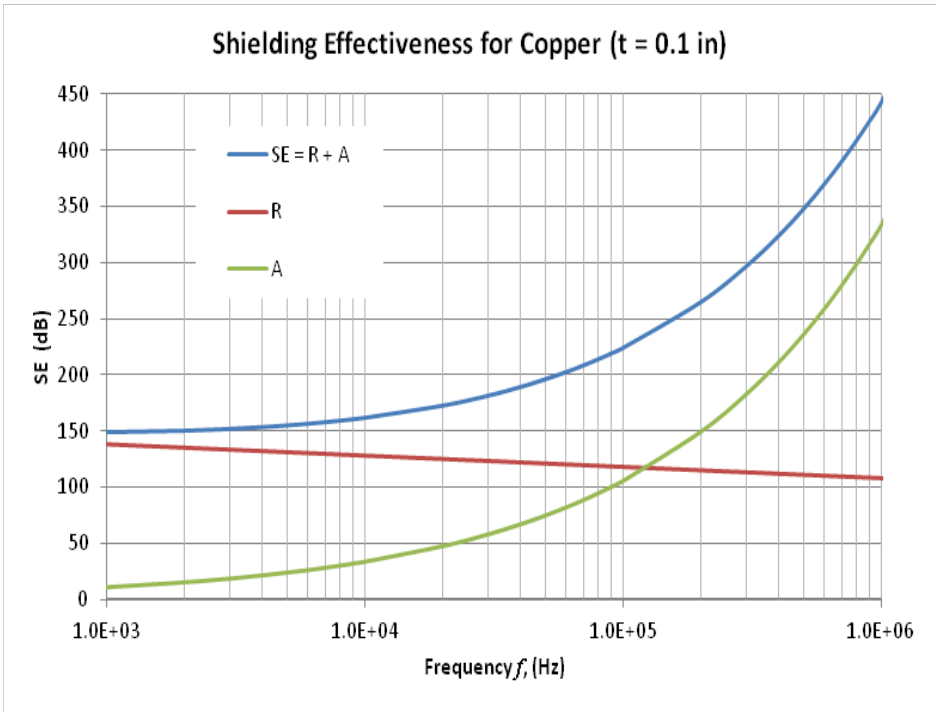

Figure 4 Shielding Effectiveness (SE) for a Thick Slab of Copper, Thickness, 0.1 Inches, as a Function of Frequency f. Note that Absorption begins to Dominate above 100 kHz (10^5 Hz).

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BIOGRAPHY

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New Standing Headquarters Focuses on WMD Elimination

Donna Miles
American Forces Press Service

WASHINGTON, June 19, 2013 – It's a nightmare scenario: an adversary has assembled a stockpile of weapons of mass destruction with plans to inflict devastation on the United States, its allies and friends, and the world.

A standing headquarters element established in February 2012 and expected to reach full operational capability within the coming year is part of a coordinated U.S. military effort to identify, counter and secure -- and, when necessary, to eliminate -- WMD threats.

The Standing Joint Force Headquarters for Elimination was stood up to provide geographic combatant commanders the planning, intelligence and operational capability required in the event that they need to eliminate a foreign nation's WMDs and WMD programs, Army Maj. Gen. Lucas N. Polakowski, the organization's commander, told American Forces Press Service.

The headquarters works in support of the president's National Security Strategy to Combat Weapons of Mass Destruction in the hands of hostile states and terrorists, he explained. Air Force Gen. C. Robert Kehler, commander of U.S. Strategic Command, calls this the No. 1 threat to U.S. national security.

Kehler established the headquarters to provide expert planning, intelligence and operational capability for combating and eliminating WMDs. The goal, he said when announcing the stand-up, is to provide a full-time, trained joint command-and-control element able to integrate into forward headquarters to help manage the elimination mission.

Leveraging the capabilities of the Defense Threat Reduction Agency and Stratcom's Center for Combatting Weapons of Mass Destruction, for which Polakowski serves as deputy director, the SJFHQ-E would deploy to augment a combatant commander's staff in conducting the mission, Polakowski said.

"It is such a specialized area, so [the combatant commands] don't have the complete depth of [chemical, biological and radiological] and counter-WMD expertise that we have resident in these three organizations," he said. "These three entities, under the headquarters mantle, would provide that resource and expertise to the combatant commands and any command underneath them."

Experts assigned to the SJFHQ-E would provide capabilities needed to command and control operations that involve going into a foreign nation to locate, characterize, secure, and disable or dispose of hostile WMDs and WMD programs so they no longer pose a threat, Polakowski said.

Typically, such missions would be conducted in close coordination with allies and partners, he said.

Having a permanent headquarters trained and ready to act, if needed, improves the Defense Department's ability to plan, train for and execute highly complex WMD elimination operations, Polakowski said.

"This is another tool in our toolkit, so that if the requirement arises, we as a nation are ready," he said. "We want to have a deliberative and in-place capability that we have trained upon and are ready to execute if our nation calls on us to do it."

To prepare for such a mission, the SJFHQ-E works closely with the combatant commands, conducting crisis planning and testing response procedures during major exercises.

"We train and prepare in peace in order to be ready when and if the nation needs to call upon this capability," Polakowski said.

The SJFHQ-E reached initial operating capability in September 2012, after reaching major milestones during the Ulchi Freedom Guardian 2012 exercise in South Korea.

Polakowski, who assumed command in March, said he hopes to increase the level of support the SJFHQ-E provides to the combatant commands as he continues to build his staff. By design, SJFHQ-E will be a relatively small element that he said probably will top out at fewer than 100 members.

But capabilities -- rather than numbers -- are Polakowski's priority. He hopes to achieve full operational capability within the next year, which means the SJFHQ-E will have the breadth of capabilities it needs to take on more -- and more demanding -- missions.

The best use of the SJFHQ-E's capabilities, he said, will be if they are never needed to respond to a real-world crisis.

Ensuring a robust ability to conduct the WMD elimination mission, the standing joint force headquarters and its partner organizations send an important message to potential adversaries who have WMD programs or are working to develop them, he said.

"It puts them on notice," he said, letting them know that "we, as a standing joint force headquarters, are prepared in case of the need to go in, locate, secure and help with the elimination of a potential foreign adversary's program."

"This should serve as a deterrent to those trying to establish their own WMD programs," he said. "And if they already have one, it should dissuade them from continuing to maintain it."

The Four Foodborne Pathogens

LTC Jeffrey S. Nelson
Defense Threat Reduction Agency

Foodborne Diseases

"Food carries with it the risk of foodborne illness"[1]. Consuming biologically contaminated food or drinks can cause a foodborne disease. Once in the digestive tract, a microscopic organism capable of causing disease can reproduce, produce toxins, and invade other regions of the body. This "incubation" period, lasting from hours to days, may be followed by nausea, diarrhea, and abdominal cramping, depending upon the organism producing the disease[2].

In January 2011, the Centers for Disease Control and Prevention (CDC) released estimates on the effects of foodborne diseases. The CDC estimates that, each year, about 47.8 million people, which is about one in six US citizens, becomes sick from foodborne diseases. Of those, nearly 128,000 people become hospitalized with over 3,000 deaths. Of the 47.8 million annual illnesses, 31 known foodborne pathogens cause over 9 million illnesses. The remaining 38 million illnesses, or 80 percent of the total illnesses, result from agents that cannot be determined because there is not enough data to specify an agent or that the agent has not been discovered or recognized as a foodborne pathogen[3]. See Table 1

Usually, foodborne infections are identified after several infected people seek medical care. There are laboratory tests that identify the organism responsible for the illness. Culturing stool samples identify bacteria, while viruses are usually identified by testing stool samples for genetic markers that indicate which virus is present. Many foodborne illnesses remain undiagnosed because the sick person does not seek medical attention or no test is conducted. The CDC estimated that, for every case of salmonellosis that is diagnosed and reported, 38 cases actually occur[4].

Survivability

Microorganisms require nutrients and usually can only survive in a narrow range of environmental conditions. Some survive only within their human hosts. Some need oxygen while some cannot survive in oxygen. Many are destroyed in sunlight and other environmental stressors. Most can only survive in a limited range of temperature, pressure, and pH. Despite all this, some infectious organisms have found a way to make it onto our dinner tables and cause infections.

Many serotypes of Salmonella can survive in a wide range of environments. These include differences in nutrients, pH, temperature, and oxygen, as well as the environmental stressors of osmotic shock and DNA damage[5]. Salmonella has been shown to not only survive, but to grow, on the surfaces of cut melons, watermelons, and papayas at temperatures as low as 10°C.[5 6] E. coli has been shown to be able to survive on cubes of cantaloupes and watermelon

Cause	Illnesses	%	Hospitalizations	%	Deaths	%
Major known pathogens	9,388,075	20	55,961	44	1,351	44
Unspecified agents	38,392,704	80	71,878	56	1,686	56
Cause	47,780,779	100	127,839	100	3,037	100

Table 1 Estimated Annual Number of Episodes of Domestically Acquired, Foodborne Illness, Hospitalizations, and Deaths Caused by 31 Pathogens and Unspecified Agents Transmitted Through Food in the US.[3]

down to 5°C when stored for 34 hours and on their rinds under humid conditions for 14-22 days[7]. A similar study demonstrated that E. coli was able to grow on the surface of strawberries after 24 hours at 23°C and survive at 5°C and -20°C for three days[8]. Listeria monocytogenes has been shown to survive on chicken breasts that were cooked at one of five different temperatures (150°F, 160°F, 165°F, 170°F, and 180°F) and sealed in plastic for four weeks at 4°C and 10°C.[9] Even after pasteurizing milk at 71.7°C for 15 seconds, the standard for pasteurization, Listeria monocytogenes has been shown to survive[10]. Ground beef not cooked to the proper temperature remained contaminated with Listeria monocytogenes after refrigeration at 4°C and freezing at -20°C.[11] C. botulinum spores have been shown to be able to survive in an acidic environment (4.2 pH) for 180 days[12].

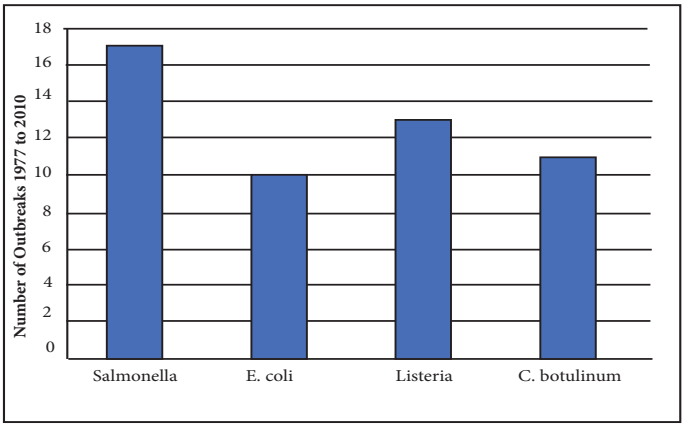

Figure 1 Number of Outbreaks for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

	Salmonella	*E. coli*	*Listeria*	*C. botulinum*	TOTAL
Outbreaks	17	10	13	11	51
Deaths	7	5	105	2	119
Infections	245,257	1,269	472	191	247,189

Table 2 The Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

Availability

Many of the foodborne pathogens are easily obtained naturally, as evidenced by the extent that people in the food production process take to avoid the pathogens (and some still make it through). Salmonella can be found in eggs, meat, poultry, milk, and produce. In fact, a 2005 investigation revealed in a sampling of US food that 5.7% of all meat and 33% of poultry tested positive for Salmonella[13]. E. coli can be found in beef, produce, milk, and contaminated water. Listeria monocytogenes is found in milk, cheese, vegetables, and ready-to-eat meats (hot dogs, etc.). C. botulinum can be found in home-canned vegetables and fruits that have been improperly heated or preserved[13]. Humans can serve as reservoirs for infectious diseases. Mary Mallon, known as the famous "Typhoid Mary," was an Irish emigrant who worked as a cook in the New York City area 1900-1907 and then again 1910-1915. Unknown to her, she was a carrier of the typhoid bacteria despite being healthy herself. While serving as a cook, she spread the bacteria to at least 53 people with three dying of typhoid fever. The New York City Health Department quarantined her twice: 1907-1910 and 1915-1938. An autopsy at her death in 1938 revealed that Mary was still infectious with the live typhoid bacteria and that it was located in her gallbladder[14].

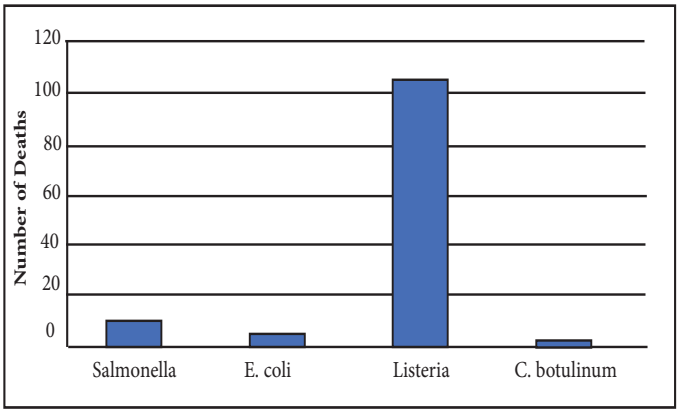

Figure 2 Number of Deaths for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

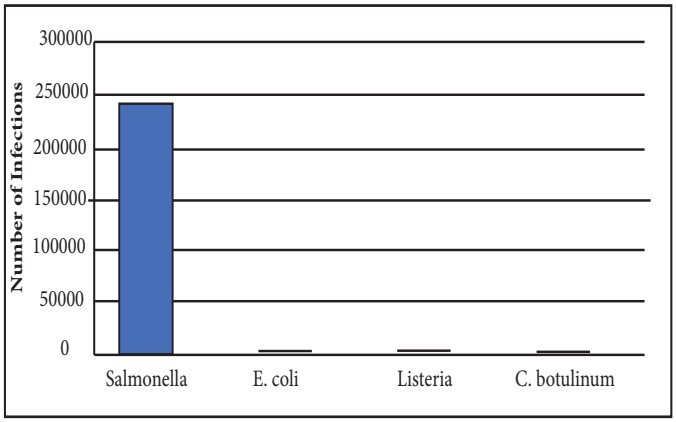

Figure 3 Number of Infections for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

Year	Food	Died	Infected	Pathogen
1994	Ice cream	0	224,000	*Salmonella*
1985	Milk	4	16,284	*Salmonella*
2010	Eggs	2	1,519	*Salmonella*
2008	Salsa	2	1,442	*E. coli*
1999	Water	2	781	*Salmonella*
2010	Ground beef	0	500	*Salmonella*
2006	Peanut butter	0	425	*Salmonella*
2007	Pot pies	0	272	*Salmonella*
2009	Alfalfa sprouts	0	235	*Salmonella*
2006	Tomatoes	0	183	*Salmonella*
2006	Spinach	1	183	*E. coli*
1985	Cheese	48	142	*Listeria*
2010	Bean sprouts	0	106	*Salmonella*
1998	Hot dogs	17	75	*Listeria*
2006	Lettuce	0	71	*E. coli*
2009	Cookie dough	0	65	*E. coli*
2007	Snack food	0	65	*Salmonella*
2010	Duck eggs	1	63	*Salmonella*
2007	Pet food	0	62	*Salmonella*
1977	Hot sauce	0	59	*C. botulinum*
2008	Cantaloupe	0	51	*Salmonella*

Table 3 Most Infections from Previous Foodborne Outbreaks.

Outbreaks

Contaminated food outbreaks occur naturally every year. The sources for information on these outbreaks came from the CDC, the World Health Organization (WHO), ProMED, and state health departments.

Salmonella, E. coli, Listeria, and C. botulinum were the four most frequent causes of foodborne outbreaks found from 1977 to 2010[15]. Note from Table 2 and Figure 1 that Salmonella caused the most outbreaks with 17, while E. coli caused the least number with 10.

Also observe from Figure 2 that, by a large margin, Listeria caused the most deaths, 105, with relatively fewer infections, 472, than Salmonella or E. coli, 245,257 and 1,269 respectively.

	Salmonella	*E. coli*	*Listeria*	*C. botulinum*
Outbreaks	17	10	13	11
Deaths	7	5	105	2
Average Number of Deaths per Outbreak	0.4	0.5	8.1	0.2
Infections	245,257	1,269	472	191
Average Number of Infections per Outbreak (without 1994 *Salmonella* outbreak)	1329	127	36	17
Median Infections per Outbreak	183	39	21	8

Table 4 Number of Outbreaks, Deaths, Deaths per Outbreak, Infections, and Infections per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

By far, Salmonella infected the largest number of people, 238,427, as shown by Figure 3. Salmonella is responsible for the four largest outbreak infections, nine of the ten largest outbreaks, and fourteen of the twenty-one largest outbreaks. See Table 3.

Analysis of Previous Biological Outbreaks

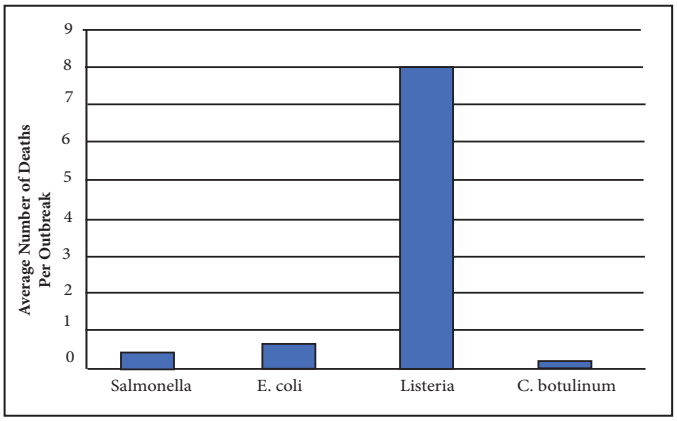

Figure 4 Average Number of Deaths per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

The four most frequent causes of foodborne outbreaks from 1977 to 2010 were Salmonella, E. coli, Listeria, and C. botulinum. As part of the analysis of Salmonella, the 1994 outbreak of ice cream contaminated with Salmonella enteritides, resulting in 224,000 infections, was sometimes ignored due to the large

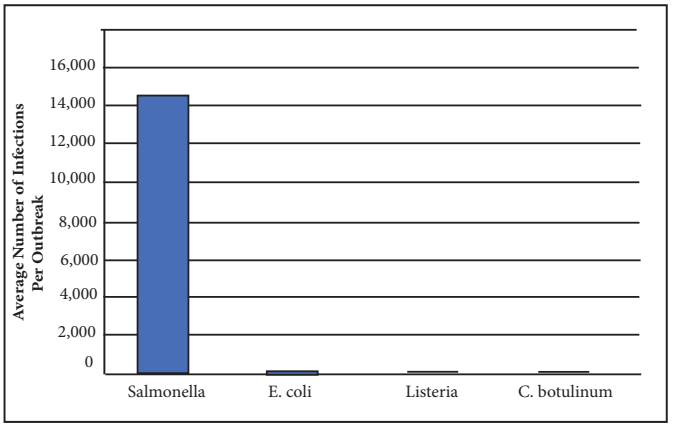

Figure 5 Average Number of Infections per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.Causes of Foodborne Outbreaks 1977-2010.

number of infections skewing the analytical results. Analysis of these four organisms in Table 4 reveals the following findings.

First, not only did Listeria cause the most deaths overall, it caused the largest average number of deaths for each outbreak, [8,1,] compared to less than one for the other three organisms. See Figure 4. Outbreaks of Salmonella, E. coli, and C. botulinum may or may not result in one death. However, when a Listeria outbreak occurs, expect people to die. While about one-third of the Listeria outbreaks result in no deaths, three other outbreaks have resulted in 16, 17, and 48 deaths.

Second, the average Salmonella outbreak infected significantly more than the other three organisms with a median of 183 infections and with four outbreaks infecting more than one thousand. See Figure 5.

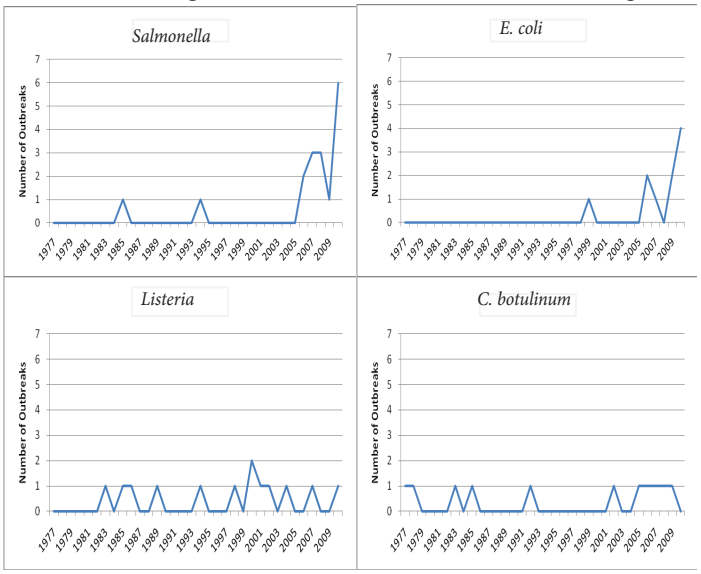

Figure 6 Number of Outbreaks per Year for Salmonella, E. coli, Listeria, and C. botulinum 1977-2010.

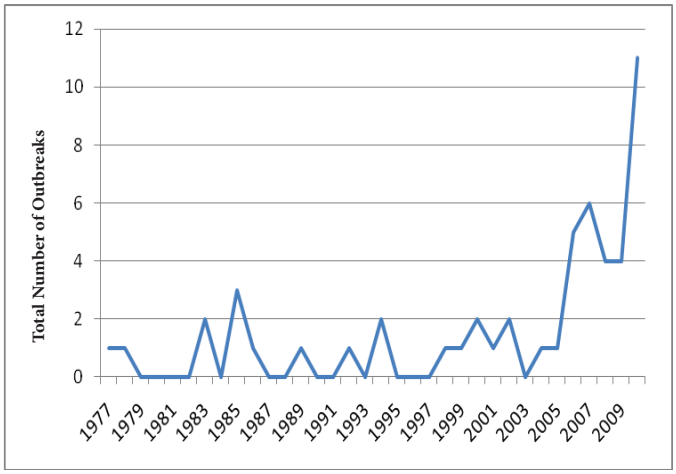

Figure 7 Total Number of Outbreaks per Year for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

Case Fatality Rates	*Salmonella* *	*E. coli*	*Listeria*	*C. botulinum*	TOTAL
Total	0.003%	0.394%	22.246%	1.047%	0.048%
1977-2006	0.025%	0.290%	21.225%	1.136%	0.044%
2007-2010	0.001%	0.855%	53.333%	0%	0.281%

Table 5 Case Fatality Rates for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

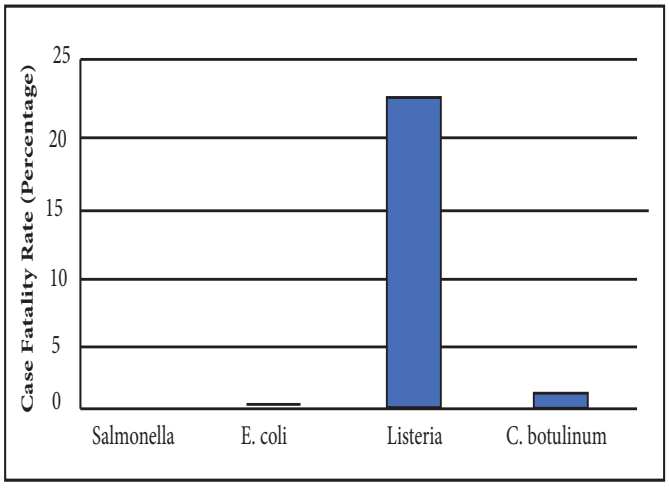

Figure 8 Case Fatality Rates for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

Figure 6 graphically displays the number of outbreaks per year for the four foodborne pathogens. While Listeria and C. botulinum appear relatively constant with an outbreak appearing occasionally, Salmonella and E. coli appear to have greatly increased since 2006. Figure 7 displays the total number of outbreaks by year. Notice that it also indicates that foodborne outbreaks increased since 2006. The large number of Salmonella outbreaks, with help from E. coli, causes this to occur.

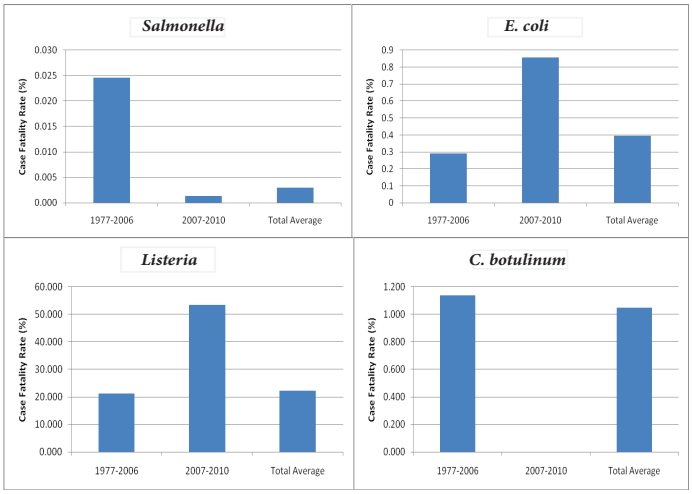

Figure 9 Case Fatality Rates per Year Group for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

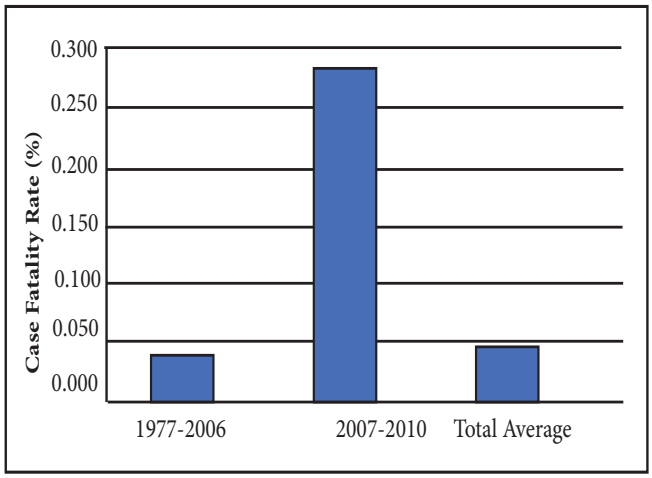

Figure 10 Overall Trend in Case Fatality Rates per Year Group for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010.

Case Fatality Rates

The case fatality rate is the number of deaths for each infection displayed as a percentage. The equation is as follows:

Case Fatality Rate = (Number of Deaths / Number of Infections) x 100%

See Table 5 for the case fatality rates for the four foodborne pathogens. Figure 8 displays the results from Table 5. It indicates that Salmonella very rarely causes a death. Listeria, alternatively, takes a life for every five infected people.

In an effort to determine if the outbreaks have become deadlier, the case fatality rates were divided into two groups. About half of the outbreaks occurred from 2007 to 2010, so this represents the more recent group. The earlier group are those outbreaks that occurred from 1977 to 2006. The later group was compared to the earlier group and the total average in Figure 9. E. coli and Listeria show an increase, suggesting that they are becoming deadlier, while Salmonella and C. botulinum show a decrease, suggesting that they are becoming less deadly.

All of the outbreaks taken together demonstrate an increasing trend and that outbreaks are becoming deadlier. See Figure 10.

Increased Number of Outbreaks

Figure 7 shows that there has been an increase in foodborne outbreaks. The WHO[16] observed that the incidence of salmonellosis, for example, has increased in the past 34 years on many continents. The following are reasons why the number of foodborne outbreaks is on the rise.

There has been an improvement in reporting. The surveillance system PulseNet, developed in 1995 following a large E. coli outbreak in 1993, significantly increased the ability of investigators to connect geographically-dispersed foodborne illnesses[17]. Around the world, the average time from the start of an outbreak to its discovery decreased from 30 days in 1996 to 14 days in 2009 while the start of the outbreak to the start of public warnings about the outbreak also decreased from 40 days to 19 days for the same time period[18].

There has been a recent recognition of foodborne pathogens. It was not until 1982 when E. coli O157:H7 was first recognized as a human pathogen[19]. Listeria monocytogenes has also only recently been recognized as a foodborne pathogen[16,20]. Tauxe[21] has stated that as we have been able to control or eliminate well-established pathogens, new pathogens have emerged and then dominated.

Foodborne pathogens have adapted. The changes experienced by species of microorganisms can result in new pathogens. These same changes can cause known pathogens to become more pathogenic or more survivable in the environment. One of these changes may be resistance to human intervention such as antibiotic resistance. See Salmonella's resistance to fluoroquinolones[22].

Change in consumer lifestyles. There has been an increase in the number of people who eat out. The USDA[23] estimated that Americans will increase spending at full-service restaurants (by 18 percent) and fast food chains (by 6 percent) between 2000 and 2020. This is based upon the changing demographics and lifestyles of Americans: increase in income, increase in the average age, and decrease in the proportion of "traditional" households which spend less money per person on food away from the home. Often, the speed of service provided by that teenager or college student at the fast food chain is no match for the safe food preparation provided by the mature mother or father preparing the family meal at home.

Increase in population. The US population has increased to 308,745,538.[24] More people available means that there are more people to become infected, even if the rate of infection remains the same.

Globalization of the food supply. There was a time when the American consumer looked forward to the summertime for the wide variety of produce that was not available at other times of the year. Now, this produce is available year round from countries with longer and unlimited growing seasons and from countries south of the equator with a growing season months before and after ours. With the increased number of countries importing food into the US and the lower standards of food processing, there is an increased probability that food will arrive infected.

New pathogens have been introduced or reintroduced to the US. Before 1991, epidemic cholera had not been present in South America during the 1900s. First Peru, then six other countries in the Americas (including 14 cases in the US) suffered cholera outbreaks. These outbreaks were suspected to have been caused by Chinese shipping which reintroduced cholera[16,25].

The numbers are flawed. This article does not include all of the foodborne outbreaks since 1977. The assumption made is that the outbreaks included are substantially representative, both in number and in characteristics, so that accurate conclusions can be asserted, such as types of most frequent pathogens and outbreak frequency over time. Several reputable sources agree with the overall statement that the occurrence of foodborne outbreaks is increasing[16,26]. Even though the CDC reported[27] a 20% reduction in illnesses, its study only tracked five illnesses, one of which showed an increase, and reported relative rates of laboratory-confirmed infections, not number of outbreaks.

Conclusion

The Secretary of the USDA has often said words to the effect that America's food supply is the most abundant, the safest, and one of the cheapest in the world[28]. This is especially true for a food supply that feeds 308 million people. However, Americans are being attacked by the food that we eat. I recommend the consumer be better informed on food safety issues, including proper storage and preparation of food. Most of the same safe food handling procedures that keep a consumer safe from natural biological outbreaks should provide protection from a bioterrorism attack using the same pathogen. The real threat of a bioterrorist attack through deliberately-contaminated food, resulting in mass casualties or deaths, does not come from a biologically engineered microorganism, but from the pathogens that frequently cause foodborne outbreaks. Foodborne pathogens have proven themselves to be able to survive through the food production process and arrive on our dinner tables despite our best efforts.

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BIOGRAPHY

LTC Jeff Nelson is a Consequence Management Advisory Team member at the Defense Threat Reduction Agency in Kirtland AFB, New Mexico. He has a B.S. in Health Science from the University of Nevada, a MS in Administration from Central Michigan University, and a MS in Combating Weapons of Mass Destruction (Biological) from the Air Force Institute of Technology. He served as an Army Chemical Officer 1992-2004 and a Nuclear and Counterproliferation Officer 2004-present. His email address is jeffrey.nelson@dtra.mil.

Nuclear Policy Seminar

CW5 Stephen A. Gomes
United States Army Nuclear and Combating Weapons of Mass Destruction Agency

The genesis of the Nuclear Policy Seminar (NPS) came about after one of our officers from the Operations Division attended the Nuclear Policy Course (NPC) offered by the Defense Nuclear Weapons School (DNWS), at Kirtland AFB, NM and suggested that it was a very worthwhile course and that it would be nice to have something similar presented in the National Capitol Region (NCR).

Due to the challenges of a shrinking DOD budget, and constrained travel funds for training, this was significantly impacting our training opportunities. We thought that a course similar to the NPC facilitated locally would be of immense value to many Joint Service Action Officers and Nuclear and Counterproliferation Officers (Functional Area 52) in and around the NCR.

We designed the seminar as a way to bring the nuclear community together to discuss not just a brief history of nuclear policy, but an update on current policy, doctrine and way ahead. As this was not the official DNWS Nuclear Policy certificate producing course, no certificates were awarded.

USANCA hosted the Nuclear Policy Seminar (NPS) from 19-21 June 2013, at Fort Belvoir in the LTG Leslie R. Groves facility. The target audience for the NPS were personnel whose work is related to or require some level of knowledge and understanding regarding U.S. nuclear strategy, policy and doctrine, adaptive planning, nuclear force structure, nuclear stockpile management, New START Treaty, and the Nuclear Posture Review.

Our intent in offering this seminar was to provide an opportunity at no cost to personnel assigned to the NCR (and open to anyone who could travel) in the current constrained fiscal environment, to hear the latest and most current issues related to the Nuclear Enterprise.

Mr. Daniel Klippstein, Director, USANCA opened up the seminar by thanking both attendees and guest speakers in taking the time out of their busy schedules to support the first Nuclear Policy Seminar hosted by USANCA in the NCR. He also addressed the timing and importance of the seminar with a focus on the following topics:

- Current issues and challenges facing both fiscal and regional instabilities
- Enhancing the network associated with the nuclear policy community
- Sharing current national policy information with the nuclear policy community
- Evolution and development of current nuclear policy

BG Fortney briefs attendees on strategic nuclear topics.

- Regional influences on U.S. nuclear policy

The NPS focused on challenges we currently face and the timing of the seminar could not have come at a more opportune time. The opening day of the NPS was also the day the POTUS gave his address in Berlin:

> "...as President, I've strengthened our efforts to stop the spread of nuclear weapons, and reduced the number and role of America's nuclear weapons. Because of the New START Treaty, we're on track to cut American and Russian deployed nuclear warheads to their lowestclevelscsincecthec1950s.
>
> But we have more work to do. So today, I'm announcing additional steps forward. After a comprehensive review, I've determined that we can ensure the security of America and our allies, and maintain a strong and credible strategic deterrent, while reducing our deployed strategic nuclear weapons by up to one-third. And I intend to seek negotiated cuts with Russia to move beyond Cold War Nuclear postures.
>
> At the same time, we'll work with our NATO allies to seek bold reductions in U.S. and Russian tactical weapons in Europe. And we can forge a new international framework for peaceful nuclear power, and reject the nuclear weaponizationcthatcNorthcKoreacandcIrancmaycbeseeking." POTUS speech, Berlin, Germany 19 June 2013

"Today, the President announced new guidance that aligns U.S. nuclear policies to the 21st century security environment … the President has directed DoD to use the new guidance to begin the process of updating and aligning its directives and contingency plans in order for this policy to be implemented over the course of the next year."

White House Fact Sheet: Nuclear Weapons Employment Strategy of the United States, 19 June 2013

The speech by the POTUS allowed for a lively discussion that dovetailed into many of the briefs during this seminar, and having OSD speakers were essential to the success of the NPS.

The NPS started with a briefing conducted by Mr. Paul Bernstein on the Evolution of Nuclear Policy, and the guest speaker was Brig Gen Michael Fortney, Director, Operations and Nuclear Support Directorate, Defense Threat Reduction Agency (DTRA).

Brig Gen Fortney's briefing on Strategic Nuclear Discussions: The Continuing Role of Nuclear Weapons in Strategic Deterrence and Status of the Nuclear Weapons Enterprise set the tone for the NPS and his introduction slide harmonized the seminar and set up the other speakers allowing a seamless transition for the remainder of the seminar.

Brig Gen Fortney covered the truths about nuclear weapons as a scene setter, the role of the U.S. arsenal; force structure considerations pertaining to policy, treaty and budget; TRIAD, and concluded with the state of the enterprise regarding weapons systems and the Enterprise infrastructure.

A Nuclear Weapons Council (NWC) Orientation and Weapons Update was presented by Ms. Susan Norwood, NWC Chair. She gave an overview of the NWC followed by some in-depth discussion areas. She explained that the NWC

COL John Greaves Chief of Operations presents a certificate of appreciation to Mr. Bernstein.

serves as the focal point for interagency activities between the Department of Defense (DOD) and Department of Energy (DOE) as maintaining the U.S. nuclear weapons stockpile.

The NWC also provides policy guidance and oversight of the nuclear stockpile management process to ensure high confidence in the safety, security, reliability, and performance of U.S. nuclear weapons. There were several excellent discussions on policy and future issues, and the threats facing the community. The non-attribution forum allowed for a more open discussion of the many and varied topics presented during the seminar. Due to the classifications of the briefs, we cannot elaborate on further content for this article

Based on the many positive comments, it was recommended that we host another Nuclear Policy Seminar next year, and tentatively we can look to possibly early June 2014 for the next NPS. This way for those that are interested in signing up for the Joint CWMD Planners Course (JCPC) conducted by DTRA and hosted by USANCA can take advantage of the time here.

The following agencies were instrumental in their active support to the seminar by providing speakers that not only brought a wealth of knowledge, but also helped to frame and facilitate discussions: OSD, Joint Staff, DA Staff, DTRA, NSA, NNSA, 8th Army, DHS, U.S. Air Force, U.S. Army Reserve, U.S. NCCS and USANCA.

USANCA would also like to thank the following speakers for making this such a successful seminar:

Brig Gen Michael Fortney, DTRA
Col Thomas Cartledge OSD
LTC Craig Rivet 8th Army
MAJ Barton Jennings, USANCA
CW5 Bruce Brandes, USANCA
Mr. Paul Bernstein Faculty NDU
Mr. Clark Cully, OSD
Mr. Jeff Davis, NNSA
Mr. Steve Heil, DIA
Mr. James Henry,
Mr. Jeff Nolan JS
Ms. Susan Norwood, NWC
Mr. Robert Sampson, OSD
Mr. Phillip Smith, DTRA
Mr. Keith Sloan CWMD Counterproliferation Policy

USANCA stands ready to provide the necessary tools, techniques, procedures, and personnel to the Warfighter by providing resident expertise in offensive nuclear and adaptive planning to ensure an Army/Joint interface in nuclear operations.

BIOGRAPHY

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Joint Combating Weapons of Mass Destruction Planning Course

LTC Rene (Rey) Ramos-Rivera
Course Director
Defense Threat Reduction Agency/USSTRATCOM Center for Combating Weapons of Mass Destruction (DTRA/SCC WMD)

Ms. Rachael Buckley
Contractor Support
Defense Threat Reduction Agency/USSTRATCOM Center for Combating Weapons of Mass Destruction (DTRA/SCC WMD)

The United States Army Nuclear and CWMD Agency in conjunction with the Defense Threat Reduction Center (DTRA) /USSTRATCOM Center for Combating WMD (SCC-WMD) co-hosted the Joint Combating Weapons of Mass Destruction (CWMD) Planning Course (JCPC) from 24-27 June 2013. The JCPC introduced students to US Government (USG) and Department of Defense (DOD) policy, strategy, doctrine and planning related to CWMD. Instructors taught the importance of recognizing CWMD equities in an operational context and demonstrated ways to incorporate those equities into the Joint Operational Planning Process (JOPP). The first half of the course focused on the three pillars of CWMD (nonproliferation, counterproliferation, WMD consequence management) and the eight military mission areas of CWMD, as identified in the National Military Strategy to Combat WMD and current joint doctrine. During the second half of the course, students merged CWMD and JOPP concepts through a series of facilitator-led, small-group table top exercises.

The JCPC is conducted in the National Capital Region three times per year and is available to the Combatant Commands, pending funding availability. Since its inception in 2004, the various iterations of the JCPC have been conducted 45 times and have trained over 1,200 students on CWMD planning. These classes have included training sessions held on-site at USCENTCOM/USSOCOM, USEUCOM/USAFRICOM, USPACOM, USSTRATCOM, and USFK.

Student ask question during the Joint Combating Weapons of Mass Destruction Planning Course.

This particular iteration of the JCPC brought together 37 students from a variety of organizations and backgrounds. Organizations represented included: DTRA/SCC-WMD/ Standing Joint Force Headquarters for Elimination, USANCA, USSOUTHCOM, USSOCOM, 33rd CST (WMD), the National Defense University, Joint Staff J7, and the National Guard. In a collaborative learning environment, the contributions by students of such varied backgrounds and experience levels led to a great deal of discussion, enhancing the learning experience for all involved.

At the end of the course, five students with varying backgrounds where asked to provide feedback on the instruction they received from the JCPC. They were asked the following question:

Staff Sergeant William Peppard, NY Air National Guard

Having a better understanding of the Joint Planning Process (CWMD), how will you apply this knowledge in your current or future jobs? Which subject/section provided you a better knowledge base?

Staff Sergeant William Peppard, NY Air National Guard: "This course greatly enhanced my knowledge in the Joint Planning aspect of Department of Defense's CWMD Mission. [JCPC] also contributed to the understanding of WMD Consequence Management as it applies to the New York Air National Guard mission support to Civil Authorities during incidents and the planning of National Security Special Events, such as the Super bowl in 2014 in my region."

MAJ Alida Forbes, USAF, DTRA/SCC-WMD J53

MAJ Alida Forbes, USAF, DTRA/SCC-WMD J53
A: "After attending the Joint CWMD Planning Course, I

CDR Thomas Muldrow, USSOUTHCOM

have a better appreciation of how established and prioritized end states in the GEF are captured as objectives, effects, and tasks in plans. Additionally, I have a better understanding of the phase states and how CWMD activities are integrated and synchronized during planning and execution. As a result, I can provide more structured insight during my office's reviews of theater campaign plans, support plans and with drafting regional support annexes. I gained the most knowledge from the Joint Planning Overview & Planning Process and CWMD in Plans and Operations Section."

Dr. Donna Smith, DTRA/SCC-WMD J9NT (A&AS Support)

CDR Thomas Muldrow, USSOUTHCOM
A: "As the USSOUTHCOM J52 Deputy Division Chief, our Division is responsible for USSOUTHCOM intermediate objective focused on CWMD. This knowledge will be useful as we continue our rewrite our FY15-19 Theater Campaign Plan. The National and DoD guidance to Combat WMD as well as interagency and strategic modules were very useful."

Dr. Donna Smith, DTRA/SCC-WMD J9NT (A&AS Support)
A: "This course has been useful for me in two ways: First, the objective planning process is very similar to the process for developing mission related R&D strategies and guidance to effect efficient and cost effective investment so the concepts I learn this week are directly transferrable to strengthening DTRA R&D guidance. Secondly, to effectively develop the capability (via R&D) the user community needs but does not know it wants, it is important to understand how the community thinks and how it plans and this course provided a window into that."

The DTRA mission is to safeguard the U.S. and its allies from Weapons of Mass Destruction (Chemical, Biological, Radiological, and Nuclear) and High Yield Explosives by providing capabilities to reduce, eliminate, and counter the threat and mitigate its effects. The agency is the Department of Defense's Combat Support Agency for the CWMD mission and develops improved CWMD capabilities for the warfighter. The mission of the SCC-WMD is to synchronize the CWMD plans of the warfighters, and identify and advocate for needed CWMD capabilities. Together, these organizations provide CWMD expertise, support, and products at strategic (global and national), operational (theater and regional), and tactical (battlefield) levels to prevent the proliferation of WMD, deter and defeat WMD use, and reduce the effects of WMD that may be used against us.

For more information on the JCPC, future course dates, and registration, please visit the Defense Nuclear Weapons School Website: https://dnws.abq.dtra.mil

BIOGRAPHY

LTC Rene (Rey) Ramos-Rivera is a CBRN Officer assigned to the Defense Threat Reduction Agency. He has a BS in Chemistry from Inter-American University of Puerto Rico and a MA in Operational Security Management from Webster University. He was previously assigned as the Deputy CBRN Officer, United States Army Central Command. His email address is rene.ramos-rivera@dtra.mil.

Ms. Buckley is a Policy Analyst with SAIC, currently supporting DTRA/SCC-WMD J55. She has served as an instructor and exercise facilitator for the Joint CWMD Planning Couse for the last four years and also focuses on CWMD-related strategy, doctrine and internal plans for DTRA. Ms. Buckley has been a part of the CWMD community since 2006, supporting HQDA, HQ USAF, and DTRA/SCC-WMD. Prior to that, she worked tracked strategic management initiatives for OSD and spent several years focused on the PPBE process for HQ USAF. Her email address is rachael.buckley_contractor@dtra.mil.

Highlighted Courses available at the Defense Nuclear Weapons School (DNWS) and Defense Threat Reduction University (DTRU) Theater Nuclear Operations Course (TNOC)

TNOC is the only course offered by a Department of Defense organization that provides training for planners, support staff, targeteers, and staff nuclear planners for joint operations and targeting. The course provides overview of nuclear weapon design, capabilities and effects to include U.S. nuclear policy, and joint nuclear doctrine. TNOC meets U.S. Army qualification requirements for the additional skill identifier 5H. The course number is DNWS-R013 (TNOC). Call DNWS at (505) 846-5666 or DSN 246-5666 for quotas and registration information.

Next class availability:
May 12, 2014 - May 16, 2014
August 04, 2014 - August 08, 2014

Joint CWMD Planning Course (JCPC)

JCPC introduces students to US Government (USG) and Department of Defense (DOD) policy, strategy, doctrine and planning related to CWMD; teaches students to recognize CWMD equities in an operational context; and demonstrates how to incorporate them into the Joint Operational Planning Process (JOPP). This course will be hosted at USANCA on the following dates:

March 17, 2014 - March 21, 2014
June 16, 2014 - June 20, 2014
October 27, 2014 - October 31, 2014

For the latest course information, log onto https://dnws.abq.dtra.mil https://dnws.abq.dtra.mil or call the Registrar at 505 846-5666 DSN 246-5666.

Nuclear and Counterproliferation Officer Course (NCP52)

NCP52 is the Functional Area 52 qualifying course. Initial priority is given to officers TDY en route to a FA52 assignment or currently serving in a FA52 position. There is limited availability outside of the FA52 community. Please call the FA52 Proponent Manager at (703) 806-7866 to inquire on available seats.

Next class availability:
Jul - Aug 2014

U.S. Nuclear Policy

This course covers U.S. Nuclear Policy and its history; reviews NATO policy; discusses nuclear deterrence: theory, principles, and implications; discusses instruments of national power and implications for nuclear weapons; reviews nuclear surety and intelligence; discusses nuclear treaties and arms control.

This course is taught at the Defense Nuclear Weapons School (DNWS) Albuquerque, New Mexico.

Email: dnws@abq.dtra.mil
Fax: (505) 846-9168 or DSN 246-9168
Online registration:
https://dnws.abq.dtra.mil/StudentArea/Login.asp

CWMD Journal Distribution

To be added to the electronic distrubution list please contact Executive Secretary Ms.Cassonya Gates at Email: cassonya.l.gates.civ@mail.mil.

A current electronic version of the Journal can be located at USANCA's AKO Portal. Electronic versions of archived Combating CWMD Journals/NBC Reports can be located on the Homeland Defense & Security Information Analysis Center website: http://www.hdiac.org/

SERPENT TRAINING NOW AVAILABLE:

What is SERPENT?

SERPENT (Simulation Environment & Response Program Execution Nesting Tool) is an end-to-end tool that simulates offensive operations or counterforce attacks on chemical/biological (CB) targets and quantifies target lethality, hazardous material dispersion to the atmosphere, and collateral effects on civilian and military populations. Advanced users can tailor the tool to address additional analysis needs.

Functionality:

Provides a high fidelity methodology for estimating the source term characteristics for CB targets.

Provides the tools for determining "kill criteria" and damage assessment while minimizing collateral hazards.

Provides the ability to "bound the problem" and make comparative analyses for targeteering and weapon selection when intelligence information is limited or lacking.

Operational Applications:

Targeting & strike planning (deliberate/crisis).

Weapon design optimization, conceptual weapon and new technology analysis, rapid response development capabilities. Test support & evaluation.

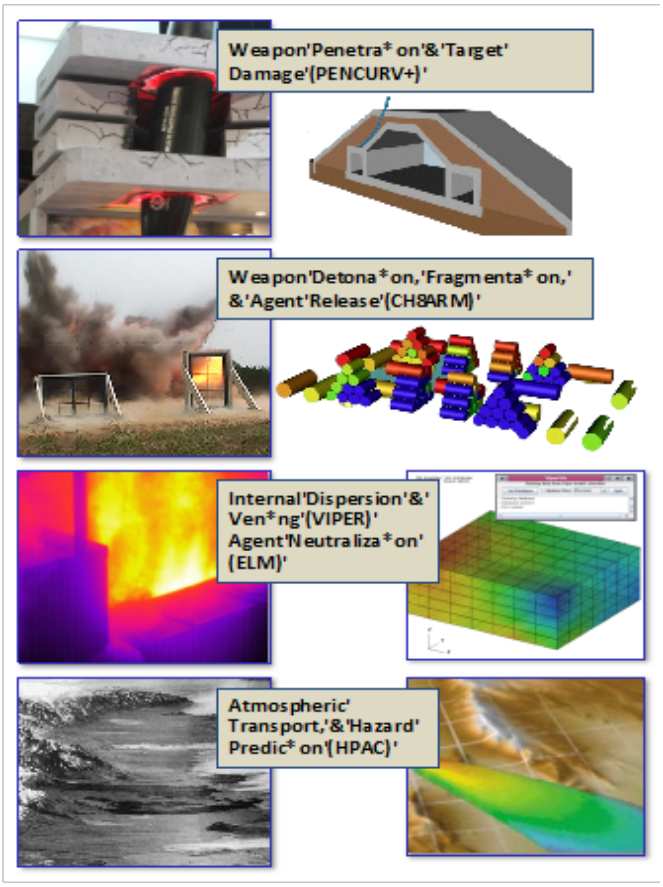
Analysis Classes and Products:

Lethality: Single shot probability of kill (SSPk), number of weapons to defeat target, and targeting recommendations

Collateral Hazard: weapon/target interaction, cumulative damage (from multiple weapon strikes), and hazard footprint

Sensitivity and Bounding Analyses: attack parameters (impact conditions, delivery conditions), storage configurations (intelligence unknown), time of attack (morning, night, season)

Phenomenology



Who Should Attend?

Attendance at a training session either at a specified on-site location or the Exelis Colorado Springs office will include an overview of the technical basis and application of SERPENT as well as hands-on tutorials with the software. In addition, the session is intended to provide a forum for identifying unsatisfied or emerging requirements and opportunities for collaboration that could be exploited by improving, customizing, exposing or integrating capabilities within the SERPENT toolkit. Training laptops will be provided.

Please email Rodger Greer, Workshop Coordinator, (rodger.greer@exelisinc.com or ph: 719-599-1600) if you are interested in SERPENT training.

SERPENT is developed for and funded by the **Air Force Nuclear Weapons Center** (AFNWC - formerly AFNWCA) at Kirtland Air Force Base, New Mexico.

U.S. Army Nuclear and Combating Weapons of Mass Destruction Agency (USANCA)

MONA-CWZ
CWMD Command Group

Director**	**x7868**
Deputy Director *	**x7852**
Executive Officer	x7857
Agency Secretary	x7846
Office Manager	x7851
Budget Analyst	x7853

MONA-CWO
Operations Division

Chief *	**x7855**
Deputy Plans and Operations *	805-4986
Nuclear Operations Branch	
Chief	x7859
Nuclear Operations	x7847
Nuclear Operations	x7139
Targeting Officer	x7858
CWMD Plans Branch	
Chief	x7856
CWMD Plans	x7782
CWMD Plans	805-2017

MONA-CWC
Capabilities Division

Chief *	**x7883**
Deputy Capabilities Div	x7871
International Programs	x7874
CBRN Survivability	x7870
CBRN Survivability	x7873

MONA CWA
Analysis Division

Chief *	**x7860**
FA52 Proponent Manager	x7866
Army Reactor Office	x7861
Biology Branch	
Chief	x7878
Microbiologist	x7879
Chemical Branch	
Chief	x7877
Chemical Engineer	x7881
Nuclear Branch	
Chief	x7864
Nuclear Effects (EMP/HEMP)	x7865
Nuclear Medical Science	x7863
Nuclear Effects (Modeling)	x7867
Nuclear Effects (Modeling)	805-9508
Nuclear Effects	x7876
Nuclear Effects	x7880
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IM Chief	x7848
IT/IM/Portal Manager	x7801
VTC Facilitator/Manager	x7801
On-Site IT Specialist	x7875

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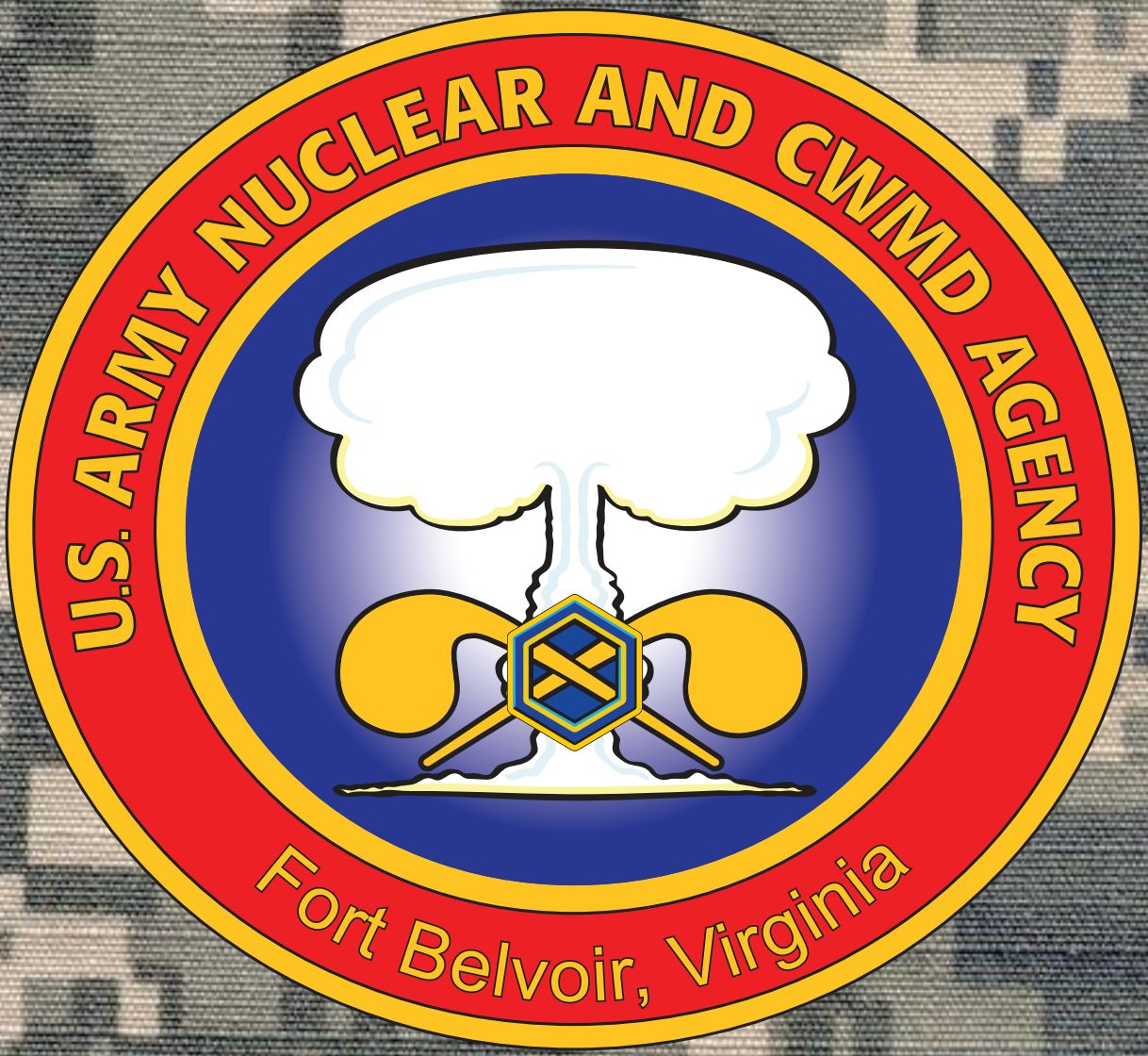
Exec Admin Asst: (G-3/5 ARSTAF)
(703) 692-6855 DSN 222-6855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