NBC REPORT

U.S. Army Nuclear and Chemical Agency

Spring / Summer 2004

DTRA's Role in the CB Defense Program

FA52 and the Airborne Command Post

Guidance for Federal Protective Actions and Recovery After Radiological and Nuclear Incidents

Emerging Decontaminants and Replacement of DS2

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Provide nuclear and chemical technical expertise in support of all Army elements, and to other U.S. Government and NATO agencies as requested.

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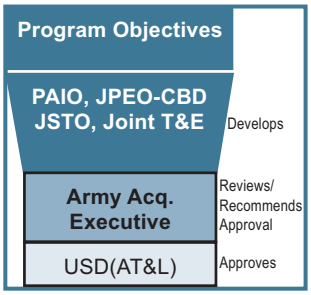

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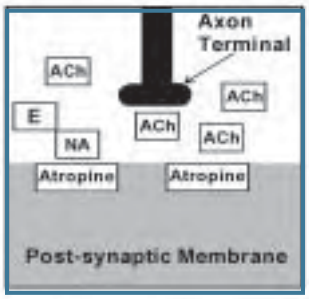

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NATO/ABCA Meetings: Lessons Learned

Dr. Charles N. Davidson
DIRECTOR
U.S. Army Nuclear and Chemical Agency

Recently, seven new national flags were raised in front of NATO Headquarters in Brussels, completing the ceremony by which membership in the NATO Alliance expanded to 26 nations. The United States was a strong advocate of this expansion, reaffirming our commitment to carrying out military operations on a coalition or multinational basis. One ramification of this is increased emphasis on the need to achieve interoperability through standardization.

As many of you know, USANCA is responsible for managing DoD involvement in the two principal NATO forums that standardize non-medical NBC doctrine, concepts, TTP, and materiel requirements. And I'm sure you're aware that "managing DoD involvement" means more than just climbing on a plane to Brussels several times a year to sit around a table at NATO Headquarters. But, how much more?

I attended my first NATO meeting as a young Lieutenant in 1963 (right, **sixty**-three) when the Alliance headquarters was in Paris. My most recent one was just a few months ago when I headed a tri-Service US delegation to a senior-level meeting in Brussels on Joint NBC Defense. In between were literally dozens of NATO meetings at which I was US Head of Delegation, and 8-10 more international meetings at which I chaired the American-British-Canadian-Australian (ABCA) Quadripartite Working Group on NBC Defense.

In short, I've "been there, done that" as far as managing DoD involvement in such meetings. Unfortunately, I've also "made that mistake." I thought it might be useful to summarize the top 10 lessons I've learned over the last 40-plus years in preparing for NATO and ABCA meetings, so that those of you who may one day do the same won't make the same mistakes I did.

Know the timeline. Plan backward to set critical milestones for taskers, drafts, position papers, position meeting, approvals and the like. No real secret here, but the increased formality of an international meeting puts a premium on going through all the preliminary wickets. And going through wickets always requires a timeline.

Conduct a position meeting. Require attendance at the meeting by each of your delegates. Invite and welcome all other stakeholders, too. This is the best opportunity for anyone that's knowledgeable, interested, and in a position of responsibility to influence the US position. (In fact, it has been argued that attending the position meeting is more important than attending the international meeting itself.) The delegation leader should assign delegates the job of drafting position papers for each agenda item in advance of the position meeting. At the position meeting, attendees discuss and agree on each draft position, bringing their personal knowledge to bear. US reps to other relevant NATO bodies should attend to ensure consistency of positions. Don't skip this step for any meeting that has a published agenda.

Dry run all presentations. Rehearse NATO pitches in particular for speed of delivery and to ensure all slide points are highlighted by the briefer. A good place to do this is at the position meeting. Remember that everything you say at a senior-level NATO meeting will be simultaneously interpreted into French. Speaking more slowly is a requirement to allow interpreters to keep up. And forget all you've learned about not reading the slides. You must at least highlight each slide bullet because what you don't say won't get interpreted. Pointing to a slide and saying something akin to "You can read my conclusions yourself" is insulting to all French speakers around the table. Don't do it.

Secure buy-in from all stakeholders. Get formal concurrences from all affected Army offices, and from appropriate offices in other Services, OSD and Defense agencies. Representatives at the position meeting can sign the coordination sheet there; you will have to obtain chops on the agreed position papers

from other offices by a subsequent short staffing process. This is another reason to push for maximum attendance by stakeholders at the position meeting itself. You will want to take a copy of the coordination sheet with you to the international meeting to assure your US hosts that you've done your homework.

Cross-coordinate between NATO and ABCA reps. One of the advantages of a single agency like USANCA being involved in both NATO and ABCA NBC activities is our innate ability to do this cross-coordination. Despite this, we have still missed the boat a couple of times and failed to complete this step. The result can be two different (or even opposing) positions on the same agenda subject being expounded at NATO and ABCA meetings. And I have found it to be an unfortunate fact of life that one of the other nations common to both programs will spot this during the first nanosecond and make you aware of it with varying degrees of diplomacy or lack thereof.

The flip side of this lesson is the occasional tendency to suggest that one forum not work on a problem because you are aware that the other forum already is and it's "about finished". I have seen "about finished" NATO STANAGs and ABCA QSTAGs remain that way for years. Although duplication of effort should be avoided, and a number of QSTAGs are simply one-page covering sheets of STANAGs, don't get trapped in the waiting game whereby you postpone addressing a topic in one forum only because it's being worked in the other. You may have a very long wait with delayed standardization being the result.

Obtain formal approval of position papers. Generally, this is provided by a General Officer or SESer. After position paper coordination is complete with the requisite chops received, take this final step to back up yourself and your delegates with the authority to speak for the United States. Insist on this approval in writing, even if it's in an e-mail.

Anticipate and drive meeting outcomes. This almost goes without saying for any meeting you participate in, but international meetings are more formal by nature and are more difficult to redirect once they get started down a particular path. So think through your desired outcome in advance. If appropriate, let the chairperson know your intentions prior to the meeting's start so he or she won't inadvertently lock in on a course of action contrary to achieving your outcome. Most chairpersons will be genuinely interested in accommodating your substantive views if they know them in advance.

Educate other players in advance. Advocate two fundamentally basic principles: 1) "plan at meetings; execute between meetings", and 2) "comment in detail on STANAGs and QSTAGs early on, not later on." I can personally attest to the frustrations that occur when these maxims are ignored. When all nations have agreed at a meeting to a particular course of action, carry out that course of action afterwards even if you personally have second thoughts. Pursuing or even suggesting a different course of action subsequently is tantamount to substituting one nation's (or worse, one individual's) judgment for that of the collective body of NATO or ABCA nations. This meets the classic definition of arrogance. If you wish to advocate a different course of action, raise it at the next meeting when all nations have an equal chance to discuss it across the table.

The time for detailed substantive and editorial comments is during early drafting of an international document. After the document has progressed through several study drafts and maybe even the first ratification draft, that time is past. (It follows that stakeholders must see early drafts as well as later ones.) When the final ratification draft is circulated, skip the detailed laundry list of comments for improvement. Your options at this stage should be "ratify," "ratify with (stated) reservation," or "do not ratify." Provide detailed comments for improvement to the custodian nation for integration later into the document's next revision.

Disseminate results immediately. This means get the word out to all stakeholders within one week. Every office that chops your position papers, as well as the approving authority, needs to know the outcome. And, since NATO NBC meetings of one form or another occur throughout the year, US reps preparing for these other meetings need your results in a timely manner. Sending them out a month or two later is not timely and can lead to the embarrassment of others.

Task out and/or start work on actions quickly. Waiting until three months prior to the due date or next meeting is a good recipe for disaster. And you only have to fail to produce an action at a NATO or ABCA meeting once or twice before you (the United States!) will be typecast by other nations as unreliable.

Taking advantage of all 10 of the above lessons learned won't guarantee successful participation in NATO or ABCA meetings, but it'll be a great start!

Implementation Plan for Management of DoD's Chemical Biological Defense Program (CBDP) –One Year Later

BG Patricia Nilo
Acting Deputy Assistant to the Secretary of Defense (Chemical Biological Defense)
Mr. Christopher Cole
Analytical Services, Inc.

One of the key missions of the Department of Defense (DoD) is to enhance readiness to confront the threat of chemical and biological (CB) weapons through capabilities developed under the integrated Chemical, Biological, Radiological, and Nuclear Defense Program (CBRNDP). Following Operation Desert Storm, many deficiencies were highlighted in the way the Services developed and acquired CB defenses. In response to the many identified shortfalls, Congress mandated the establishment of a defense-wide approach to CB defense research, development, and acquisition (RDA) that DoD implemented in 1994. In 2003, the Department revamped the CBDP in order to enhance its ability to meet the needs of the warfighter and further streamline requirement and budgetary actions. The decision was also recently made to include radiological and nuclear defense in the OSD-level program this year. These improvements in the DoD CBRNDP ensure that the US military has the capabilities and information to operate effectively and decisively in the face of chemical, biological, radiological, and nuclear (CBRN) threats in warfighter and homeland defense missions. We do this while advancing national interests within the CBRN defense arena and by working with other government agencies, state and local governments, Congress, the private sector, and international partners.

Establishment of the CBDP (July 1994 – April 2003)

Before 1994, each of the Services had separate and distinct chemical and biological defense programs to include testing, procurement, and sustainment of equipment designed to protect their personnel in the event of a chemical or biological attack. As stated above, concerns about the inadequacy of this arrangement arose following Operation Desert Storm, and in the 1994 National Defense Authorization Act (Public Law 103-160, Sect.1703) Congress required the establishment of the CBDP. This Joint program assigned the "responsibility for overall coordination and integration of the chemical and biological warfare defense…to a single office within the Office of the Secretary of Defense" to include all RDA related activities. The advantages of this consolidated arrangement included enhanced visibility for many relatively low cost items, elimination of redundancy and duplication of effort (especially in the areas of research and technology development), and the creation of a single DoD account for all chemical and biological defense RDA programs. The law also required that all CBRN defense training be conducted with the US Army Chemical School.

Through the 1994 Joint Service Agreement (JSA) on Nuclear, Biological, and Chemical (NBC) Defense Management, the military Services established a program management structure to ensure the integration and coordination of Service operational needs. As stated in the Public Law, the Secretary of the Army was designated the Executive Agent for the CBDP with responsibility for coordination and integration of the program and reviewing the CBDP program funding each year. In order to accomplish the Executive Agent coordination and integration responsibilities for the DoD, the Department of the Army formed the Joint Service Integration Group (JSIG) and the Joint Service Materiel Group (JSMG). The JSA chartered the JSIG to coordinate and integrate the Services' NBC defense requirements, review NBC training, and produce multi-Service and Joint NBC defense doctrine. The JSMG's mission was to coordinate and integrate the Services' NBC science and technology and NBC research, development and acquisition programs, and to consolidate NBC logistics planning.

Through these organizations, development and procurement progress was made in all areas, and the Services were able to successfully develop and field the first generation of Joint chemical and biolog-

ical defense systems. In the contamination avoidance or detection commodity area, this included the M22 Automatic Chemical Agent Alarm (ACADA) and the Portal Shield automated biological point detection system. For individual protection, the CBDP issued the Joint Service Lightweight Integrated Suit Technology (JSLIST) ensembles (a newer, more capable groundcrew protective ensemble) to all the Services to protect their ground troops from enemy use of CB weapons. The program also acquired enhanced collective protection, including the Chemically Protected Deployable Medical System (CP DEPMEDS). The Sorbent Decontamination System has provided an enhanced capability to perform immediate decontamination to contaminated equipment in the field. Procured through the Joint CBDP, all these systems are providing enhanced capabilities for military personnel in the field today.

Based on the growth and complexity of the program and a renewed interest in the importance of NBC defense, a significant review of the CBDP's requirements generation process and management structure began in late 2001. This review included initiatives to reduce the number of Milestone Decision Authorities (MDAs) and to ensure the inclusion of CB requirements for force protection, homeland defense, and consequence management. In the endeavor to continuously improve, both materially and organizationally, the CBDP implemented a significant transformation in 2003 to enhance the structure and become even more responsive to the Services' and Combatant Commands' requirements.

Implementation Plan

Following 11 Sep 2001, the critical need for an integrated and viable DoD CBRNDP increased significantly. The visibility, priority, and scope of CBDP intensified far beyond the original Joint program established in 1994. In 2002 and 2003, several initiatives occurred to provide a more streamlined and efficient oversight and management structure within the Joint Chemical and Biological Defense Program. In support of the Implementation Plan signed on 22 Apr 03, two memorandums were issued in the Fall of 2002. These memorandums established the Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear (JRO-CBRN) Defense and the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD), while splitting out science and technology and placing this mission within the Chemical/Biological Directorate, Defense Threat Reduction Agency (DTRA), which was recently named the Joint CBRN Science and Technology Office (JSTO-CBRN). The key organizational relationships within the DoD CBDP are portrayed in Figure 1, page 6.

The purpose of the Implementation Plan is to define the roles and responsibilities and provide implementing procedures for the management of the CBRNDP. Concurrently, a full utilization of the JRO and significant changes to the acquisition management of the program also needed to occur in order to achieve the objectives of the Implementation Plan.

Formally established by the 9 Sep 02 memorandum signed by the Vice Chairman of the Joint Chiefs of Staff, the JRO became the Chairman's focal point for all CBRN defense issues in passive defense, force protection, consequence management, and homeland security while also collaborating with other Joint Staff elements on operational readiness, logistics and sustainment, and policy issues. The primary focus of the JRO is to coordinate and integrate requirements for all DoD CBRN defense programs, ensuring that the Services' and Combatant Commanders' requirements are developed and approved in a prompt and efficient manner. With acquisition community support, and critical Service input, the JRO also has the responsibility for formally developing the DoD CB Defense Program Objective Memorandum (POM). Additionally, the Implementation Plan called for designating the US Army Chemical School as the program's Joint Combat Developer under the JRO.

The 19 Sep 02 Acquisition Decision Memorandum approved by the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) also directed significant changes in the management of the DoD CBDP. As further clarified in the Implementation Plan, the JPEO-CBD serves as Materiel Developer and oversees Life Cycle Acquisition Management for system acquisition programs within the CBDP. The JPEO also provides centralized management and program integration for all CBDP nonmedical and medical programs. More recently, the JPEO has been given program management responsibilities associated with Project Guardian, a program established to provide CB protection at 200 DoD installations.

The new JSTO-CBRN manages and integrates CBRN science and technology (S&T) base programs. The JSTO is responsible for ensuring that the S&T programs are supporting the future capabilities as defined by the JRO. The JSTO also works closely with the JPEO to ensure alignment of the S&T and R&D programs. The S&T programs' funds management functions are performed by the DTRA under the

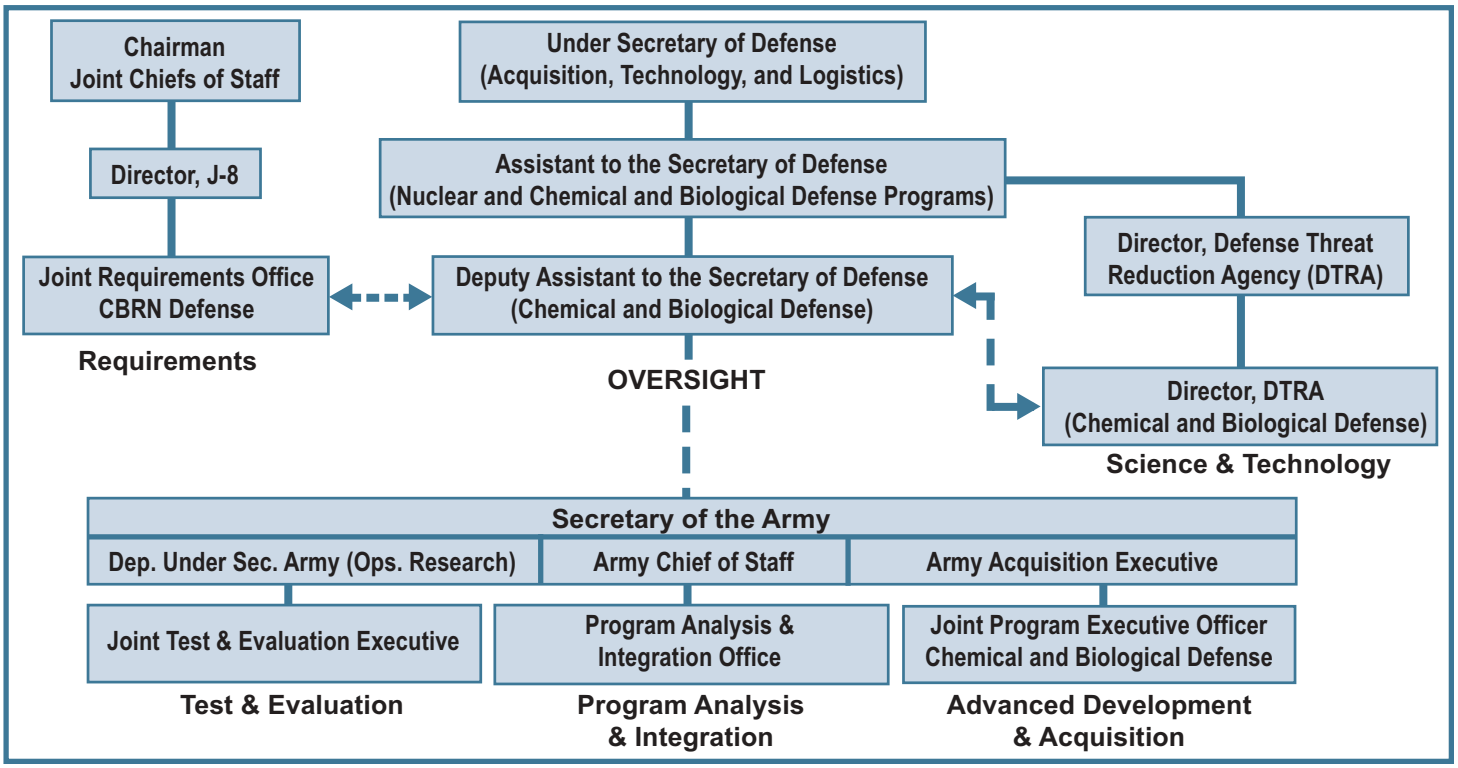

Figure 1. CBDP Organizational Relationships.

oversight of the Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs (ATSD(NCB)).

USD(AT&L) serves as the Defense Acquisition Executive (DAE) for the CBRNDP. In the capacity of DAE, the USD(AT&L) serves as the MDA for the overall program and key selected CBD systems – also referred to as "sentinel" programs. The sentinel systems are all programs in advanced development, representing a balance of cost, complexity, and criticality to justify the increased monitoring of their cost, schedule, and performance. For all other programs, USD(AT&L) has delegated the MDA to the Army Acquisition Executive (AAE) who can further delegate the responsibility to JPEO-CBD. USD(AT&L) is also the approval authority for the overarching CBDP Strategic Plan and the approval authority for the recommended CBDP POM submission. Following any necessary adjudication, USD(AT&L) approves the POM developed by the JRO and submits it to the Secretary of Defense.

Critical to the day-to-day operations of the CBDP, the Deputy Assistant to the Secretary of Defense (DATSD(CBD)) serves as the principal deputy to the ATSD(NCB) for CBDP matters and the primary staff action office for ATSD(NCB) responsibilities. As the principal deputy, the DATSD(CBD) also supports the USD(AT&L) in carrying out its MDA and oversight responsibilities for the CBDP.

As illustrated in Figure 2, all the organizations work together to develop a POM, which outlines funding plans for the Future Years Defense Program and forms the basis of the President's defense budget request from Congress. As shown, the ATSD(NCB) provides overall POM guidance, which in turn the JRO-CBRN Defense uses to develop detailed planning guidance. The program and project managers at the JPEO-CBD and JSTO-CBRN then develop budget plans based on the JRO guidance. This ensures that programs are driven by the warfighter needs and requirements.

Nearly one year has passed since the signing of the Implementation Plan. In many ways, this year proved to be extremely challenging. The conflict in Iraq required tireless efforts to ensure that our troops received the very best in chemical and biological protection, detection, and decontamination equipment. Events overseas and at home continued to focus the efforts of the program ensuring integration and support throughout the Joint Commands, the Services and key Federal agencies. As required, the ATSD(NCB) began a comprehensive review of the Implementation Plan to allow for evolution and continued improvement to the management and execution of the CBDP. This will not only be an opportunity to examine the positives of the CBDP Implementation Plan's structure, but also allow close examination to ensure that the required actions stated in the Plan have been

fully accomplished by all participants.

Future Challenges

Chemical, biological, radiological, and nuclear defense readiness will continue to remain a top priority for the Department of Defense for the foreseeable future. Because there is no silver bullet that counters the threat of chemical and biological weapons, we will continue to pursue an integrated family of systems. We will also work to meet the changing threats of tomorrow while maintaining our current programs to respond to warfighter requirements. The CBDP's evolving missions include supporting force protection and domestic preparedness, enhancing CB installation force protection (through the Guardian program), and, as a comprehensive strategy evolves, executing homeland defense programs. We will continue to push for the acceleration of CB defense technologies while adapting future systems to power projection needs. The CBDP Implementation Plan has supported the efforts of the program for the past year and it will sustain the program through the next generation of chemical and biological defense capabilities despite the many challenges that lie ahead.

Conclusion

Although the challenges are many and varied, the CBDP remains focused on providing the warfighter with the best possible capability to successfully operate in a CBRN environment. It also supports the CBRN defense needs for the Global War on Terrorism while ensuring that we are prepared to defend our homeland from attacks by terrorist elements. This program developed the critical capability to provide protection to the Pentagon after 11 Sep 01 and, more recently, continues to develop to provide protection to critical military installations.

We Protect the Force!

Brigadier General Nilo was the Acting Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense before her recent retirement from the Army. Before joining the Pentagon staff, she was Chief of Chemical and Commandant, United States Army Chemical School, Fort Leonard Wood, Missouri. She is originally from Medford, Massachusetts and has a B.A. and M.E. in Biology from Boston State College. Brigadier General Nilo is a graduate of the National War College.

Mr. Christopher Cole is a senior CBRN analyst at ANSER, Inc. Before this position, Mr. Cole was the assistant Program Manager for the Air Force's NBC Passive Defense and the WMD Emergency Response programs. He has a B.A. in Diplomacy and Foreign Affairs from the Miami University in Oxford, OH and a M.A. in National Security Studies from Georgetown University in Washington, DC.

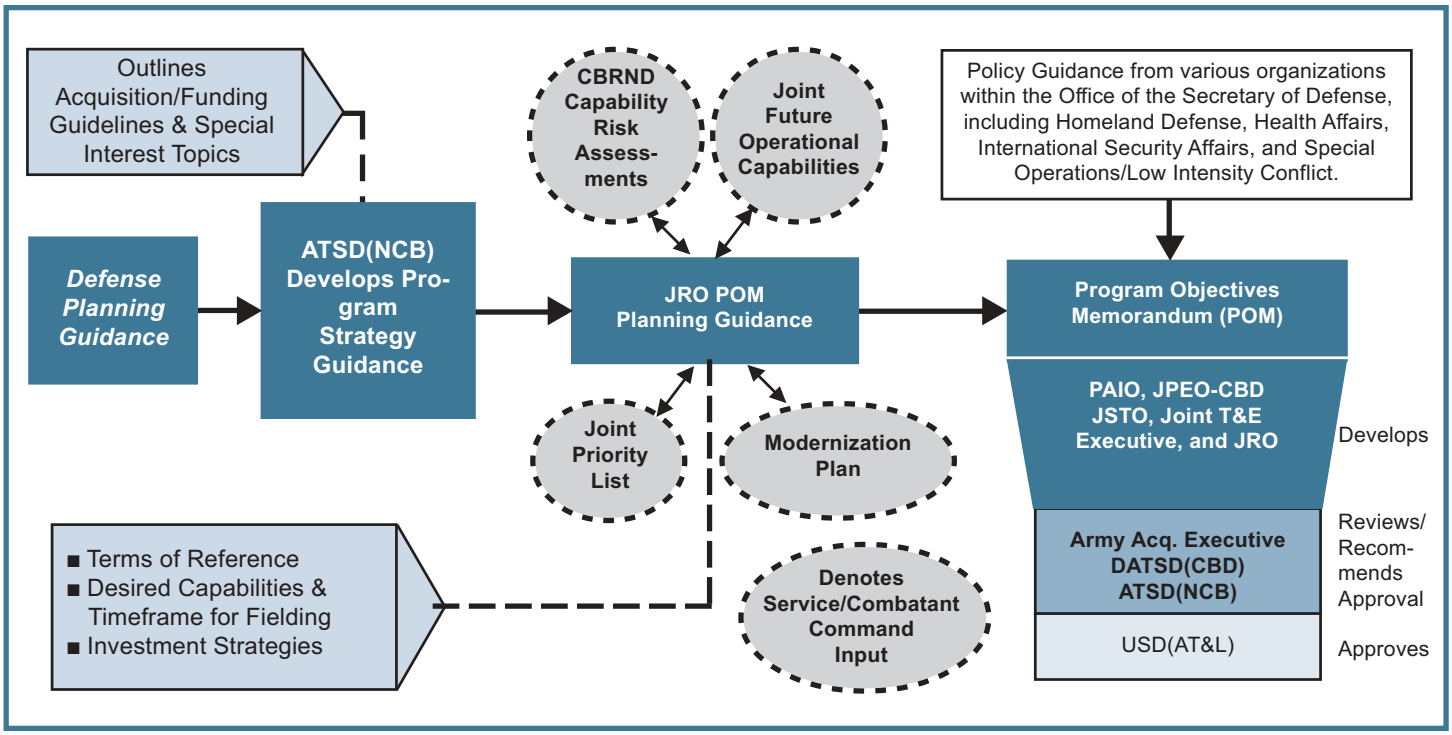

Figure 2. CBDP POM Process.

Implementation of Supporting Science and Technology Programs for the Joint Chemical, Biological, Radiological and Nuclear Defense Program

Dr. Charles R. Gallaway
Director, Joint Science and Technology Office for Chemical Biological Defense
Defense Threat Reduction Agency

"The gravest danger our Nation faces lies at the crossroads of radicalism and technology. Our enemies have openly declared that they are seeking weapons of mass destruction, and evidence indicates that they are doing so with determination. The United States will not allow these efforts to succeed. ...History will judge harshly those who saw this coming danger but failed to act. In the new world we have entered, the only path to peace and security is the path of action."

President George W. Bush
The National Security Strategy of the United States of America
September 17, 2002

The Joint Chemical Biological Radiological Nuclear (CBRN) defense program is managed in accordance with the Acquisition Decision Memorandum and implementation plan promulgated on 22 Apr 03 by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD/AT&L). The CBRN Defense program is a joint effort of the Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense (JRO-CBRN), the Defense Threat Reduction Agency (DTRA) and the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) having responsibility for requirements, science and technology and acquisition respectively. Under this implementation plan, the Science and Technology (S&T) program is executed by the DTRA. In response to this new mission, the Joint Science and Technology Office (JSTO) was created to support this program area by reorganizing the DTRA Chemical and Biological (CB) Defense Directorate to meet this new mission. This reorganization consisted of business process changes and additions to the workforce.

The JRO-CBRN is the Chairman of the Joint Chiefs of Staff's (CJCS') focal point for all Chemical, Biological, Radiological, and Nuclear (CBRN) defense issues in passive defense, force protection, consequence management and homeland security, and coordinates and integrates requirements for all DoD CBRN defense programs. DTRA coordinates closely with the JRO-CBRN and JPEO-CBD to validate requirements, evaluate current capabilities, and identify technology gaps for S&T investment. The S&T team is responsible for providing, in the most efficient and responsive manner possible, candidate technologies and products to the JPEO-CBD for advanced development into suitable, effective, and survivable CBRN defense capabilities. The JPEO-CBD serves as the material developer and oversees Life Cycle Acquisition Management for assigned system acquisition programs (medical and non-medical) within the CBDP.

The Joint CBRN defense S&T program is a robust, agile, and flexible program that addresses the dynamic threat environment and complex operational environment for US forces. The response to capability gaps exploits broad leveraging of established technical competencies

along with new and innovative approaches from potential performers drawn from DoD, commercial vendors, academia, and international providers. This capability requirement is articulated through the Joint Capabilities Integration and Development (JCID) System (see Figure 1) and executed by DTRA, JPEO-CBD and supported by the Test and Evaluation (T&E) Executive.

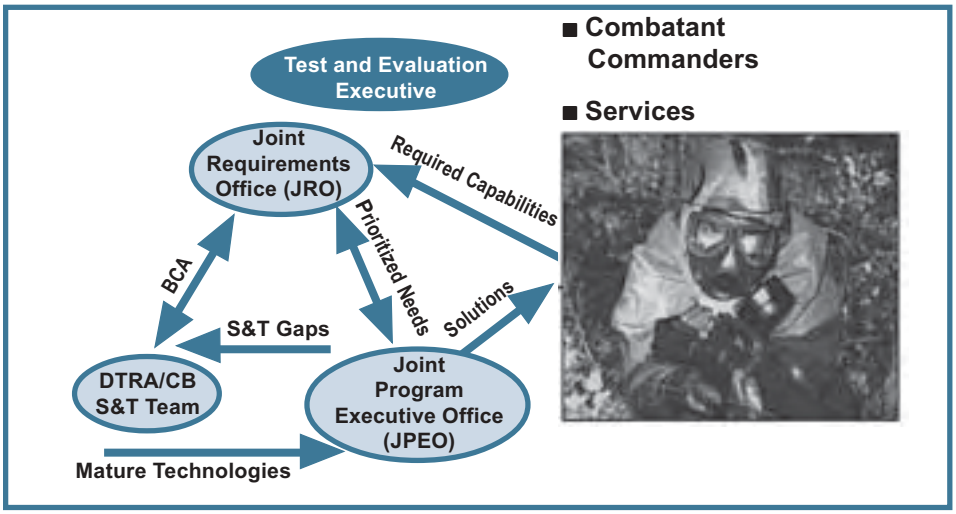

Figure 1.

As a result of the program's reorganization, the S&T program now separates management from performance to enhance agility and flexibility. The S&T program can now more efficiently leverage new and emerging technologies/ technological breakthroughs made by government, industry, international partners, and academic research organizations (see Figure 2) to meet the material developer's needs.

The JSTO coordinates with the JRO-CBRN to assess and refine existing requirements and identify gaps to resolve new threats being posed by non-traditional agents, bioengineered pathogens, emerging zoonotic diseases, and toxic industrial materials/chemicals. Achieving these goals requires that the S&T program managed by the JSTO be highly coordinated and integrated with the plans and programs of the JRO-CBRN, the JPEO-CBD, and the T&E Executive.

The priority of a given program and/or project will depend on the effort's alignment with capability requirements defined by the JRO-CBRN, and validated/prioritized threat agents that could be employed against US Forces. Priorities reflect the ranked strategic capability of the JRO-CBRN baseline capability assessment, coupled with the likelihood of a useable research, development, test and evaluation (RDT&E) product that could counter/ mitigate agent effects.

The JSTO is now developing a bottom-up, multiple-year strategic S&T program integrating near- and far-term requirements. The goal is to produce a scientifically sound, rational investment strategy focused on delivering to military users the best possible capabilities for dealing with chemical and biological threats. The JSTO will develop the annual CBDP S&T plan from external guidance, which includes, but is not limited to the following documents:

- Office of the Secretary of Defense (OSD) Program Objective Memorandum (POM) strategy guidance
- Defense Planning Guidance
- JRO-CBRN Baseline Capability Assessments
- JRO-CBRN Joint Future Operational Capabilities
- Joint Warfighter Science and Technology Plan (JWSTP)
- JPEO-CBD acquisition roadmaps and technology requirements
- Research, Development, and Acquisition (RDA) and Modernization Plans

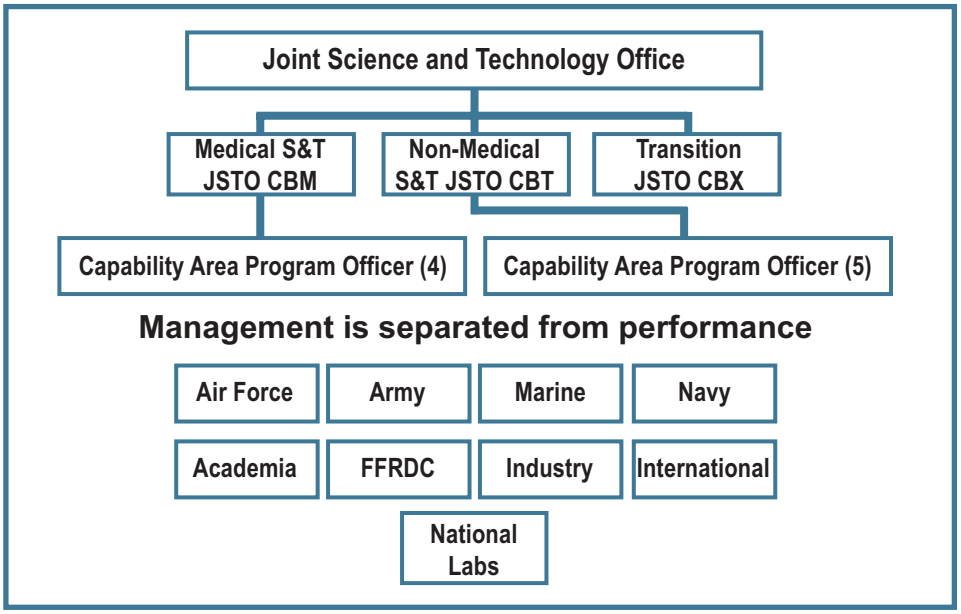

Figure 2.

In coordination with JRO-CBRN and JPEO-CBD, the JSTO develops inputs to the Defense Technology Area Plan (DTAP) and appropriate Defense Technology Objectives (DTO), responding to Service and combatant commander capability needs. The CBDP S&T Program actively develops new DTOs in an effort to emphasize the newest technological approaches toward the development of CBRN defense products for the warfighter.

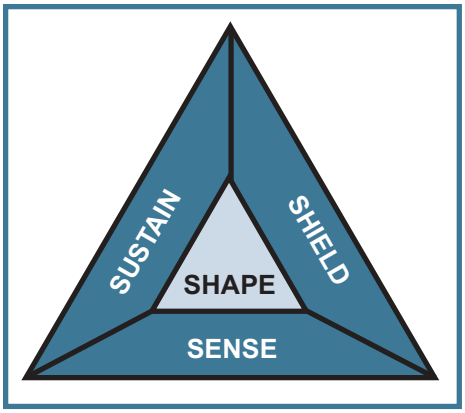

Figure 3.

The operational concept underlying current and future CBRN defense S&T planning is defined by four key principles: Sense, Shape, Shield, and Sustain (see Figure 3). They may be executed simultaneously, sequentially, or individually to maintain mission capability. There is significant overlap of these principles during planning and execution of CBRN S&T initiatives and programs and each principle is made up of individual elements. The concept provides an operational framework to assist in the maturation of technology solutions to capability gaps. These concepts apply during peacetime, transition to and during military operations.

Sense: The capability to continually provide information about the CBRN situation at a time and place by detecting, identifying, and quantifying CBRN hazards in air, water, on land, on personnel, equipment, or facilities. This capability includes detecting, identifying, and quantifying those CBRN hazards in all physical states (solid, liquid, gas).

Shape: Provides the ability to characterize the CBRN hazard to the force commander - develop a clear understanding of the current and predicted CBRN situation; collect, query, and assimilate information from sensors, intelligence, medical, etc., in near real time to inform personnel; provide actual and potential impacts of CBRN hazards; envision critical SENSE, SHIELD and SUSTAIN end states (preparation for operations); visualize the sequence of events that moves the force from its current state to those end states.

Shield: The capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures, applying prophylaxis to prevent or mitigate negative physiological effects, and protecting critical equipment.

Sustain: The ability to conduct decontamination and medical actions that enable the quick restoration of combat power, maintain/recover essential functions that are free from the effects of CBRN hazards, and facilitate the return to pre-incident operational capability as soon as possible.

The S&T Program employs a capabilities-based, vice threat-based, approach to build a robust, agile portfolio of capabilities across a spectrum of JRO CBRN-validated CB defense requirements. The goals of the S&T program can be summarized as follows:

- Develop and mature capabilities through a technology development strategy, which are synchronized to meet acquisition strategies, resource cycles, and transition criteria
- Provide the resources to conduct basic research and supporting science to the CBDP
- Sustain a robust knowledge base within DoD for the Joint CBRN Defense Program

The JSTO is responsible for integrating S&T from all sources. The JSTO ensures integration of the program, at large, between the medical and non-medical S&T components. In assessing this overarching integration, the JSTO develops additional decision support capability, including modeling and simulation as may be necessary to ensure integration and a systems approach to S&T. Managers in the Non-Medical and Medical components integrate their efforts from all technology sources. Technology development under basic research funding, Small Business Innovative Research (SBIR), Congressionally-directed projects, international programs, and the core S&T program are planned and executed to be complementary components of a comprehensive program that avoids duplicative efforts. Capability Area Program Officers (CAPOs) coordinate all S&T projects in the aforementioned venues within their capability areas.

The JSTO collaborates with other federal agencies (e.g., Defense Advanced Research Projects Agency (DARPA), Department of Homeland Security (DHS), and the Department of Health and Human Services (DHHS), to ensure that the S&T program avoids duplication of effort and leverages relevant research programs. The JSTO will assess and develop joint S&T roadmaps with DHS, DHHS, the Technology Support Working Group (TSWG); CBRN Sub-Group, and other non-DoD elements. To ensure that all stakeholders are aware of, and share in, the results of DoD

CBRN research, findings will be presented in venues fostering scholarly scientific discourse (e.g., published in peer-reviewed journals, presented at professional meetings). In the case of medical products (e.g., vaccines, pretreatments, therapeutics, diagnostics), research will be designed/conducted with the aim of providing safe/effective Food and Drug Administration-approved products to the warfighter.

The JSTO also consolidates and administers international S&T activities such as the United States/United Kingdom/Canada Chemical, Biological, and Radiological Memorandum of Understanding (US/UK/CA CBR MOU), The Technical Cooperative Program (TTCP), numerous Data Exchange Agreements (DEAs), and other cooperative arrangements with the North Atlantic Treaty Organization or others.

The S&T program will leverage new and emerging technologies and materials, and technological breakthroughs made by government, industry, and academic research organizations. Emphasis will be on a broader solicitation of concepts and technical approaches to provide the best possible science to respond to technology needs. Broad agency announcements will solicit innovative ideas from non-traditional CBDP S&T program performers in industry and academia. The JSTO coordinates the transition of technology and capabilities from outside the CBDP. The JSTO also coordinates with programs from DARPA, DHS, DHHS, other sources such as the Defense Acquisition Challenge Program and other venues to ensure candidate technologies are assessed for appropriate entry in to the S&T program.

The JSTO encourages innovation in Basic Research and Applied Research (6.1 and 6.2) projects by leveraging in-house and external solutions. JSTO ensures effectiveness in appropriate Basic Research and Applied Research projects (6.2 and 6.3 projects) through a Technology Development Strategy which includes objective criteria establishing Technology Readiness Levels (TRL) for the technology relative to its intended employment, satisfaction of which will trigger transition to 6.3 or advanced technology development. Projects in Advanced Technology Development (6.3) will have a Technology Transition Agreement (TTA) with the JPEO-CBD with defined exit criteria to advanced development (6.4 and beyond).

Advanced Concept Technology Demonstrations (ACTDs) are used to demonstrate new capabilities synchronized with an approved acquisition strategy. The JSTO coordinates the nomination and approval process for CBDP-funded ACTDs (see Figure 4). Coordination includes the JRO-CBRN, the JPEO-CBD and the representative from Deputy Under Secretary of Defense for Advanced Systems and Concepts (DUSD(AS&C)) prior to submission to the Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense Programs (DATSD(CBD)) and the DUSD(AS&C).

Finally, the JSTO is the focal point for coordination of transition to advanced development from the S&T program and will ensure TTAs are concluded prior to funding of 6.3 programs in FY05 under the Joint CBRN Defense Program.

The transition of the S&T program to the JSTO will ensure the DoD CBRN Defense Programs are responsive the technology needs of the material developer and ultimately provide timely capabilities for warfighter requirements.

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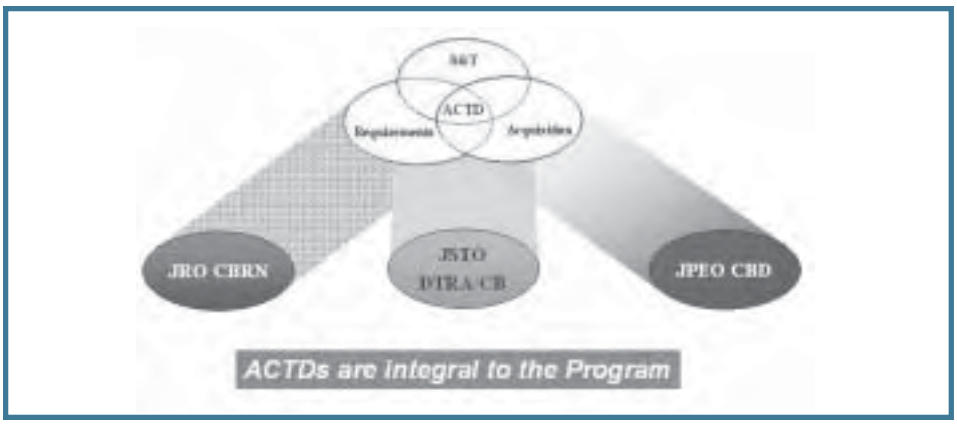

Figure 4.

Lessons Learned From The Rajneeshees' Food Poisoning Attack

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The first instance in which a terrorist group operating in the United States employed a biological agent that resulted in verifiable human illnesses occurred almost 20 years ago in a small town in Oregon.[1] The attack, which took place in September 1984, sickened 751 people, including 45 who were hospitalized.[2] Epidemiological and criminal investigations eventually determined that a religious cult, known as the Rajneeshees, employed Salmonella bacteria against residents of the town of The Dalles, Oregon, to prevent voter turnout in an upcoming election.[3] Although there were a large number of victims, little is known about the attack as it was mainly reported by local and state news agencies at the time and received very little national press coverage. Despite the lack of fatalities and national media attention from this incident, students in the field of biological defense can derive valuable lessons from this case by realizing the potential characteristics of Salmonella as a terrorist biological agent and by reviewing and understanding both positive and negative aspects of the epidemiological and criminal investigations.

The Rajneeshees, a religious cult with origins in India, started arriving in Oregon in 1981 after followers purchased a large ranch in Wasco County. The cult's leader, Bhagwan Shree Rajneesh, began establishing a new international spiritual headquarters with this property. The commune was a self-contained property with its own municipal services, airport, transportation system, water and sewage systems, and other amenities.[4] To circumvent Oregon's extremely restrictive land-use laws which limited building in rural areas, the Rajneeshees gained control over zoning by incorporating a town on the ranch, which they called Rajneeshpuram. As a legally incorporated community, the town's new legal status provided significant advantages to the commune, including the ability to field two authorized police forces.[5] After establishing the town, the cult's next goal was to increase the commune's activities and expand Rajneeshpuram even further. To avoid the state's land-use restrictions, the cult exploited Oregon's liberal voter registration laws and seized political control of a small town near Rajneeshpuram called Antelope. This exploitation, combined with continuous cultural and religious differences, was the turning point in relations between the Rajneeshees and the residents of Wasco County and the start of the plot to poison local citizens.

The Dalles, Oregon

The senior leaders of the cult began to perceive hostility and opposition from the Wasco County Court and the county government. This opposition was a major impediment in the commune's plans since the cult needed to obtain permits from this

court in order to conduct its activities.[6] The elections in November 1984 provided Bhagwan and one of his most powerful and trusted subordinates, Sheela, with a window of opportunity to gain control of the Wasco County Court. After failing to place a sympathetic candidate on the ballot due to a lack of signatures, the cult decided on a two-phase plan to help them win the election. Sheela decided to bring thousands of homeless people across the country to Rashneeshpuram under a plan called the "Share-A-Home" program.[7] She intended to capitalize on Oregon's liberal voter registration laws and have the homeless people registered and eligible to vote in the November election. There was no doubt in Sheela's mind that she could persuade these people to vote for the candidate favored by the Rajneeshees. In addition to the "Share-A-Home" program, Sheela also devised the plot to employ biological agents against local citizens in order to make the residents of Wasco County sick on election day to hamper the opposition's voter turnout.[8]

The attack's success was based on the cult's ability to incapacitate a large number of local residents without drawing attention to the commune. Sheela collaborated with the head nurse at the Rajneesh Medical Corporation, Ma Anand Puja, and decided the best agent to use was a certain strain of Salmonella. The bacteria was ordered from a local medical company and cultivated within Rajneeshpuram. When enough bacteria was produced, Sheela instructed fellow Rajneeshees to contaminate salad bars at ten local restaurants located in The Dalles. These attacks, which took place in two waves in September 1984, were experiments to assess whether or not Sheela could sicken the voting population in the town at the time of the election, which was over two months away.[9] By the end of the outbreak, almost a thousand people reported symptoms: 751 were confirmed to have food poisoning.[10] Despite the success of the attack, further plans to continue the poisoning were halted after the Rajneeshees abandoned the "Share-A-Home" program and realized they could not win the election.

The agent used by the Rajneeshees to sicken residents of The Dalles was a bacteria called Salmonella typhimurium. This strain of Salmonella is a common cause of food poisoning or Salmonella gastroenteritis (salmonellosis). The rod-shaped bacteria enter the body through ingestion and rapidly multiply over hours and days, damaging tissues and overwhelming rival bacteria.[11] Symptoms of the infection appear anywhere from 6 to 48 hours after ingestion of contaminated food or water and include abdominal pain followed by diarrhea, chills, fever, headache, muscle ache, and vomiting.[12] Doctors can detect Salmonella typhimurium by using patients' stool samples taken over a period of several days.[13] Lasting up to four days, the infection is normally not fatal, but could be severe in the young, the elderly, and patients with weakened resistance.[14]

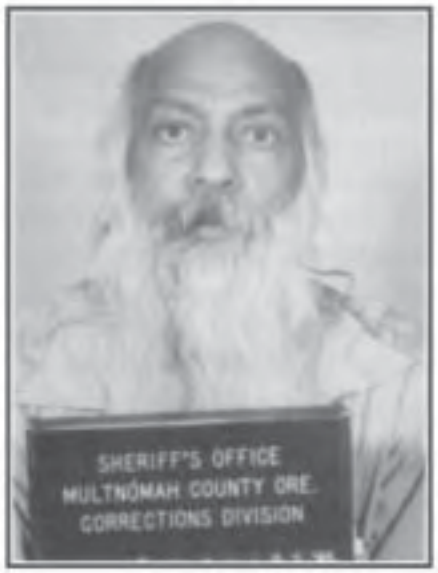
An analysis of Salmonella typhimurium's characteristics explains why this bacteria was such an effective bioterrorism agent for the Rajneeshees. Their plan called for sickening large numbers of people without drawing attention to themselves. Salmonella is one of nature's heartiest germs that is commonly found in natural outbreaks of food poisoning.[15] By choosing Salmonella typhimurium, the Rajneeshees wanted to fool investigators into believing the attacks were natural outbreaks and not caused intentionally. This case proves that not all agents used by terrorists are lethal and intended to kill their victims in order for these groups to achieve their goals. Terrorists may also attempt to conceal the attack from investigators instead of trying to gain recognition for their cause by claiming responsibility.

Another characteristic of the bacteria that benefited the Rajneeshees was the agent's legitimate use in laboratory quality tests. Salmonella typhimurium is one of several control organisms used to meet requirements for quality assurance expected in licensed clinical laboratories.[16] The cult's medical clinic was required to test the proficiency of its technicians by having them identify samples contaminated with known agents. Salmonella typhimurium was one of the pathogens maintained for this purpose.[17] Due to the testing requirements and the fact that the cult's medical facility was considered a state-licensed medical clinic, Sheela and Ma Puja easily obtained quantities of the bacteria by simply ordering several bactrol disks containing Salmonella typhimurium from a medical supply company located in Seattle, Washington.[18] This case also demonstrates the dual-purpose use of certain agents and the ease at which terrorist groups can obtain pathogens. The agent does not have to be a controlled substance whose purchase is restricted today by germ banks such as the American Type Culture Collection. There are other germs that are capable of harming innocent people that are freely exchanged between scientists, such as different strains of Salmonella that are used in quality assurance tests. While some agents are intended to help fight infectious diseases or create vaccines, they also have the potential to kill or sicken people if they fall into the wrong hands.

Since Salmonella typhimurium is also a bacteria that is easy to cultivate, a large complex laboratory or highly trained technicians are not required to grow the agent. Once the cult obtained the bactrol disks, Ma Puja and her medical staff were able to mass-produce the Salmonella typhimurium in their small laboratories located on the compound. Large-scale production of the agent took place in a facility consisting of two A-frame structures joined together by a bathroom. The laboratory contained a large freeze dryer with tubes and other equipment and a small green incubator that contained petri dishes used to cultivate the bacteria.[19] As the head of the cult's health center and medical facilities, Ma Puja's was responsible for growing the cultures. Her qualifications to run the facilities and germ production site were simply based on the license she received as a family nurse practitioner, her work experience in several oncology labs overseas, and by being a registered nurse.[20] This shows that by choosing the appropriate agent, production of large quantities of bacteria is inexpensive and involves simple equipment and skills.[21] Terrorist groups do not need highly trained technicians or numerous and expensive pieces of scientific equipment in order to obtain enough deadly pathogen necessary to carry out their attacks.

Along with the bacteria's ability to incapacitate rather than kill, the nonlethal characteristic of Salmonella typhimurium also provided the Rajneeshees the capability to easily disseminate the agent without harming the person handling it. After enough Salmonella typhimurium was produced in the lab, Ma Puja had the light brown liquid placed in small test tubes sealed with cork stoppers and then gave the test tubes to several Rajneeshees to contaminate salad bars.[22] By simply opening the vials and sprinkling the bacteria in coffee creamers and on items in salad bars, including potato salad, macaroni, pea salad, blue cheese dressing, and four bean salad, members of the cult effectively poisoned several hundred local citizens without infecting themselves.[23] This characteristic demonstrates that missiles, bombs, rockets, or other explosive devices are not needed to disseminate certain bacterial agents in order to infect people. A simple spray bottle or shaker is all that is needed in some cases in order for an attack to be effective.

Once an outbreak occurs, the creation of a quality epidemiological investigation team is a key element in determining the factors and mechanisms that contributed to the illnesses. It is imperative that local officials ask for the appropriate assistance if necessary. When the hospital staff and pathologists at the town's only hospital, the Mid-Columbia Medical Center, were over-



Cult Leaders: Ma Anand Sheela and Bhagwaan Shree Rajneesh

whelmed by the attack, the staff sought help from outside sources. The Wasco-Sherman Public Health Department and the Oregon State Public Health Laboratory were the first agencies to provide additional assistance. Once the county and state offices became overwhelmed

by the poisonings, additional help was further sought from the US Centers for Disease Control and Prevention and its Epidemic Intelligence Service (EIS). The EIS consists of doctors who learn epidemiology firsthand by investigating suspicious disease outbreaks throughout the country.[24] This core epidemiological team was made up of more than 20 health workers, including local sanitarians, county and state health officials, and EIS officers.[25] The successful establishment of similar teams and agencies is needed in any investigation so officials can pool their resources and expertise in order work together to properly control outbreaks, identify causative pathogens, and to understand their modes of transmission and geographical distributions.

One of the first things health officials did to deal with these poisonings was to quickly identify the bacteria that was making people sick. Less than two days after the outbreak began, a pathologist at the Mid-Columbia Medical Center determined from a patient's stool sample that Salmonella was the agent causing the illnesses.[26] Two days later, scientists at the Oregon State Public Health Laboratory conducted further analysis on the stool samples and identified the bacteria as Salmonella typhimurium.[27] This scientific analysis was impressive considering the speed at which the agent was correctly identified given the technology at the time and the fact that there are over 2,500 known strains of Salmonella. Quickly and correctly identifying the harmful pathogens in an outbreak allows medical personnel to take appropriate steps needed to save patients' lives. In this case, the strain used in the salad bar poisonings was treatable with most antibiotics.[28]

Upon proper identification of the bacteria, the epidemiological team tried to discover how the agent spread and what the limits of the outbreak were. Fortunately, a member of the county health office found a connection among the patients in the hospital: most of those who had gotten sick had recently eaten at a salad bar.[29] Patients were interviewed and a common denominator established that ten different restaurants, located along Interstate 84, a major east-west highway near The Dalles, contained the salad bars with the contaminated food items.[30] By understanding the agent's mode of transmission and geographical distribution, officials can take the appropriate steps necessary to confine or eliminate the outbreak. The analysis performed in Oregon led investigators to recommend that restaurants close their salad bars in order to prevent further spread of food poisoning.

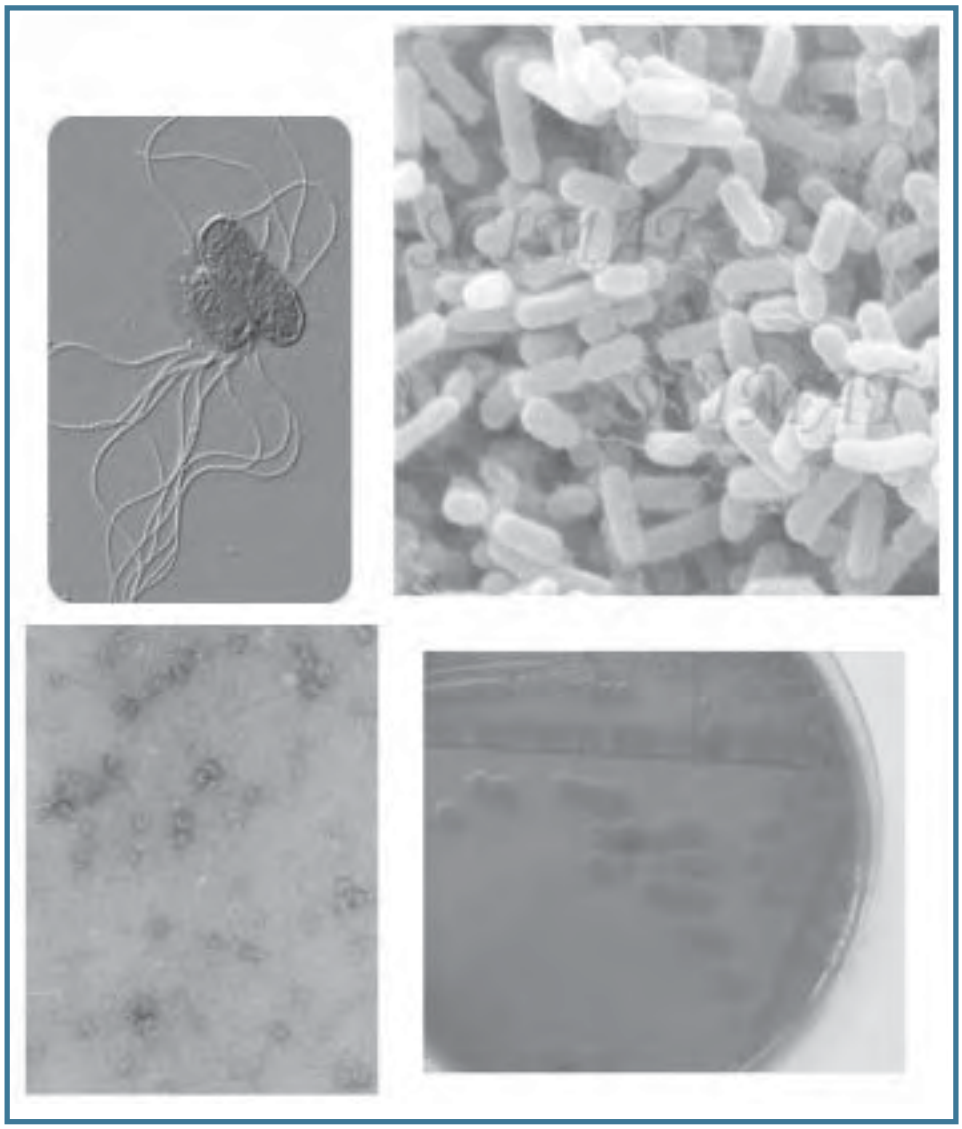
It is also imperative that in addition to identifying the pathogen, investigators attempt to find the source of the illnesses in order to prevent additional outbreaks. Once officials from the local, county, state, and national level came together, an exhaustive epidemiological investigation began in an attempt to locate the source of the Salmonella. Hundreds of patients and their families and friends were questioned. Investigators examined restaurant workers, also sickened in the attack, and their food-handling practices. Salad bar temperatures were analyzed to determine the effectiveness of the refrigeration systems. Dairy farms were visited to test cows, cow feces, raw milk, and the farms' pond water for Salmonella. Two local water systems, along with neighboring vegetable patches and local farm produce, were tested for contamination.[31] The end result was that health officials were unable to find a common source of infection among the food handlers and the customers. Investigators concluded that the contamination "could have occurred where food handlers failed to wash their hands adequately after bowel movements and then touched raw foods".[32] While this investigation did not correctly identify the real source of the ill-

nesses, thorough epidemiological analysis is needed in any outbreak in the attempt to correctly find the true common source of infection. This will help officials make informed decisions regarding the containment of the outbreak. In this case, investigators' prescription for stemming the illnesses, closing the salad bars, had been correct, albeit for the wrong reasons.[33]

Despite correctly identifying the bacteria and taking proper steps to contain the outbreak, the negative aspects of this case must also be examined. A formal criminal investigation case against the cult was not opened until well after the attack occurred. It was over a year after the outbreak that law enforcement officials developed credible evidence that intentional contamination was responsible for the illnesses.[34] While the case did end with Sheela and Ma Puja being placed in jail, the criminal investigation was opened only after the Rajneeshee's leader, Bhagwan, broke a four year vow of silence and accused Sheela and other leaders of the cult of betraying his faith.[35] There were instances, however, where the criminal investigation could have started sooner and revealed the true source of the contamination earlier in the case.

One of the reasons law enforcement officials were unable to initially crack down on the Rajneeshees was their inability to convince the lead investigators that members of the cult were possible suspects. There were numerous instances where actions taken by the Rajneeshees against the local population should have been enough to open a separate criminal investigation against the commune. When the county commission challenged the Rajneeshees' attempts to further expand their commune, the cult responded with harsh attacks and dire, unspecified threats.[36] Rajneeshee officials openly insulted their critics, calling them idiots, liars, bigots, and rednecks. Sheela and other leaders started carrying weapons and threatened revenge against the "United States of Aggression" if any of the cult members were hurt.[37] County officials received threats in the mail and were threatened at public meetings.[38] Rajneeshees sued people for slander at the slightest provocation and used the courts to steamroll opponents, who often lacked the resources to defend their activities.[39]

Despite the local population's belief that the cult was responsible for the attack, state officials were swayed more by the lead epidemiologist's conclusion that there was "no evidence" to support the hypothesis that the outbreak was the result of deliberate contamination.[40] A report was issued claiming that unsanitary practices by restaurant workers caused the outbreak and dismissed allegations that intentional contamination was a factor.[41] The state epidemiologist firmly believed that the Rajneeshees were being unfairly harassed because of their strange religious beliefs.[42] Despite



Salmonella Typhimurium

numerous hostile acts performed by the cult, these conclusions denied local law enforcement officials the probable cause needed to open a criminal investigation.[43] It is imperative that epidemiologists conducting their aspect of the investigation and officials working at the local level analyze all data relevant to the case before releasing results. If this is not done properly, incorrect conclusions may result in missed opportunities that negatively impact the outcome of the investigation.

Criminal investigators were also guilty of not working with epidemiologists. Before finally deciding on using Salmonella typhimurium to contaminate the salad bars, Ma Puja ordered several dangerous pathogens from the American Type Culture Collection, to include Salmonella typhi, Francisella tularensis , and Shigella dysentariae as possible back up agents for the attack.[44] Since the criminal case was initiated a year after the attacks, the Rajneeshees had ample time to destroy certain evidence. No pathogens ordered from the germ bank were ever found at the cult's compound.[45] The invoices from the germ bank, however, were seized in the search. Unfortunately, criminal investigators did not show them to public health officials who would have understood their significance.[46] This was a red flag in the investigation since the dangerous pathogens ordered by the cult were all unnecessary in a clinical lab the size of Ma Puja's. Had this data been revealed to epidemiologists, the possibility existed for health officials to realize cult members were dealing in biological terrorism. In order to have a swift, thorough, and effective criminal and epidemiological investigation, data must be shared between all agencies involved in a case. The smallest piece of overlooked evidence may result in a missed opportunity.

A final shortcoming of the case involved the lack of a published study of the incident. Due to the ease at which the Rajneeshees spread the disease, officials decided not to release a study in order to avoid copycat attacks.[47] They believed there was a risk that publicity about this outbreak would produce the unfortunate side effect of inciting other biological attacks.[48] While there is some truth to this statement, dissemination of the criminal and epidemiological findings in this attack will lead to greater awareness and the possibility of earlier recognition of similar incidents. The overall advantage of sharing the investigations' findings should outweigh the risk of similar attacks happening in the future.

Summary

In order to reach their goals, terrorist groups do not need to kill large numbers of people or attempt to gain national or global recognition for their organizations. They may only need non-lethal bacterial agents that are easy to purchase, cultivate, and transport in order to achieve their objectives. Incapacitation, instead of killing, is a possible outcome based on their aspirations. Contamination of food or water sources is a simple, effective way of producing desired casualties. One major outcome of the Rajneeshee attack that affects today's scientist, health officials, and law enforcement agencies is the change in the mindset regarding outbreaks of infections and illnesses. Such outbreaks used to be considered only as naturally occurring events and not deliberate acts: this is no longer the case. The belief that the food poisonings happened naturally hindered officials in their investigation of the attack. Health officials could not comprehend an intentional spread of bacteria, as an attack of this nature had not previously occurred and little information about bioterrorism was available. Officials now realize in an outbreak caused by intentional contamination, it is imperative that law enforcement officials work with epidemiologists during the investigation. People are best protected when health care professionals and criminal investigators cooperate during an investigation of a deliberate attack. Attentive law enforcement agencies and medical professionals who observe patterns of disease outbreaks that work closely together have the greatest potential in detecting and responding to bioterrorism acts before the attackers are capable of causing further casualties or developing additional weapons.

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Guidance for Federal Protective Actions and Recovery After Radiological and Nuclear Incidents

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The Federal inter-agency "dirty bomb" exercise, Top Officials-2 (Topoff-2; Seattle, WA, 12-16 May 2003), brought to the forefront a number of issues in Federal radiological emergency response and recovery. In particular, it raised the question of how the Federal government would make protective action recommendations following acts of radiological or nuclear terror. The Environmental Protection Agency (EPA) published the Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, but it was not written with current terror scenarios in mind and its applicability needed some affirmation. Of particular priority to Homeland Security Secretary Tom Ridge and the White House Homeland Security Council (HSC) was the fact that Federal agencies had not agreed upon an approach to long-term site remediation for such an event. The EPA has clean up standards and procedures, and the Department of Energy and Nuclear Regulatory Commission have standards for the clean up of their respective sites (by ownership, control, or license), but no clear approach or standard emerged as suiting the needs of federal, state, and local governments in the aftermath of radiological or nuclear terror. The Department of Homeland Security (DHS) formed an interagency workgroup to address these issues. This article provides an overview of the outcomes of that process to include; protective action guides for radiological and nuclear terror incidents, approach to long-term site restoration and implementation procedures, and further recommendations are given.

Background

If the World Trade Center attack on 26 February 1993 wasn't the wake-up call it might have been, the attacks of 11 September 2001 certainly were. Foreign terrorists have demonstrated the planning, resources, and will to achieve their stated, but previously underappreciated end of inflicting terror against the United States and its allies. Al Queda and its associated groups have stated unequivocally that they intend to acquire and utilize nuclear, chemical, and biological weapons against the US. Increased vigilance coupled with new legal authorities and advanced technologies have allowed US intelligence agencies to better gather and analyze data and information on the goals, means, and methods of terrorists. Specific intelligence has yielded plans to explode a so-called "dirty bomb," or radiological dispersal device (RDD), in the US, and concerns over the potential use of an improvised nuclear device (IND) have continued unabated for several years now. The Federal government is fairly well prepared for traditional radiological accidents associated with the commercial nuclear fuel cycle and industrial use of radioisotopes. But can we argue we are prepared for terror scenarios?

A radiological dispersal device (RDD) is any device that causes the intentional dissemination of radioactive material across an area without a nuclear detonation. The mode of dispersion typically conceived, as an RDD, is an explosive device coupled with radioactive material. The explosion presents an immediate threat to human life and property. Other passive and active means of dispersion may be employed, such as covert pumping, spraying, or hand-distribution of a radioactive liquid, aerosol or powder, spraying from aircraft, injection into air-handling systems and other possible methods. There are a wide range of possible radiological consequences that may result from an RDD depending upon the type and size of the device, and how dispersion is achieved. The consequences of an RDD may range from a very small, localized area (e.g., such as a small area of a street, single building, or city

block) to large areas, conceivably many square kilometers. However, most experts agree that the likelihood of a large impacted area is generally low due to the technical difficulty of achieving effective aerosolization and dispersion of a large quantity. In most plausible RDD scenarios, the radioactive material would not cause acutely harmful radiation doses, and the public health concern from those materials would be an increased risk of cancer among exposed individuals. Hazards from fire, smoke, blast and shrapnel (from an explosion), industrial chemicals and other chemical or biological agents may also be present. While typically lumped in with other weapons of mass destruction (though often called a weapon of mass disruption), a successful RDD is really an environmental disaster and should be treated as such once the emergency phase is over.

Radiological and nuclear terror differs from radiological and nuclear accidents in several key ways. First, we know where and how accidents occur. They occur almost exclusively at fixed facilities or on transit routes. Facility operators have a good understanding of the kinds of failures that result in accidents, and the number of ways accidents can occur (within reason) is limited. Exercises are regularly held to practice emergency plans and procedures, and improvements are made. Local communities, such as those around nuclear power plants (NPPs) or weapons facilities, are informed and involved in emergency planning, including development of public communication strategies, practicing shelter-in-place, and orderly evacuation along prescribed routes. Accidents may also occur along transit routes, but these are relatively rare and substantial contingency planning and exercising occurs for such accidents as well.

Nuclear and radiological terror, on the other hand, may occur virtually anywhere. We envision such acts targeting major cities, but the number of potential targets and the diverse circumstances of potential attacks make focused response planning almost impossible.

The scope of potential accidents is limited and fairly well understood. Facilities tend to have fixed quantities of licensed radioisotopes or well characterized suites of radionuclides on site, which may be released in an accident. Accidents of any magnitude are limited to a relatively small number of facilities, and these tend to have highly trained personnel, advanced process designs, the most rigorous safeguards and back-up systems, and the most aggressive contingency planning. The design of US nuclear power reactors, for example, practically precludes a Chernobyl-type of accident. Smaller facilities, such as radiopharmaceutical or radiation source manufacturers, generally possess much less radioactive material (or very short half-life materials), which may be involved in an accidental release.

No one, however, has any relevant real-world experience with a dirty bomb inflicted on a city (though the Cs-137 incident in Goiania, Brazil, 1986, is instructive), or a nuclear detonation (Hiroshima/ Nagasaki, 1945, are not particularly relevant) for purposes of planning, preparation, and response. Thus, federal officials must rely on computer simulations that may or may not reflect reality.

The nature of the response to these is obviously vastly different. In the case of an IND, evacuation, fire suppression, massive life-saving efforts, basic human welfare maintenance, and population relocation would likely drive all response activities for a number of days. Eventually, the questions of clean up, site restoration, and reoccupation would be asked. In the case of an RDD, officials would very quickly begin contamination control activities, manage economic and psychological outcomes, and plan for the environmental restoration of the area. Given the greater likelihood of some sort of RDD event (even imminence in the minds of some), the DHS and the White House HSC have aggressively pursued a strategy to deal with radiological terror. While nuclear incidents are much more complex in every way, basic plans, procedures and guides need to be applicable to them as well. Federal response and recovery thinking for terrorist use of a nuclear device is still underdeveloped.

The federal government, however, has well developed plans for responding to releases at fixed facilities and along transportation routes, and even for the unlikely event of reentry of a satellite carrying a radiological payload. Federal resources integrate with state and local emergency response mechanisms when state and local response capacities are overwhelmed, and provide funding and technical assistance through the Stafford Act. In extreme cases, mili-

tary civil support assets may be called upon to assist in incident management, victim care, engineering support, and other needs. These plans are going through review, revision, and rewriting to harmonize federal capabilities and asset deployment under the centralized leadership of the DHS.

Protective Action Guides

A key document in planning and preparation for protection of the public during radiological emergencies is the Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (US Environmental Protection Agency, May 1992, EPA-400-R-92-001), known as the PAG Manual. A protective action guide (PAG) is the projected dose to an individual where public protection is recommended. A protective action is action taken to avoid or reduce radiation dose to the public (such as shelter-in-place, or evacuation).

The PAG Manual, first published by EPA in 1975, was written to address the kinds of nuclear or radiological incidents deemed likely to occur. While expected to be applicable to any radiological release, the PAGs were designed principally to meet the needs of NPP accidents, the worst type of incident under consideration. This is important for two reasons: power plant accidents are almost always signaled by preceding events, giving plant managers time to make decisions and local emergency managers time to communicate with the public and initiate evacuations if necessary; and, the suite of radionuclides is dominated by relatively short-lived isotopes. Since 11 September 2001 the federal government has been compelled to reevaluate the PAGs for their applicability to the new terror threat. In addition, an unfinished chapter in the PAG Manual on site restoration has taken on new urgency.

The PAG Manual provides guides for decision-makers when quick decisions are required, often with little data inputs. The primary purpose of the guidance is to present a framework for decisions that: 1) prevents acute radiation effects, 2) reduces risk of chronic effects and 3) utilizes optimization to balance protection with other important factors to ensure that actions taken cause more benefit than harm. The guides are specific to the phases of an emergency, which are loosely defined as follows: Early – the period during which there is active release of radiological material, and field data is limited; Intermediate – the period after active release of radiological material has ceased and field data become available; Late – the period when site restoration occurs and reoccupation of lands may occur. Clearly, these time periods can vary, and there is overlap between phases, but the distinctions are useful to planners and decision-makers.

Table 1 reproduces key PAGs from the EPA PAG Manual. PAGs are available for the early and intermediate phases only, since they represent a dose that decision-makers wish to avoid. Late phase site restoration criteria do not technically constitute a projected dose at which a protective action is recommended. Rather, clean up and site restoration criteria are derived site-specifically, and should be anchored by health protective precedents.

Protective action guides are only for use for relatively short time periods under emergency conditions. Note also, that PAGs are non-regulatory guides, and that they are meant to be flexible to provide bases for decisions under varying emergency circumstances.

It is important to have some reasonable estimate of the expected dose to the public so that sound guidance can be given. As pointed out earlier, NPP accidents lend themselves to the use of PAGs, because estimates of radionuclide releases can typically be made with sufficient time to execute protective actions. Government officials must assess the likelihood that exposures will occur, the potential health implications, and the costs and logistical difficulties of executing a particular protective action. For example, evacuation is costly in monetary terms, and also has a fairly high risk of injuries and fatalities associated with it. On the other hand, a large population left exposed could result

Table 1. Early and Intermediate Phase Protective Action Guides

PHASE	PROTECTIVE ACTION	PROTECTIVE ACTION GUIDE	REFERENCE
Early	Shelter-In-Place of Public	1 to 5 rem projected dose[1] (normally initiated at 1 rem)	EPA PAG Manual
	Evacuation of Public	1 to 5 rem projected dose (normally initiated at 1 rem)	EPA PAG Manual
Intermediate	Relocation of General Public: 1st Year	2 rem/yr projected dose	EPA PAG Manual
	Relocation of General Public: Subsequent Years	500 mrem/yr projected dose	EPA PAG Manual
	Food Interdiction	500 mrem/yr projected dose	EPA PAG Manual
	Water Interdiction	500 mrem/yr projected dose	(EPA, draft under consideration)

in significant collective dose and increased risk of cancers in the population. Relocation, a longer-term option, is very costly in monetary terms, and causes significant distress and inconvenience to relocated populations.

In the Early Phase (often called the Emergency Phase, up to about 4 days), populations should be evacuated if the projected dose is in the range of 1 to 5 rem, and would normally be initiated at 1 rem for protection of children and sensitive populations. Shelter-in-place may be advised for lower levels to avoid internal exposures, or for populations that would have difficulty evacuating, such as medical or special needs populations. Sheltering in place is gaining in credence among emergency management officials for a wider range of circumstances.

Relocation of populations may be appropriate in the Intermediate Phase if projected doses are 2 rem or more over the course of the first year, and 500 mrem in any subsequent year. This rough gradation reflects the fact that typical radionuclide releases from NPP accidents decay away fairly quickly. Radiation doses received via food and water should each be kept below 500 mrem, or alternate sources should be secured.

Recommendations Of The DHS Workgroup

Since the EPA PAG Manual was not developed with today's terror scenarios in mind, affirmation of the PAGs for use in RDD and IND incidents was needed, or new values would be required. The DHS interagency workgroup evaluated the current PAGs for the early and intermediate phases, and determined that they were appropriate for use in the event of an RDD, and useful for an IND.

Of particular interest was the fact that advance notice of radiological or nuclear terror, as we have seen is typical of NPP accidents, is unlikely. Avoiding the plume is the first line of protection. Are the PAGs useful and applicable when radioactive material is already in the air, or on the ground? While getting word out to potentially affected populations in time to do any good may seem nearly impossible in an RDD incident, the PAG levels themselves were still determined to be appropriate. Due to the inherent time constraints, sheltering in place, at least until orderly evacuation can be arranged, would likely be more appropriate guidance than a hasty evacuation when airborne contaminants may still be present.

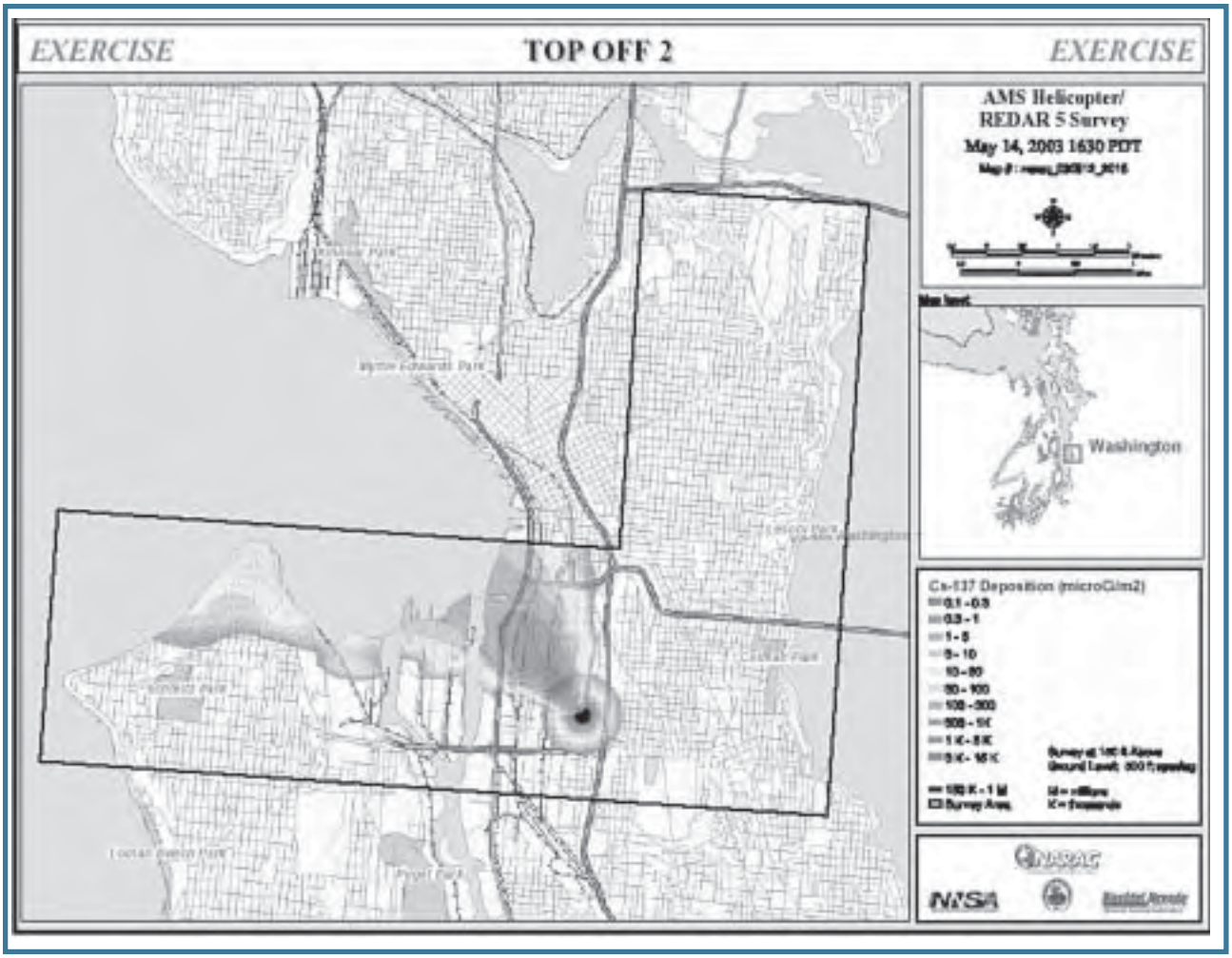
Another key question was whether these dose values are relevant in an IND incident. In the case of an unannounced or surprise IND, many lives may be saved in the hours after detonation if officials can effectively communicate evacuation orders to downwind populations, and the evacuation process itself can be executed in a timely, manageable fashion. Such urgent decision-making will not have the same kind of cost-benefit basis as less catastrophic incidents. In the hours when evacuation is critical, those estimated to receive 5 rem would most likely take a back seat to those in the direct path of deposition and potentially subject to hundreds of rem, followed by groups receiving tens of rem. Such decisions can only be made during the incident. However, if advance notice is received, the 1 to 5 rem evacuation PAG would be useful. Thus, the workgroup did not favor establishing separate protective action guides for use when an IND has gone off suddenly.

A further point of interest was the scaling of the Intermediate Phase relocation PAG; 2 rem for the first year, and 500 mrem in subsequent years. While it is possible terrorists would employ short-lived radionuclides in an RDD (one can always hope), it is more likely they will acquire one of several readily available industrial isotopes with a longer half-life. If the isotope of choice is ^{137}Cs ($T_{1/2}$=30 years), as may well be the case, one year will not significantly reduce the radioactivity on site. In this case, decontamination and dispersion by natural forces will have a much greater impact than decay. Decision-makers should be prepared for Intermediate Phase doses that will not significantly change in the ensuing years. For example, if projected doses were 1 rem each year for a number of years out, relocation orders may be warranted in the first year.

During the Intermediate Phase, and as soon as possible, long-term site restoration planning should begin. This planning process is relatively independent of Intermediate Phase emergency response activities. It should be an open and inclusive process the goal of which is to agree upon a public health protective site restoration strategy.

The workgroup considered numerous approaches to setting criteria for cleaning up after a radiological or nuclear terror incident, including dose and risk based regulatory standards of the Nuclear Regulatory Commission, the Department of Energy, and the Environmental Protection Agency. In addition, clean up guidance issued by national and international radiation advisory bodies (such as the National Council on Radiation Protection and Measures, and the International Commission on Radiological Protection) were considered.

The workgroup determined that the nature of potential impacts from radiological and nuclear terror inci-



dents was extremely broad, ranging from light contamination of one building to widespread destruction of a major metropolitan area. Therefore, it was concluded that a pre-established numeric guideline was not recommended as best serving the needs of decision-makers in the Late Phase. Rather, a site-specific process, utilizing local objectives for expected land uses, should be used to determine the options and approaches available, and the most acceptable criteria for that site should be selected. For example, if the incident is an RDD of limited size, such that the impacted area is small, then it might reasonably be expected that a complete return to normal conditions using very protective criteria can be achieved within a short period of time. However, if the impacted area is very large, then achieving very low criteria for remediation of the entire area and/or maintaining existing land uses may not be practicable.

The clean up process should be implemented by engaging knowledgeable technical experts and key stakeholders to provide decision-makers with advice on the options, costs, and implications of various courses of action. This process, detailed in the workgroup's guidance document, should result in the selection of the best and most acceptable solution, a process often referred to as optimization.

Optimization is a concept that is common to many state, Federal, and international risk management programs that address radionuclides and chemicals, though it may be called by other names. Cost-benefit analysis is one form or aspect of optimization that many are familiar with. Broadly speaking, optimization is a flexible, multi-attribute decision process that seeks to consider and balance many factors. The evaluation of clean up alternatives, for example, should factor all relevant variables, including; areas impacted (e.g., size, location relative to population), types of contamination (chemical, biological, and radioactive), human health, public welfare, technical feasibility, costs and available resources to implement and maintain remedial options, long-term effectiveness, timeliness, public acceptability, and economic affects (e.g., on residents, tourism, business, and industry). The optimization process may consider a variety of dose and/or risk benchmarks from state, Federal or other sources (e.g., national and international advisory organizations) as goals or starting points in the analy-

sis of remediation options, and levels may move up or down depending on the site specific circumstances and balancing of relevant factors.

The workgroup drafted an implementation plan for the site restoration analysis and decision process. The plan describes a team approach in which two working groups, one of stakeholders and one of technical subject matter experts, interact to arrive at a solution for the site, under the management and oversight of a group of senior local, state and Federal officials. The stakeholder workgroup would represent local interests, and relate local land use wishes and public health and welfare concerns. The technical group would perform analyses, evaluate technologies and options, assess cost-effectiveness, and estimate timelines for completion. Through ongoing discussions, all three working groups should arrive at an agreed remediation solution and criteria for site restoration.

The constitution of the groups and the interactions among them may be shaped to meet specific local needs and concerns. For example, larger, more complex incidents may require a number of technical experts with specific skills and knowledge, and the location may warrant varying stakeholder group composition. The implementation plan is scalable to the situation.

The goal of the whole process is to reach an agreed upon approach to site clean up and restoration within a reasonable timeframe that is effective, achievable, and meets the needs of local stakeholders. The final decision must be approved by the top local, state and Federal decision-makers, in order to commit funding and resources to the clean up and restoration process (it is assumed the Federal government will be the principal source of funding). The most important customer in the process is the local government.

Final Thoughts

The threat of an RDD is very real. Intelligence experts fear that dirty bomb plots may be more than just schematics found on scraps of paper in Afghanistan; they fear active plots may be underway. Much has been accomplished in the last couple years to prevent and prepare for an RDD. Early and Intermediate Phase protective action guides for radiological and nuclear terror are important steps forward. But, much remains to be done.

Dirty bombs are inherently low-tech and not particularly interesting. It's time we look beyond arcane schemes of dispersal and the impending devastation of a worst-case dirty bomb. We should focus attention on realistic scenarios and what to do if one is successfully deployed. Some progress has been made in terms of looking beyond the event itself to the realities we will face after the dust settles. The Late Phase site restoration guidance developed by the subgroup is one piece of the puzzle. But, it still falls short of what is ultimately needed to manage the potential long-term environmental consequences.

The emergency lasts hours to days; the environmental damage may last years. How will we clean it up? Do we have the technologies and procedures to efficiently, effectively and expeditiously decontaminate large areas of a city? Are Federal agencies prepared for such a long-term clean up, and all the associated scientific, social, political, and institutional implications and demands? The homeland security establishment, immersed in emergency response planning and exercises, must focus critical attention to the ponderous, but crucial challenge of cleaning up the aftermath. Regardless of the means of dispersion we will be faced with a significant environmental problem.

Finally, more Federal government attention needs to be given to both response and recovery following a nuclear detonation. The level of thinking has not gone far beyond the immediacy of triage. This may be due to several reasons: it is a low probability event (there are other priorities); we are lagging and the preparation needed is daunting; and, it is just too awful to think about. This is a critical area for interaction between the Department of Defense and the other Federal agencies. If risk is defined as probability times severity of hazard, or consequences, then a nuclear detonation is a high risk proposition that cannot be discounted any longer.

References

[1] US Environmental Protection Agency, May 1992, EPA-400-R-92-001

[2] Radiation dose in rem (roentgen equivalent man), total effective dose equivalent

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Nuclear Disablement Team in Operation Iraqi Freedom: Part II

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This article continues the discussion from the Fall / Winter 2003 *NBC Report* regarding Nuclear Disablement Team (NDT) operations conducted during Operation Iraqi Freedom (OIF). The previous article focused on the transformation of the NDT from a concept to a reality in 30 (very hectic) days last April. This article focuses on how this reality was tested during the execution of various missions in Iraq. In particular, this article will discuss specific missions during the NDT deployment and future NDT operations.

As mentioned in the previous article, the NDT was capable of executing three of four phases of the Defense Threat Reduction Agency's (DTRA) Weapons of Mass Destruction-Elimination (WMD-E) concept. DTRA was assigned the four-phased WMD-E mission in March 2003, which consisted of the initial identification of weapons and related facilities (site assessment), collection of intelligence and forensic evidence at these sites (exploitation), disablement of weapons/facilities to prevent use against Coalition forces (disablement), and disposal/removal from theater (elimination). This mission involved many teams task organized to execute a particular phase after discovery of nuclear, biological, chemical (NBC) or missile weapons and facilities in Iraq. The NDT was capable of executing assessment and exploitation missions but deployed primarily to execute the disablement mission.

Table 1 summarizes the timeline of the NDT deployment. The NDT deployed to Camp Doha, Kuwait as a fully manned and equipped team. At Doha, the team linked with its NDT equipment escorts and a DTRA liaison element, which later became Task Force Disablement and Elimination (TF D/E) led by Navy Captain Rick Weyrick. The DTRA TF D/E was charged with the disablement and elimination piece of the overall WMD mission in Iraq. At Combined Forces Land Component Commander (CFLCC) Headquarters, planning and coordination were completed for the movement of the NDT's personnel and equipment to Iraq. After much discussion with CFLCC and TF D/E leadership, COL Mickey Freeland, the NDT Commander, coordinated for the NDT to fall under the 75th Exploitation Task Force (XTF). The staff from the 75th Field Artillery Brigade formed the nucleus of the 75th XTF located in Baghdad. They had been charged with the full-spectrum WMD mission in Iraq, and therefore, had been augmented with personnel possessing chemical, biological, radiological, nuclear and high-explosive (CBRNE) and intelligence expertise.

Once the command structure was in place, an initial concept of

Table 1. NDT Timeline (2003)

- 1 March: Warning Order of possible deployment
- 1 April (Birthdate of NDT): Deployment Order Directed Chief of Staff of the Army (CSA) to deploy NDT
- 7-17 April: Training
- 30 April: Arrival at Camp Doha, Kuwait
- 7-8 May: Movement to Camp Slayer, Iraq
- 11 May: "Right-seat ride" with Mobile Exploitation Team
- 16 May: At Tuwaitha Site C Recon
- 18-20 May: At Tuwaitha Site C – NDT Inventory
- 6-23 June: At Tuwaitha Site C – IAEA Inventory
- 17 May – 30 July: Ad Hoc missions
- 15 July – 2 August: Three-Phased redeployment

operations (CONOPS) and task organization (TO) were developed for an anticipated short-suspense operation at the At Tuwaitha Nuclear Research Center (TNRC), Site C. Intelligence was sketchy, but identified that the facility contained nuclear material and had possibly been looted and/or damaged. The initial CONOPS and TO were later refined as the team gained operational experience; however, each team member, NCO and officer alike, contributed his particular expertise to development of the overall mission plan – a trait repeated again and again before every mission.

Due to the urgency of the Tuwaitha mission, the NDT convoyed to Baghdad (supported by a chemical brigade element) a week later. The team set up its base of operations at Camp Slayer, approximately one kilometer from both the Baghdad airport and V Corps Headquarters. Camp Slayer was occupied with many different units competing for limited resources, so logistical support was an immediate challenge. The team coordinated with the chemical brigade to attach four NBC soldiers (54B) to the NDT. These soldiers would provide support as required for a radiological Emergency Contamination Control Station (ECCS) and decontamination of NDT personnel. The NDT pieced together intelligence on the site from Defense Intelligence Agency sources, planned a recon, trained for the mission, coordinated for transportation and logistical support on-site, and tested all necessary equipment to meet a 10-day suspense date to execute the Tuwaitha mission.

At Tuwaitha Mission

At the site, the NDT mission was to determine and record the status of the nuclear and radiological material, inventory the materials, improve physical security, and assess the health risks.

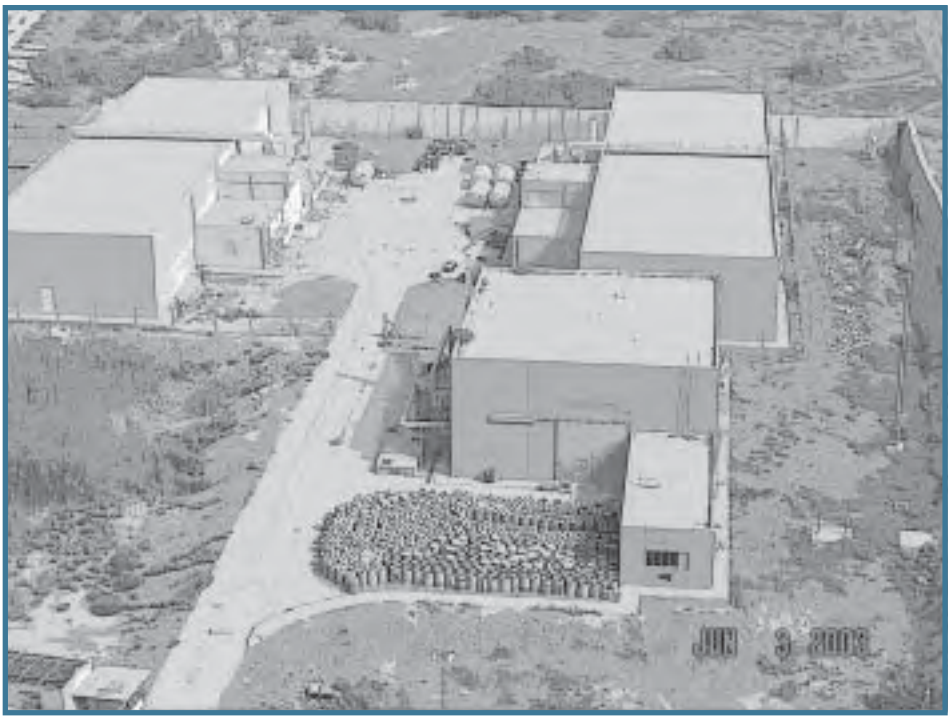

Figure 1. Aerial View of At Tuwaitha Site C. Building 1 is Pictured on the Upper Left; with Building 2 and Building 3 on the Upper and Lower Right Respectively.

As shown in Figure 1, At Tuwaitha Site C consisted of three warehouses on a four-acre compound, which stored over 500 metric tons of various uranium compounds previously inspected and sealed by the International Atomic Energy Agency (IAEA) under international nuclear material safeguards agreement. So, another critical mission component was to determine the integrity of the IAEA seals on safeguarded material. Building 1 housed barrels of various uranium compounds, Building 2 housed barrels of natural uranium powder called "yellowcake," and Building 3 housed a large number of sealed radioactive sources.

The team completed a leaders reconnaissance of the site, which caused extensive revisions to its preliminary mission plan. Intelligence had hinted of possible looting at the site and theft of material. A DTRA Direct Support Team (DST) surveyed areas outside the compound, while COL Mickey Freeland, MAJ John Greaves, MAJ Jerry Vavrina, SGM Randy Hefner and SFC Bruce Schellpfeffer reconnoitered areas inside the perimeter. The NDT reconnaissance element did not enter the buildings, but found reality much worse than intelligence had predicted. They observed evidence of extensive damage, with all three buildings unsecured, doors pried open, windows broken, and no electrical power at the site. Even worse, the contents of many barrels were dumped in the anterooms of two buildings, and piles of nuclear material were also found dumped outside these buildings. The reconnaissance certainly demonstrated the critical need for air sampling on-site, radiation safety precautions, wear of personal protective equipment (PPE), augmentation with a decon/ECCS team, power generation, and extensive documentation

equipment (still/movie cameras). The team documented damage to the site and completed a full radiation survey of the exterior of each building and the compound itself. With this new information, the NDT worked the next two days revising their operational plan and training for this mission.

Two days later, a fully trained, manned and equipped NDT, augmented by chemical brigade elements, a DST, and a security detachment, convoyed the 26 kilometers to Site C. Once on-site, the team linked up with a platoon from a V Corps infantry regiment, who provided security throughout the mission. A secure perimeter was critical since all NDT personnel working "downrange" in the contaminated area wore full PPE (Tyvek suits, respirators, gloves, booties) without weapons. The security detail had to respond several times to shots fired into the perimeter, which further demonstrated their critical role in keeping the NDT safe. To everyone's surprise, the site had changed since the reconnaissance. Additional large-activity gamma and neutron sources and empty uranium-storage barrels were found outside the buildings. The Office of Reconstruction and Humanitarian Assistance (ORHA), the predecessor of the current Coalition Provisional Authority (CPA), had collected these items from surrounding Iraqi communities. As a result, the team changed its TO to that shown in Table 2.

Team 3 was originally planned as a second inventory team, but instead completed clean-up of the sources, spilled materials, and barrels left by ORHA.

Table 2. NDT Task Organization

- Team 1: Initial Entry
  - Objective: Characterize, ID, mark hazards
  - 1 HP: Survey/sample ambient exposures and surface contamination
  - 1 EOD Tech: Unexploded Ordnance (UXO)/booby-trap clearance, data recorder
  - 1 EOD Tech: videographer, backup survey as required
- Team 2: Inventory
  - Objective: Inventory and record building contents
  - 1 Nuclear Engineer: Inventory / ID contents
  - 1 HP Tech: Airborne Monitoring / recorder
- Team 3: Cleanup crew
  - 2 Nuclear Engineers: Inventory and move spilled material into building
  - 1 EOD Tech: Recorder
- EOD Emergency Contamination Control Station (ECCS)
  - 4 54Bs : 2/2-person teams concurrently: 1 for equipment, 1 for personnel
  - 1 OIC : log and control entry/exit downrange; dose/time tracking
  - 1 TOC OIC : Point of Contact for downrange personnel

The other two teams inventoried the site's contents with the least hazardous, Building 2, inventoried first, followed by Building 1 and Building 3. The buildings' interiors were found to be in even worse shape than observed during the reconnaissance. In particular, the inside floor of Building 1 contained a "beach" of uranium compounds, bottles and bags ten meters square and one meter high all mixed together on the floor. Building 3 contained dozens of high-activity radioactive sources dumped in a pile on the floor. Only Building 2 was in fairly good shape, with most of its barrels intact. To make matters worse, IAEA seals on the doors inside the buildings had been breached.

The team bivouacked at the site to maximize work efficiency. The NDT inventoried the barrels and documented by video the condition of the site to include the IAEA seals, but were unable to determine the amount of spilled material. All senior members of the NDT went downrange as eyewitnesses to the contents of each building. This action was necessary since it was clear that the US occupying force was now responsible for Iraq's nuclear material under international treaty. The team's report resulted in the US Government inviting an IAEA inspection team to inventory the site using IAEA database records. The NDT was tasked with

the unanticipated mission of US delegation for a treaty-related mission, which involved escort of the IAEA team and rendering every available assistance to the IAEA inspectors.

While waiting for the arrival of the IAEA two weeks later, the NDT convoyed daily to the site to work with former members of the Iraqi Atomic Energy Commission (IAEC) (many of whom had previously worked at TNRC) to completely seal all buildings and erect a perimeter wall and access gate. This work was done to both safeguard the nuclear material as well as protect the local populace. Meanwhile, the 75th XTF redeployed and was replaced by the Iraqi Survey Group (ISG). As a result, the NDT fell under the operational control of the ISG through the TF D/E. As such, the NDT became one of the analytical TF D/E teams (along with biological, chemical and UAV/missile teams) and, consequently, picked up ad-hoc exploitation-type missions as well. The ISG Commander understood that NDT skill sets such as health physics, nuclear Explosive Ordnance Disposal (EOD), and nuclear engineering were just as useful in exploiting a site for intelligence data as in disabling a site.

Upon arrival of the IAEA team, the NDT fully briefed them on the NDT assessment of Site C and completed a joint reconnaissance of the site. Logistics immediately became a problem since the IAEA team had a 17-day window to complete their mission and unfortunately, did not deploy with sufficient expendable supplies and safety equipment to complete their mission. As a result, the IAEA and NDT shared equipment and supplies, contracted Iraqi workers as necessary, and modified their task organization to complete the mission. When emergency supplies could not be procured quickly enough, both teams brainstormed to continually develop field-expedient and safe solutions to problems. In particular, the mix of uranium compounds in Building 1 produced toxic gases, which required NDT personnel to work in M40 masks and IAEA teams members to use equivalent commercial respirators.

The IAEA members stayed at the Al Rasheed Hotel in Baghdad, and the NDT was directed to stay at the hotel also to foster better cooperation and simplify logistics and security requirements. While the former five star hotel was in serious disarray, it did have (occasionally) warm showers, which were a welcome benefit for the NDT Soldiers, who had no access to showers for the first month of their deployment.

The NDT faced increasing demands due to intense scrutiny by the press and senior-level Pentagon officials, and the grueling workload of cleaning-up, sorting and accounting for tons of spilled nuclear material in full PPE. Therefore, they were split into two elements to allow for additional mission and recuperation time. Health physics, EOD, operations, and nuclear expertise were split equally between the two elements. LTC Kurt Westerman led SSG Donald Bowes (Health Physics Technician) and EOD technicians SFC Schellpfeffer and SSG Rocco Covello on one NDT(-) element. LTC Brent Bredehoft led MAJ Vavrina (Health Physicist (HP)), LCDR Art Tucker (Nuclear Engineer), and SSG Kevin Unterbrink (EOD technician) on the other NDT(-) element. These two NDT elements rotated work on a 2-day on / 2-day off schedule. One element would convoy daily to Site C while the other team would complete ad-hoc missions or work to procure equipment. MAJ Greaves and SGM Hefner alternated shifts as Tactical Operations Center Officer in Charge (TOC OIC) at the site. COL Freeland worked daily at the site and provided daily situation-reports to various headquarters in Iraq and in the US.

To accomplish the IAEA mission on time, NDT members not only escorted the IAEA inspectors, but also worked side-by-side with them. The inventory necessitated the transfer of tons of uranium powder back into barrels by-hand with shovels, handtrucks, and HEPA vacuum cleaners inside field-expedient tents to contain the resulting dust. The mission was a success, as shown in Figure 2, which provides a comparison of the site before and after the IAEA-NDT clean-up. Only 10 kilograms (kg) out of 544,000 kg of material were unaccounted for, well within measurement error!

Ad Hoc Missions

As the word spread about the NDT's expertise, any mission involving radiological material turned into a tasking, primarily for the NDT to determine the hazard or confirm the presence of nuclear material. Several NDT missions to sites such as Ash Shakili and Shaqlawa were executed more as part of the exploitation mission than the disablement mission. Ash Shakili was a severely looted site, 2 kilometers from Tuwaitha, that housed machinery associated with the uranium enrichment processes. The NDT surveyed this site and took many samples to be used as possible evidence of a nuclear weapon development program. In support of an Other Government Agency (OGA), the NDT was also tasked to verify suspected weapons-grade uranium spectroscopy results on sources discovered in Shaqlawa, a military garrison within the Kurdish territory of northern Iraq. An NDT team identified that the sources were not special nuclear material, but only high-activity commercial-use radioactive sources.

NDT ad hoc missions also involved sites related to the disablement mission such as Al Qaim, the Al Tamud Missile Factory, and Tuwaitha Site B. Al Qaim was a storage site, which contained "yellowcake" byproducts of the Iraqi uranium enrichment process. An NDT(-) element surveyed the site and supervised transport of the material for storage at Tuwaitha Site C. Al Tamud was a severely looted site 5 kilometers from the Baghdad airport, which housed a missile factory. A very alert Chemical Corps officer, 1LT Christian Piatt, discovered a very high dose rate (1 rad/hour, about 10,000 times background rates) area and ensured US Soldiers were kept off the compound. An NDT element surveyed the site, located and removed a large europium source commonly used in Iraq as a lightning arrestor.

Tuwaitha Site B is a 34-acre complex with ninety or more buildings that was the former center of Iraqi nuclear research and reactor development. Multiple radioactive sources were found in several storage areas. Additionally, there were two destroyed reactors located on the site. One reactor had been bombed by the Israeli government in 1981, and the other reactor had been bombed by Coalition Forces in 1991. NDT members assisted in the conversion of a large bunker into a radioactive waste and source storage facility. This bunker was later (and is currently still being) used as a temporary holding area to receive radioactive sources collected by DTRA contractors as part of the elimination mission.

Redeployment

Once it was determined that the disablement phase of the overall WMD-E mission was nearing completion due to lack of any working facilities, plans began for the redeployment of the NDT. The NDT refined their CONOPS to include a three-phased redeployment of personnel in order to maintain the disablement capability in theater during their redeployment timeframe. Starting one month before the elimination mission was initiated, the NDT worked extensively to smooth the transition from the disablement mission to the elimination mission. The NDT educated the chain of command on the implications and requirements of collection, storage, and movement of thousands of Iraqi radioactive sources that would constitute the WMD-elimination phase. The NDT worked with various Army commands and the CPA, to include the Iraqi Ministry Of Health, to effect coordination between these agencies to ensure the safety of US Soldiers and Iraqis who may encounter radioactive sources. The NDT also trained DTRA Site Assessment Teams (SAT) to safely identify and assess radioactive material sites.In addition, the NDT provided equipment lists, personnel dosimetry services, operational and technical expertise, and Iraqi radioactive source intelligence to DTRA contractors as part of the handoff to civilian support of the OIF WMD-E mission. The NDT escorted the contractor advance party to Tuwaitha Site C and Site B and shared their operational expertise with them. Roughly half of the NDT equipment inventory, to include life support and technical equipment, was signed over to DTRA for use by the contractors. The NDT Deputy Commander, LTC Brent Bredehoft of DTRA, stayed an additional two months in Iraq and assisted the contractors in completing numerous

Figure 2. The Inside of Building 1 of At Tuwaitha Site C Before and After the Joint NDT-IAEA Inventory and Clean Up. Barrels and Spilled Material Shown Contain Various Types of Solid Radioactive (Mostly Uranium) Compounds.

radioactive-source elimination missions throughout Iraq.

Future Operations

Missions executed by the NDT in Iraq validated the original concept developed in March 2003. The 11-man NDT quickly became the "go-to-guys" in theater for any radiological issue or concern. In today's world where counter-proliferation is becoming increasingly important, it is essential that military planners identify the need for this capability when planning an operation in any nation possessing radiological sources. USANCA continues to maintain this Department of Defense (DoD) nuclear/radiological disablement capability and continues to refine this concept using OIF lessons learned.

At the onset of OIF, the Department of Energy was selected as the proponent for movement of radioactive material in Iraq. The NDT mission experience demonstrated that DoD personnel trained in functional areas 52 (Nuclear Research and Operations), 72A (Nuclear Medical Science (Health Physicist)) as well as nuclear-trained EOD personnel possessed the correct skill sets to assume this mission. Therefore, one new proposal to refine the NDT concept adds more EOD and health physics technician billets and associated equipment to allow packaging and shipping of radioactive material. This added capability would transform the NDT into a Nuclear and Radiological Assessment and Disposition Team (NRADT) capable of handling a full-spectrum WMD-E mission (assessment/exploitation/disablement/elimination), including radiological source recovery and even incident/accident response missions. These additional capabilities are feasible since the personnel skill sets (EOD, health physics, nuclear engineering/physics) for these types of missions are the same; only the amounts of various equipment sets differ. Under the NRADT concept, high-activity radioactive sources that were beyond the equipment capability of the NDT during OIF would be within the charter of the more robust NRADT. Table 3 shows the proposed NRADT organization.

Staffing and deliberate planning are also underway to institutionalize the NDT into a permanent DoD capability. Currently, the NDT is slotted to transfer to the CBRNE Command by its fiscal year 07 full-operational capability date. The future of the NDT, or NRADT, and the required resources needed to maintain it will be determined when better-defined requirements are furnished by regional combatant commanders. Hopefully, this problem will be rectified soon, to preclude standing up another ad hoc capability in 30 days before the next major operation. This ad hoc method may have worked in support of OIF, but it is not the recommended solution!

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Major John Greaves is a FA52 officer currently stationed as a Homeland Security/Consequence Management Exercise Planner in J7, Joint Warfighting Center, Joint Forces Command, Norfolk, VA. Major Greaves is a graduate of the US Army Command and General Staff College.

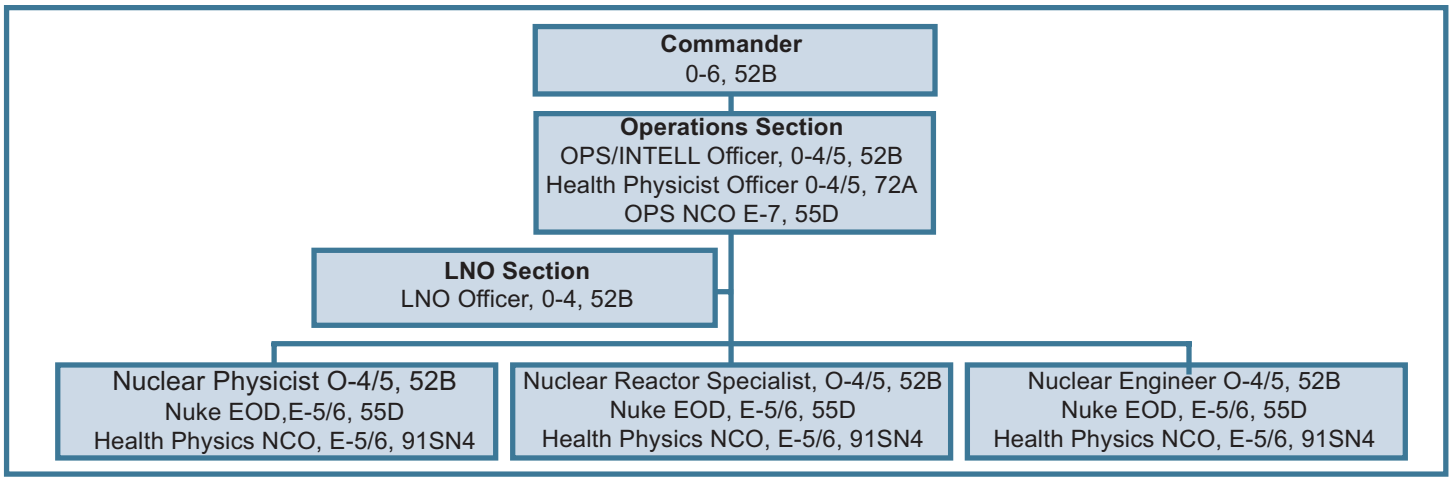

Figure 4. Proposed NRADT Organization

The Atomic Dream - - Belvoir Facility Heralded the Birth of Military Nuclear Power

Mrs. Jennifer Brennan
Staff Writer, Belvoir Eagle

The cloud of steam that poured from its heart, a generator powered by a rotating turbine, could produce electric power for a city of 2,000 people. In one of its rooms, military nuclear specialists would scurry around an electrical panel monitoring readings. A color-coded panel taught them how to monitor a nuclear power plant's internal structure while the meter readings displayed the plant's vital statistics.

It was 1957, and the Army's first nuclear power plant, the SM-1, was alive and in operation at Fort Belvoir. The SM-1 remains today, sitting atop a plateau overlooking the Potomac River's Gunston cove. It is kept secure behind the fence of the CECOM Research and Development Center.

The SM-1 blazed the trail for other nuclear power plants in the Department of Defense. During a visit to the SM-1 in December, the white dome stood firm with patches of rust. A sign on a locked gate surrounding the dome reads, "U.S. Army Property," and in red lettering: "No Trespassing." Decaying leaves and bits and pieces of branches were scattered across the snow-covered steps leading into the SM-1. "And here she is," Brendan M. Burns, U.S. Army Nuclear And Chemical Agency Army Reactor Program Manager, exclaimed as he looked up at the dome in admiration.

Inside, voices would slightly echo, the air was chill, and an area where infrequent visitors could be exposed to radiation lies sealed with a pad lock. Paint peels from walls stained with decades of dirt. The building's nerve center, the control room, was layered with dust, a stark contrast to the flurry of activity that once went on there.

Burns wore a dosimeter to measure radiation levels, but assured the areas entered were harmless. Burns said quarterly inspections are conducted to check the levels of radiation.

The SM-1's origins

The SM-1 stands for Stationary, Medium power. The "1" represents its roots— the first prototype of its kind developed by the Army, Atomic Energy Commission and the Department of Defense.

Its roots date back to a presidential address before the General Assembly of the United Nations. President Dwight D. Eisenhower gave an "Atoms for Peace" speech on December 8, 1953. The "birth" of atomic power followed shortly thereafter. Instead of using diesel-fueled power, the atomic dream was "power too cheap to meter," Burns said.

The Army's decision to build a nuclear power plant came shortly after Eisenhower's address. At the start of World War II, the Army began relying heavily on petroleum, oil and lubricants. The demand became high and a lot of time was consumed transporting conventional fuel by way of airplane, ship or military ground vehicles.

The vision behind the SM-1 was to find a better solution to the time and effort devoted to transporting conventional fuel to specific locations. Studies showed this problem could be alleviated with use of nuclear fuels.

After studying the pros and cons of nuclear power, the U.S. Army Corps of Engineers began developing plans for its first prototype. A survey of various locations, conducted in the United States, led to the land chosen to build the first prototype – on Fort Belvoir. After 18 proposals were received to build and design the Army's first prototype, the contract was awarded to ALCO products. Construction began on

A Sign Marks a Danger Area in the SM-1 Building

the SM-1 on October 5, 1955 and the plant began producing electrical power on April 15, 1957.

Shortly after the SM-1 was in operation came a sister model, the SM-1A. The SM-1A was built in Fort Greeley, Alaska and supplied nuclear power to the Fort Greeley Army installation. Another of the Army's nuclear reactors was located aboard the Sturgis, a floating barge equipped with a reactor that produced 10 megawatts of power.

The SM-1 led the way as a training facility, preparing service members to work at nuclear power plants in remote locations.

Training at the SM-1

Volunteer military service members in the Army, Navy and Air Force were selected for training at the SM-1, a training site for nuclear power plant operations. In the yearlong training, they learned how to operate, maintain and repair the plant as deemed necessary. How to fuel and defuel a power plant was also a lesson learned. At least 800 graduated from the training course.

Michael Hunter recalled fond memories during the months in 1971 that he trained at the SM-1. Hunter came to Fort Belvoir as a student in the nuclear reactor program. After training at the SM-1, Hunter was qualified to operate a nuclear power plant. On Thanksgiving Day in 1972, Hunter was assigned to nuclear operations on the Sturgis.

Training at the SM-1 was intense, Hunter said. "They wanted to break you down so they could train you back up," Hunter said, as he reflected on memories of his first night shift at the SM-1. "I think the biggest thing it taught me was to think on my feet – as a young kid."

Today, Hunter works from his office at Fort Belvoir and manages the Army's war reserve of prime power generators. If Hunter took a stroll through the SM-1, he has no doubt that he would remember each of its parts, he said.

Though the SM-1 primarily trained service members for jobs in nuclear power operations, it had another function. The SM-1 generated enough power to light Fort Belvoir during the day. And at night, the SM-1 generated power that was fed to the local communities surrounding the installation, according to Burns. Although the SM-1 was not built to supply power to the community, it is believed to be the first nuclear power plant to supply power to a commercial grid. The SM-1 generated 2,000 kilowatts of energy - enough power to supply power to a community of approximately 2,000 people, Burns said. Though Fort Belvoir and the surrounding community drew from the plant's generated electric power, the SM-1's days as an active nuclear power plant came to a close with the deactivation of the Army, Atomic Energy Commission in 1973.

SM-1's fate

The nuclear fuel and control rods were removed from the SM-1 and the plant was shut down on March 16, 1973.

Discussions centered on opening the SM-1 as a museum following its closure. But security concerns and the costs to maintain the SM-1 and hire personnel caused the idea of a museum to dwindle.

"It seemed good at first but there were too many things that had to be worked out," said Malcolm McLeod, Deactivated Nuclear Power Plants Program manager. "Besides the

MAJ John Carter, a nuclear physicist with the Army Nuclear Reactor Program, explains the control room of the SM-1.

money and other issues, there was this problem with clearance."

What is to come of the SM-1 is still being determined.

"It is expensive to clean up a nuclear facility," Burns said. "To me it would be ideal, the sooner the better to decommission this."

In order to move toward decommissioning the facility, the Army has started an all-hazard survey, taking into consideration environmental needs. Historical records are under review and people are being interviewed about the time they spent at the SM-1. The floor tiles are being checked for asbestos and samples of soil are being collected. "It's not like you're tearing your house down you know," Burns said.

Sam Crispin, U.S. Army Corps of Engineers safety specialist, accompanied Burns during the visit to the SM-1 in December. His prime responsibility is to monitor the safety and security of the SM-1. DynCorp maintains the grounds and mows the lawn surrounding the SM-1. Overall, the SM-1 is "very easy to maintain," Crispin said.

The SM-1, the Army's first nuclear power plant, remains at Fort Belvoir today.

McLeod said assuredly, there are "no health and safety issues to the public."

When Burns reflects on the history enveloped in the building, he is nostalgic.

"We're not hiding anything. There's nothing to hide. It's a national treasure," Burns said.

Editor's note: Story and photos first appeared in the Jan. 15, 2004 issue of the Belvoir Eagle, Fort Belvoir, Va. Jennifer Brennan and Donnie Biggs serve on the Belvoir Eagle staff. Donnie Biggs provided the photographs in this article.

Mrs. Jennifer Brennan is a Staff Writer for the Belvoir Eagle. She has worked in journalist assignments with the Potomac News, Manassas Journal Messenger, and the Stafford County Sun. Mrs. Brennan has an Associate's Degree in Print Journalism from Ricks College and a B.S. in Print Journalism from Utah State University.

Photo, taken from historical archives, shows military personnel training when the plant was in operation. *The easy to follow plant schematic was an early example of human factors engineering in nuclear plant control room design.*

Brendan Burns, Army Reactor Program Manger, and Samuel Crispin, U.S. Army Corps of Engineers safety specialist, explain the inner workings of the SM-1.

Special Nuclear Material Imaging Using a Germanium Strip Detector

CPT Clifford V. Sulham
Dr. Larry W. Burggraf
Air Force Institute of Technology

"The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense or the US Government." (AFIT 35-101, para 15.5)

The Air Force Institute of Technology (AFIT), working with the Defense Threat Reduction Agency (DTRA), saw a need for a gamma ray detector capable of producing images of radioactive materials. DTRA sponsored a thesis project to study the feasibility of using a germanium strip detector (GSD) to image special nuclear material (SNM). For the purposes of this project, the SNM was assumed to be plutonium 239 (Pu-239). The particular application of interest was imaging fissile material that is located within the pit of a nuclear weapon. The faculty advisor of the research was Dr. Larry Burggraf, and Capt Clifford Sulham, a Master's student at AFIT, performed the research.

Research Objectives

This thesis project was undertaken in order to provide the DTRA weapons inspection community an improved capability for distinguishing nuclear weapons from spoofs. Measurements of the size, shape and isotopic composition of nuclear weapon pits are useful properties to distinguish a spoof source. To image the size and shape, moderate spatial resolution is useful; to measure isotopic composition, good energy resolution is necessary. Current detectors used during weapons inspections only collect a gamma spectrum from the radioisotopes within the weapons storage cask. From gamma spectra at high-energy resolution, the types of radioisotopes present are determined, but the quantity of the SNM materials and their physical dimensions can only be estimated. Gamma imaging detectors can distinguish the size and shape of a radiation source, but most cannot distinguish isotope sources having similar gamma spectra. The particular capability desired and investigated was to determine if a GSD, an imaging detector having good energy resolution, is capable of imaging a Pu-239 signature and differentiating weapons grade plutonium (WGPu) from reactor grade plutonium (RGPu).

There are scenarios in which an imaging detector with good energy resolution would be useful to identify a spoof weapon. If the actual weapon was removed from the storage cask and a small point source of WGPu was put in its place surrounded by an appropriately reduced amount and modified type of shielding and scattering materials, the spectra may appear nearly identical to the actual weapon spectra. Only the size and shape of the smaller amount of WGPu would distinguish a spoof from the actual weapon. It would be very difficult to distinguish this spoof from an actual weapon using only gamma spectral information. A second demanding spoof scenario involves merely replacing WGPu in the weapon with RGPu in order to divert the WGPu to other weapons use. Distinguishing a spoof made of RGPu, but resembling the nuclear weapon in all other aspects, requires that a detector have very good energy resolution (less than 3 keV full width at half maximum at 640 keV).

Inspection Background

When a weapon is being inspected, only passive inspection techniques are allowed. This means that the detector can only measure the radiation emitted by the SNM that penetrates the cask. Normally, this is in the form of gamma and neutron radiation. Only gamma photon spectroscopy can identify the SNM reliably. Typically, as the photon energy increases, the probability that the photon will escape from the weapon and cask also increases. However, detection efficiency of gamma detectors for these more penetrating gamma rays decreases with increasing gamma energy. To reliably escape from the containment cask, photons must have en-

ergy greater than 200 keV [1], so isotopes measured and imaged must emit photons having energy above this threshold at a detectable rate. Pu-239 has prominent photon emissions at 375 keV and 413 keV, which have energy high enough to escape from the weapon/cask system, and still low enough to be measured efficiently by a gamma detector. These two photons are proposed to be used for imaging Pu-239 in an operational scenario.

For determining whether the plutonium is RGPu or WGPu, a ratio of two peaks near 640 keV can be used. When the areas under two measured gamma peaks from the different isotopes are compared with each other, the ratio of peak areas can be used to determine the relative amounts of the two isotopes, knowing the decay fraction of each gamma. If these gammas have similar energies, their attenuation through shielding in different weapon/cask systems will not alter the measured peak ratio. If the gammas from the two isotopes have different energies, the attenuation will be different in different systems; additional information about the system is then required to accurately calculate the isotopic ratio from the peak ratio. For treaty verification applications, the relative amounts of Pu-239 and Pu-240 in the SNM can be used to distinguish WGPu from RGPu. WGPu is defined as plutonium composed of more than 93% Pu-239 and less than 7% Pu-240 while RGPu has more Pu-240. Pu-239 has a 645.94 keV peak with a yield of 0.00002%, and Pu-240 has a 642.35 keV peak with a yield of 0.000013%. In addition to these two peaks, there are also a 639.99 keV peak from Pu-239 and a 641.47 keV peak from americium (Am)-241. The Am-241 peak will build up over time from the decay of Pu-241. Based on this information, a detector must have an energy resolution of approximately 2 keV in order to accurately determine the grade of the plutonium by detecting these gamma emissions [2]. The photon peaks from Pu-239 that are considered for imaging and grade determination.

Imaging Approach

A GSD is a semiconductor detector made of a single high purity germanium crystal. The capability of a GSD to produce images is a result of the orthogonal positioning of the charge collection strips on opposite faces of the germanium crystal. Figure 1, page 36 is a schematic of a strip detector with five charge collection strips on both faces [4]. At the top of the drawing and the bottom of the drawing are orthogonal charge collection strips; the volume between the strips is the germanium. The crystal is thus divided into an array of 25 pixels of germanium, each between different combinations of top and bottom strips. When an interaction between a gamma photon and the germanium occurs, electron-hole pairs are formed. The electrons induce a charge that is measured by the charge collection strips on one side and the holes induce a charge that is measured by the strips on the opposite side. Since the strips on the two sides are orthogonal to each other, an event that is simultaneously measured by a strip on the top and on the bottom can be pinpointed to a single pixel in the 5x5 array. Localizing the position of an interaction due to the measurement of an event by two strips is shown in Figure 2, page 36.

Experimental Approach

To achieve the objectives outlined for this experiment, five steps were performed. The equipment was set up, a source capable of simulating SNM was procured, the detector was characterized, an image processing code was written, and finally, measured images were characterized.

The equipment used for this project was a 5x5 ORTEC high purity germanium double-sided strip detector (HPGeDSSD), Figure 3, page 37. The HPGeDSSD housing contained ten preamplifiers, which were powered by an X-Ray Instrumentation Associates (XIA) power distribution module. Three XIA digital gamma finder (DGF) modules accomplished the data acquisition. The DGF's are pulse processors with four channels capable of capturing data from four analog signals simultaneously. An analog pulse sent to the DGFs is stamped with its energy and time of arrival. Finally, once data collection is complete, the data is downloaded to the controlling computer through a Jorway CAMAC crate controller for further processing. Software control of the DGFs is performed using a program provided by XIA [5,6].

Neutron activating strips of tin (Sn) created a radiation source capable of simulating the energies of interest for Pu-239. The Sn strips, fabricated by an AFIT machinist, were neutron activated at the Ohio State University reactor. The strips were placed in the central irradiation facility of the reactor for two and a half hours, with a reactor power of 90%. The desired isotopes from the neutron activation were antimony (Sb)-125 and Sn-113. These two isotopes had photons with energies of 392 keV, 427 keV, and 635 keV. These gamma photons are close in energy to the photons of interest of Pu-239, which are 375 keV, 413 keV, and 640 keV.

The detectors resolution and efficiency were characterized using standard radiation test sources. The average energy resolution of the charge collection strips was 2.71 keV at 428 keV and 2.83 keV at 662 keV. The intrinsic efficiency of the

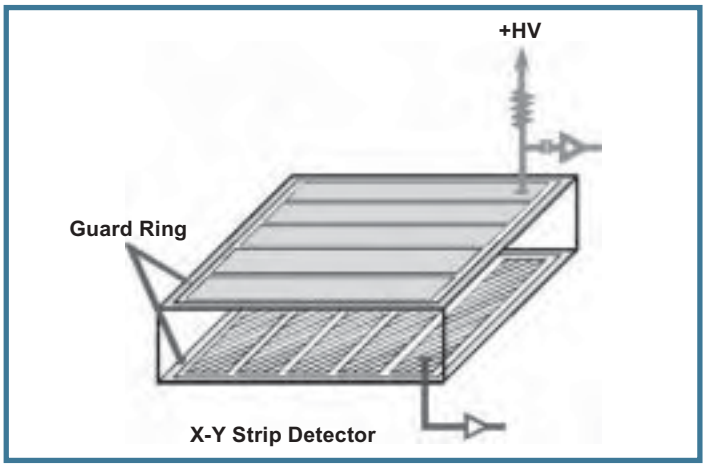

Figure 1. Schematic Of A Strip Detector With Five-Charge Collection Strips On Each Side Of The Detector [4]. The Volume Between The Charge Collection Strips Is Intrinsic Germanium. Orthogonal Placement Of The Strips Provides The Capability To Produce Images With The GSD.

detector was 1.9% at 428 keV and 0.67% at 662 keV.

The imaging system was created by aligning a parallel hole collimator in front of the HPGeDSSD, to ensure that each hole of the collimator was directly in front of a single pixel on the detector. After the alignment of the imaging system, a radiation source was used to irradiate a known portion of the detector and the raw data for producing images is collected. A FORTRAN 95 code was written and implemented to process the raw data and form an image. The processing code sorts through the raw data and finds events that are coincident in both energy and time, determines the pixel location where the event occurred, and keeps a running sum of the number of counts recorded for each pixel. The energy to be imaged is specified by the user, and only events that occur in the full energy peak of this energy are sorted for coincidences. The coincidence window for energy is the total width of the full energy peak, and the window for time coincidence is 100 ns.

In order to determine if the imaging system was capable of differentiating point sources from distributed sources, experiments had to be set up to image in both of these scenarios. The distributed source image was made using the irradiated Sn strips, imaging the 392 keV photon of Sn-113. The point source image was made using cesium (Cs)-137, and its 662 keV photon was used as the imaging energy. Figure 4, shows an image that was taken of the Cs-137 point source., shows an image of the distributed Sn-113 source. The distributed source was imaged for two hours, and the point source was imaged for one and a half hours.

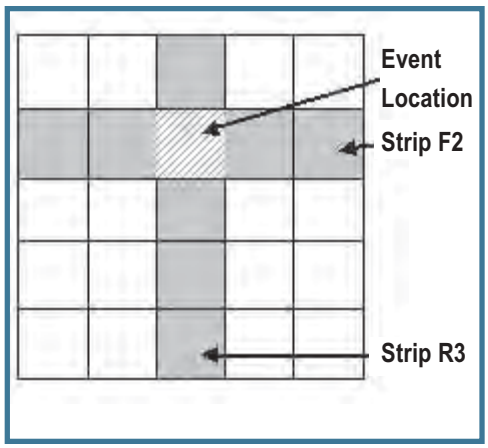

Figure 2. Position Localization Is Determined By The Orthogonal Placement Of The Charge Collection Strips On The Two Sides Of The Germanium Crystal. When A Photon Interacts With The Germanium, The Event Is Measured On A Strip On The Front (F2) And A Strip On The Back (R3) Of The Detector And The Region Where Those Two Strips Cross Is The Pixel Location Where The Photon Interaction Occurred.

Conclusions

For this GSD imaging system, the Pu-239 gamma spectra can be imaged in an imaging measurement using a collimator coupled to the detector. The grade of the Pu can be determined using a separate spectroscopy measurement, allowing WGPu to be distinguished from RGPu.

The primary objective of producing images capable of differentiating point sources from distributed sources was achieved. The energy resolution when measured using the DGF modules, in an imaging measurement, was not low enough to optimize the separation of the Pu-239 and Pu-240 peaks around 642 keV for determining the isotopic ra-

tios. However, when used in conjunction with a Canberra multichannel analyzer, it is capable of achieving the resolutions needed.

The artifacts that are visible in Figures 5 and 6, page 38, the plus around the point source, and the lower number of counts at the edges of the distributed source, could be a result of either imperfect collimation or the electronics. Further research is required to determine the dominant effect, so that steps can be taken to mitigate these artifacts in future images.

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Figure 3. The Imaging System Used For Imaging, Showing The Detector, Collimator, And Controlling Electronics.

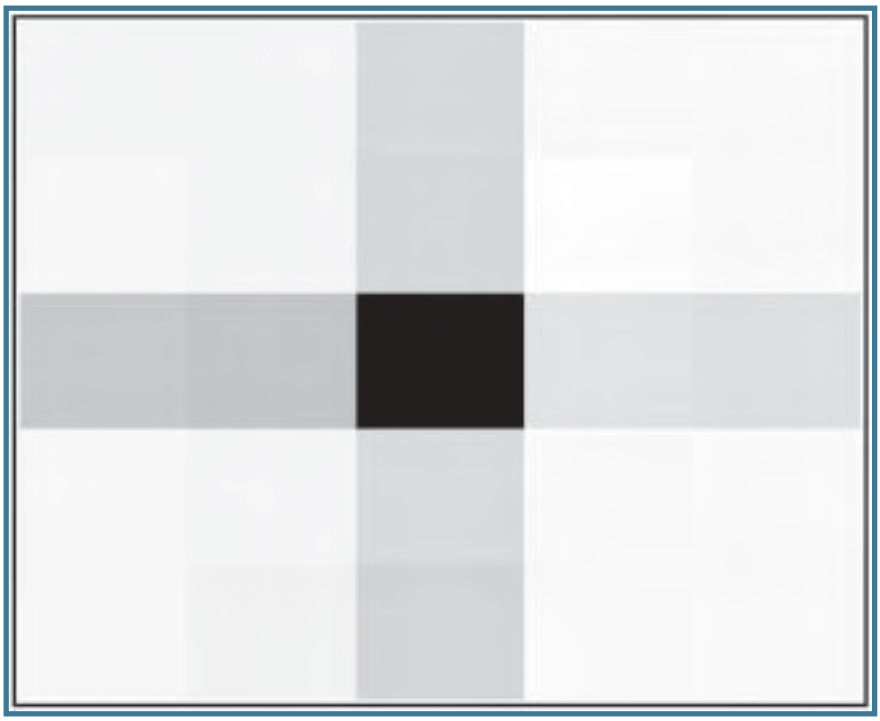

Figure 4. Image Created With A Point Source Of The 662 Kev Photons From Cs-137. The Source Was Located In The Center Of The Image, Shown By The Black Pixel.

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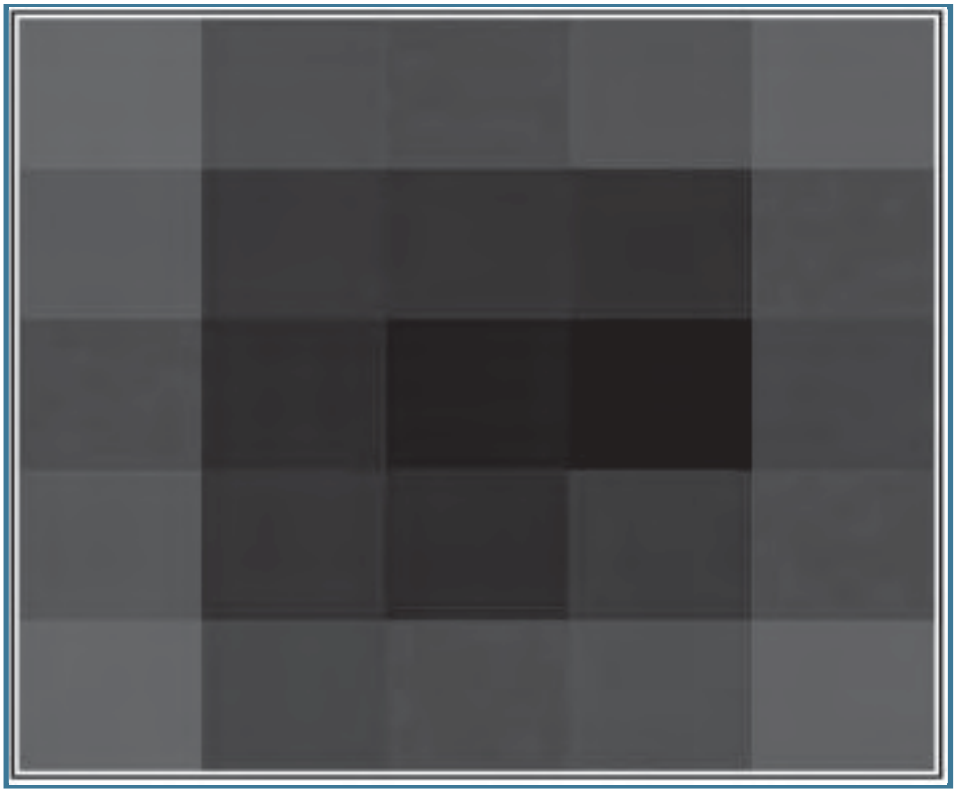

Figure 5. Image Created With A Distributed Source Of The 392 KeV Photons From Sn-113. The Image Was Uniformly Illuminated. The Darker The Pixels The Higher The Number Of Counts Recorded.

Figure 6. Combination of Four Images Taken With The Sn Strips In Configurations To Spell The Letters For AFIT

FA 52 and the Airborne Command Post (ABNCP)

MAJ Jonny R. Noble
United States Strategic Command

"For Alert Force, For Alert Force….Klaxon, Klaxon, Klaxon….Alpha, Juliet, Six, Zulu, Two, Niner.…"
"Oxygen on….engines start….checklist complete….prepare to taxi….taxi runway three-zero.…cleared for takeoff.…"

The words you just read are phrases commonly heard when scrambling to and launching United States Strategic Command's (USSTRATCOM) Airborne Command Post (ABNCP), also known as "Looking Glass." The Looking Glass provides an around-the-clock, survivable, alternate command post for the President, Secretary of Defense, and the Commander of USSTRATCOM, guaranteeing the ability to command, control, and communicate with strategic nuclear forces during national emergencies. Looking Glass derived its name because its capabilities "mirrored" those of the fixed underground command center.

So how do Army Nuclear Research and Operations Officers (FA52s) fit into this scenario, especially since USSTRATCOM is located at Offutt Air Force Base near Omaha, Nebraska? USSTRATCOM has a variety of positions available to FA52 officers. This article, however, will focus on the positions available on the ABNCP. FA52s have the opportunity to serve in this operational, nominative Joint Staff position either as an Airborne Battle Staff Mission Commander or as a Logistics Planner. This is the only full-time flying job available to a FA52 and is a unique environment for Army officers.

The highly-trained Navy flight crew and joint battle staff of the Looking Glass ensure there is always a survivable airborne platform ready to direct bombers, missiles and submarines should ground-based command centers become inoperable. More importantly, Looking Glass guarantees that US strategic forces will act only in the precise manner dictated by the Joint Chiefs of Staff and the President of the United States.

The Navy's E-6B Mercury, a Boeing 707 derivative, flies the Looking Glass mission. The aircraft is loaded with high-tech communications equipment, providing the E-6B the ability to communicate directly with the nation's ballistic submarine fleet, bomber force and Intercontinental Ballistic Missile (ICBM) force. Its battle staff, when airborne, is under the command of a flag officer, the Airborne Emergency Actions Officer (AEAO) — an Air Force, Army, or Navy flag officer. These flag officers are from USSTRATCOM or any of the supporting task force commanders or Major Commands.

Members of the ABNCP battle staff form operational teams and represent all branches of the Armed Services. The team is responsible for keeping the AEAO ready to brief the President on contingencies and available responses. The Team Chief or Mission Commander billet, aptly named for officers serving in the grade of O-5, is open to all Services, including US Army FA52s. The Mission Commander is responsible for all aspects of team training, cohesiveness and performance. Another key position is the Operations Officer, who advises the flag officer of the war plans available to the President. This position is open to Air Force, Marine and Navy officers serving in the grade of O-4.

The Airborne Launch Control System (ALCS) Officer is an Air Force-specific billet. The ALCS Officer is the missile launch team leader and, along with the Operations Officer, operates the ALCS. This system allows the Looking Glass to transmit launch codes to ICBMs in their underground silos should ground launch control centers become disabled. This capability qualifies the aircraft as a weapon system even though Looking Glass does not carry any weapons. The ALCS Officer is also the intelligence

planner and briefs the entire battle staff on current intelligence matters, develops threat assessments, and identifies emerging threats to the United States and its allies.

The Looking Glass has two Air Force-only Command and Control Managers. The first, an Emergency Actions Non-commissioned Officer (NCO), is charged with knowing the formats, contents and appropriate wording for emergency action messages used to execute US war plans. The Emergency Actions NCO and the Mission Commander form the Emergency Actions Team. The second NCO, the Force Status NCO, is an expert in force accounting procedures and accounts for and tracks every strategic weapon in the US inventory.

The O-4 Logistics Planner billet is open to all Services, including FA52 officers. The Logistics Planner is the primary logistics advisor to the flag officer on the ABNCP. He ensures returning bomber, tanker and reconnaissance aircraft have safe recovery bases at which to land and receive required support. In addition, the Logistics Planner directs the deployment of aircraft recovery teams to operational locations, evaluates damage of military/civilian assets and directs their reconstitution to ensure the US maintains a viable deterrent force.

The Meteorological and Oceanographic Effects (METOC) Officer is an Air Force or Navy officer. This officer provides analysis of areas of interest and provides information on radioactive fallout and weather impacting air, sea, ground and space operations.

The above battle staff personnel are part of the Mobile Division under the Director of Combat Operations, USSTRATCOM.

Summary

Army officers are assigned to USSTRATCOM's ABNCP for reasons that benefit both the Army and DoD. FA52s are able to serve in several key positions aboard the ABNCP in mission areas critical to national security. USSTRATCOM benefits from the infusion of fresh ideas and the insight of the Army FA52 officer perspective, while FA52 officers are exposed to the challenges and opportunities of a joint environment. This greater understanding and the contacts made while at USSTRATCOM allow FA52 officers to be more effective in subsequent DoD FA52 assignments, where interaction with USSTRATCOM is often a critical requirement.

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MAJ Jonny Noble entered the Army in 1981 and was trained as an artilleryman and Nuclear Weapons Maintenance Specialist. He later attended Officer Candidate School and received his commission into the Ordnance Corps in 1991. He is a former Explosive Ordnance Disposal (EOD) Officer with over 22 years experience in the nuclear arena. He earned a B.S. in Business Management and a M.S. in Human Resource Management, both from the University of Maryland. His previous FA52 assignments include Emergency Response Operations Officer with the Department of Energy and the National Nuclear Security Administration, Washington, D.C., as well as Mission Commander with the Defense Threat Reduction Agency, On Site Inspection Directorate, Fort Belvoir, Virginia. He is a graduate of Army Command and General Staff College.

Emerging Decontaminants and Replacement of DS2

Mr. Joseph Nellis
Army Research Laborartory

The technological evolution of advanced weapon systems has resulted in the incorporation of various types of fragile electronic and optical components. Nuclear, biological and chemical (NBC) decontamination of these components by currently fielded decontaminants often results in some degradation of the equipment. Although personnel protection is of primary importance for mission accomplishment, there is also a requirement to protect and decontaminate fragile mission-critical equipment, particularly in future combat systems. At present, no established methods are available for the "safe" and thorough decontamination of sensitive equipment such as avionics, electronics, detectors, computers, plastics, and communication equipment. The word *safe* used here denotes decontamination without significant material damage or degradation of operability, effectiveness, and serviceability of the treated equipment.

The currently fielded Decontamination Solution number 2 (DS2) is excellent for the rugged, older systems, but it is no longer compatible and safe for use on today's sophisticated systems of printed circuitry. Electronic components in weapons systems are generally inaccessible and ordinarily housed within a protective casing to protect them from physical damage. Although in most cases such protection shields them from air-borne chemical and biological agents, the seals can be damaged or degraded by DS2 or any other fielded decontaminants. The Army's war reserve of DS2 is stored at Seneca Enclave, Romulus, New York, and is 11 to 15 years old. Additionally, other chlorine-based "bleach" decontaminants available to the Soldier, such as super tropical bleach (STB) and calcium hypochlorite (HTH), also cause damage to electronics, soft parts, and computer keyboards. Above all, STB and HTH require a source of water to produce the decontamination slurry and to rinse the white residue left on surfaces. Despite its damaging effects, DS2 continues to show the best results against most chemical agents. One logistic advantage of DS2 is that it is conveniently fielded in sealed metal cans ready for use by the Soldier in the battlefield.

Although DS2 is chemically one of the best NBC decontaminants available, it has a very high pH[1] value of alkalinity, which lends to its corrosivity to skin and incompatibility or damaging effects to certain materials. It is widely known that DS2 causes operational degradation in most systems that have sensitive electronic components. Both the US Army and Air Force promote only the use of hot, soapy water to decontaminate aircraft.

So what is the best replacement for DS2? What are the path ahead and the candidate for the "Future Decon?" The chemical formulation of the desired substitute would have to be delivered to the contaminated surfaces in a variety of ways and phases to provide the necessary detoxification of warfare agents. Essentially, the ideal decontaminant candidate for replacing DS2 would have the following characteristics:

- A single solution that can detoxify warfare agents at a molecular level and remove or neutralize toxic agents, biological toxins, or any toxicants within 15 minutes;
- Ready to use with no need for water during preparation or delivery;
- Can be effective to decontaminate any surface (paint, composite, terrain, concrete, rubber seals, asphalt, metal, plastics, fabrics) without causing degradation of system or paint markings;Causes no corrosion nor interferes with electronic components or other sensitive components in the weapon system after full decontamination so that the Soldier can continue the mission successfully;
- Decontaminates interior equipments as well as exterior surfaces and subcomponents of a system, especially delicate gear and printed circuitry, without rendering it useless after one or more cycles of decontamination (hardness);
- Has a "pot life"[2] of at least 12 hrs, a storage life of 10 years, and is rap-

idly deployable to the battlefield with minimal logistics support;

- Incorporated and delivered by existing decontamination apparatus already in use by the military, without degradation of the dispensing equipment and its components;
- Can be used as decontaminant in bulk form, aerosol, and vapor phases;
- Causes minimal health and collateral damage, or is benign to people and property;
- Environmental friendly with minimal run-off of fluids and no lasting impact on soil, vegetation, animal life, or underground water; not a hazardous waste;
- Attractive for both military and civilian applications; and
- Relatively inexpensive.

CANDIDATES FOR REPLACING DS2

Finding a suitable replacement for DS2 has not been an easy task. Replacement has become a very elusive goal despite continuing efforts by expert military and civilian investigators. The ideal candidate to substitute DS2 or any of the currently fielded decontaminants does not exist yet because none satisfactorily meets all the criteria of the officially approved military requirements. Based on independent testing results, the majority of emerging candidates reduce contamination to different degrees, but the major problem is that none of them inactivates all warfare agents completely with one treatment. Many do not detoxify all warfare agents or reduce contamination to a low risk level that poses no threat to an unprotected individual. One yardstick for the low risk level is the Department of the Army approved criteria called "negligible risk values of contamination (see Table 1, page 46). The criteria numbers are commonly used when equipment is tested for NBC survivability of AR 70-75 (see USANCA's *NBC Report*, Fall/Winter 2000). Those negligible risk values may only be achieved during thorough decontamination but never during "hasty" decontamination procedures presented in FM 3-5.

Therefore, the need for replacing DS2 has been expressed by all Armed Services, and Government agencies and private industry have responded by developing alternatives known as new decontamination technologies. A handful of candidates undergoing testing are outlined next with brief comments about each one.

Sandia Foam

One rapidly emerging candidate that shows some promise for replacing DS2 is Sandia foam. It can be delivered as foam or liquid forms and is sprayed on surfaces like any other fire fighting foam. After the foam dissipates, the residual material can be washed off. When the chemical formulation was developed in 1997 by Sandia National Laboratories, Albuquerque, New Mexico, the foam quickly appealed to the community because of its nontoxic and noncorrosive aqueous nature. It was initially developed with enhanced physical stability for the rapid neutralization of chemical and biological warfare agents. The formulation is based on a surfactant system with hydrotropes to solubilize toxants and to increase rates of reaction at molecular levels. It breaks up the phosphate or sulfide bonds that hold the agent molecules together. The Sandia product also includes mild oxidizing agents that neutralize biological toxants. The prototype formulation was initially developed for all chemical agents, and the pH could be adjusted to broaden its applicability to biological agents. Recent variations of this new foam technology are known as DF-100 and DF-200.

DF-200 is becoming an attractive candidate to replace DS2. It is an enhanced version of the initial DF-100 foam, and its performance has been optimized for the military and civilian first responder units (e.g., fire fighters, police, HazMat) arriving at the scene of an attack that uses chemical agents. Critical differences between the two foams are mainly the pH and the mixing procedures of their powder-liquid or liquid-liquid components to prepare them for use. Once mixed, the solution must be used within 8 hours to be effective because the reactivity degrades over time. For bacterial spores, the solution should be used within 2 hours after mixing. Unmixed, the concentrations have a longer shelf life. After immediate application, DF-200 foam reduces contaminants appreciably within 15 minutes and is safe to operate and store. Another advantage is that this formulation can be applied in several ways as foam, liquid sprays, or fog in a variety of operational objectives.

Various agencies and private organizations have been testing DF-200 to determine its efficacy and applicability as a field decontaminant. The US Joint Services are testing it against different materials that would be most likely contaminated by warfare agents in the battlefield. Manufacturers claim that the foam is environmentally safe. This technology has also been tested rather extensively on metal surfaces and composites and has proved some effectiveness on nerve agents. It is particularly effective on anthrax and vegetative bacteria. Because of these positive results, two private US vendors are now working on formulation improvements and production. They are already commercial-

izing different formulations of the original Sandia foam for other specific uses. Also, through limited procurement authority, the US force that went to Iraq in FY03 took a large amount of DF-200, but no DS2.

Although DF-200 shows promise for military use, the emerging testing data are still relatively meager to allow reaching any final conclusion. The foam still needs more testing on porous surfaces and fabrics, and has not been approved as a field decontaminant for the Army, particularly while DS2 is still available. A debatable concern is that if DF-200 is not used within its pot life after mixing, it becomes a waste or the activated formulation loses its effectiveness (50% of original reactivity), and then off-gassing of the treated surface may pose a vapor hazard to unprotected individuals. Despite continuing investigations, opinions exist that DF-200 may have sufficient qualifiers to become at least an *interim* replacement for DS2 on the battlefield.

Figure 1. Sandia Foam

GD-5

GD-5, developed in Germany, is claimed to be a noncorrosive, nonconductive, and non-aqueous decontaminant requiring no water. It is a solution mixture of amino alcohols and non-ionic surfactant, and the detoxification effect is based on the nucleophilic substitution of all chemical warfare agents. The high reaction velocity that decomposes warfare agents is primarily attributable to its strong basicity (pH above 14) and by solvation of the anions liberated by alcohol in the mixture. Better results are attained when one is using the pure, water-free GD-5 solution without pre-wash of items to be decontaminated. When GD-5 is applied as an aerosol with the hand-held Decofogger equipment, a small amount of powdered residue is left on the surface. Limited testing was recently done in the US with this product to decontaminate computer systems and other different coupon materials. Its effectiveness against warfare agents is still inconclusive, especially in reducing biological contamination and penetration effects on materials such as elastomers.

BX-24

BX-24 is a chemical-biological decontaminant produced in Italy. It is a white solid material that releases chlorine upon exposure to water and can be dispersed without additives or solvents. BX-24's main chemical ingredients are sodium carbonate, trichloroisocyanide, and a surfactant. The powder produces a colloidal suspension in water, and when sprayed on the target surface, it forms a jelly-like layer in which reactions take place to decompose and detoxify the agent. It can be sprayed on the contaminated surface with the Decongun, which is a hand-held applicator that uses rechargeable cartridges filled with BX-24 powder and a source of high pressure water. On the treated surface, the solution has a thick white color, enabling the operator to see the decontamination reaction in progress. BX-24 has been tested in the US, Canada, and Europe against major warfare agents and shows best results on biological agents.

C-8 Emulsion

C-8 Emulsion is a modified German decontaminant that uses multipart liquid and powder ingredients. Its chemicals include calcium hypochlorite, tetrachoroethylene, added water, and an emulsifier to produce a foam emulsion. The aqueous C-8 can be given a longer reaction time on a weapon system to kill pathogenic microorganisms if another foam cleanser (RM54) is added to the mixture. All ingredients require time (about 30 minutes) to mix in the field and show some difficulty. C-8's strong emulsifying effect can also dissolve grease and oil on vehicle components. On painted

surfaces, the free chlorine in the emulsion dissolves the thickeners in the chemical agent, and the agent itself can be diffused out of the treated surface.

Cascad

Cascad is a water-based Canadian foam that uses solvent surfactants. The vehicle-equipment delivery system is one with continuous injection and reloads without shutdown. Although the powder form requires water, the surfactant is versatile because it is able to use any type of water, including gray water, fresh or salt water, or non-potable water. Hot foam can also be produced for radioactive decontamination, but it needs other complexing agent powders. With several of Cascad's decontamination modules, the foam has been tested on vehicles, equipment, buildings, aircraft, and ships. It has also been tested and approved for use by several countries. Manufacturers claim that this aqueous system meets national defense program requirements and exceeds NATO requirements. More testing is necessary to determine its penetration of materials and corrosive effects on copper wires and other metals.

L-GEL

L-GEL is a water-based colloidal silica gel (potassium peroxymonosulfate) developed by Lawrence Livermore National Laboratory. It is premixed and stored as a semisolid resembling gelatin at room temperature. The gel is applied to a surface and allowed to dry to a nontoxic white powder. It clings to walls and ceilings, and after drying within 6 hours, it can be vacuumed and discarded. If unopened, its shelf life is expected to exceed a year. It is reliquefied to the consistency of house paint by vigorous shaking. L-Gel is relatively noncorrosive (pH is about 2 to 4, similar to that of vinegar or lemon juice), and its residual material is claimed to be nonhazardous. It has been tested against several materials for detoxification of warfare agents.

Enzyme

An enzyme is a group of proteins produced by living organisms that function as catalysts, thus driving a chemical reaction. Researchers discovered that certain enzymes cause hydrolysis of chemical agents, particularly the advanced catalytic enzyme system (ACES) which hydrolyzes G agents. An enzyme formulation is agent specific and not yet useful for military purpose on all types of agents. Still, catalytic enzyme systems are of great interest because they have a quick chemical reaction, are environmentally friendly, nonflammable, noncorrosive, and can be disposed of safely and easily during decontamination. Because of their materials compatibility, enzymes are being investigated in the US and Europe for neutralization of chemical agents.

Soviet ECASOL

Soviet ECASOL is a chlorine decontamination solution that can be produced *in situ* electrolytically from brine. Brine would be relatively easy to obtain and produce Ecasol if troops are close to ocean waters. This product has been used in limited testing in biological and chemical decontamination of military clothing and equipment.

Decon Green

Decon Green is a non-corrosive solution that can be applied to many surface materials and is effective at low temperatures (-31°C). Researchers claim that this decontaminant does not leave toxic residues after decontamination of nerve and blister agents and that it neutralizes agents quickly as well as detoxifying anthrax spores to undetectable levels. Additional testing is needed to determine effects on plastics and rubber seals.

Sorbent Decon

Sorbent Decon system (SDS) consists of a powder made from aluminum oxide and sodium silicate slurry and coated with carbon. It works by adsorbing and hydrolyzing the chemical agent on the surfaces. The sorbed chemical agent is retained within the pores of the sorbent where it is decomposed over time, thus minimizing off-gassing and contact hazards. Another similar sorbent powder is the Guild bulk sorbent. The use of alumina for decontamination purposes is not new, but the SDS was developed for removing gross contamination, preventing the spread of chemical agents, and preserving the Soldier's gear and systems.

Heat

Heat has been used in many tests to decontaminate cargo aircraft during flight or on the ground. This is done by turning on the heating system inside the aircraft or vehicle and allowing the agent to "evaporate" to the outside. However, the temperature is never high enough to fully decontaminate the cargo to the minimally acceptable level. A heater or heat from engine exhaust was used to decontaminate interiors of several combat vehicles; in some instances it was successful but was considered impractical. One reason was because the fumes left all surfaces very dirty. Other heat believers have proposed to have a jet engine atop a vehicle and then place the contaminated system behind the jet for the high temperature exhaust to evaporate the contaminants and to disperse them. The high heat from a jet engine mostly likely would damage sensitive materials and plastics.

Biotechnology

The European community is developing biotechnology methods (biodegradation and bioremediation) for decontamination of waste sites and the demilitarization of energetic materials. These processes are accomplished through the use of biological organisms including fungi, bacteria, and algae. Much remains to be done before these can be used successfully in a large scale.

RSDL

RSDL is a reactive skin decontamination lotion consisting of a viscous liquid that reportedly removes and destroys warfare agents on contact. It is poured directly over the contaminated site and does not need to be removed immediately. It is safe for medical use on all intact skin and in the eyes, and for sensitive equipment.

Other decontaminants are being developed, which claim to detoxify chemical agents without damaging the surfaces being decontaminated, namely, a vaporous hydrogen peroxide, British microemulsion (water in oil with sodium dodecyl sulfate), Karcher 202 emulsion, nano-emulsion for biological agents, and the Navy decontaminant SLASH. Also, some physical methods undergoing investigation include plasmas, ionization and microwave radiation, ultraviolet light, and a slew of other exotic ones. Applications of plasmas are promising for decontamination of sensitive equipment and interiors.

Difficulties in Replacing DS2

Each of the emerging candidate replacements for DS2 has advantages and disadvantages for effective military use, especially for the decontamination of complex devices and systems in field conditions. Thus far, none of the emerging candidates meet all the criteria of a universal all-purpose DS2 replacement. While some of the promising candidates are effective against NBC agents, they also present some compatibility or hardness or degradation of materials, particularly on protective clothing and mask lenses. Also, nearly all candidates have been tested in field conditions against agent simulants but not against the agents themselves. Actual agent testing with the new technologies has been limited to decontaminating samples of component materials (panels) inside a "glove box" but not on entire intact systems. While the testing of decontaminants on flat pieces of composite or coupon materials has provided useful preliminary information, it does not necessarily follow that promising candidate decontaminants will also be fully effective against intact complex devices and systems in the field.

Chamber testing of entire systems is needed to determine whether the interior nooks and crannies of a system can be fully decontaminated by Soldiers using the newly proposed decontaminants and established field procedures. Several outdoor tests have shown that foam decontamination has problems when the foam is dispensed onto target surfaces during windy weather or when hot weather causes the foam to dissipate quickly. Foams also tend to degrade the performance of detection devices and to give false positives on detectors when one is checking for residual agent contamination. Additionally, most testing shows results only in percentage of reduced decontamination. The new decontaminants still need to be tested against the Department of the Army (DA) approved criteria in Table 1.

Furthermore, some of the emerging decontamination technologies require a long time to mix, need multiple treatments, or have logistic problems in becoming readily available to the Soldier in the battlefield. Because of the high alkalinity, many of them will corrode metals after some time. Still other candidates leave harmful residues, requiring a neutralization treatment process, or they involve costly disposal as hazardous waste or pose problems in storage or transportation. One military logistic burden with most new decontamination technologies is the availability of water on the battlefield—enough to prepare the decontaminant and for rinsing purposes so that the Soldier's weapon system is clean and ready to continue the mission. Looking beyond the battlefield and into the future, it would be ideal to have one single decontaminant for use during joint efforts of fire fighters, civilian police, and military responding to urban terrorism incidents.

Thus, the choice for the best decontaminant to replace DS2 has not been made yet. Once a "Future Decon" is selected, however, there is still the problem of how the new decontaminant is incorporated in the Armed Services. Compatibility issues with existing delivery systems need to be resolved. For instance, can the currently fielded sprayers (such as M17, M11, M13) be used to dispense the selected decontaminant? Will the chemical components degrade the seals and soft parts of the existing delivery system? Is it compatible with fielded protective clothing and ensembles, such as the enhanced Joint Services lightweight suit? Anticipating these problems, the Services have begun several testing programs to evaluate the currently fielded systems, using some of the novel decontaminants. The evaluators are

identifying remedies for those and other potential problems.

In addition, steeply declining chemical defense budgets over the last few years and higher priorities forced the industry to reduce the search for a technical solution to find a safe decontaminant. New advances and ideas in decontamination of equipment, vehicles, buildings, and personnel are long-term goals for the US Department of Defense. Undoubtedly, the emerging technologies show significant breakthrough in the field of decontamination, and others will continue to develop and improve to better address chemical agents, viruses, bacteria and bacterial spores. While the search continues for an ideal or *interim* nondestructive decontaminant, the next best measure is contamination avoidance and protection. It is often said that "an ounce of prevention is worth a pound of cure." Some ways to minimize, prevent, or avoid contamination of equipment include temporary protective shrouds and covers, which can be quickly treated and discarded safely.

The image of the traditional DS2 has been changing, but before an ideal replacement is chosen, more thorough testing of the emerging technologies is necessary. Perhaps investigators are likely to find that DS2 need not be entirely replaced but supplemented by suitable alternate procedures for use on fragile items. Eventually, a less damaging decontaminant will emerge for the delicate electronics of today's sophisticated weapon systems used by Soldiers on the battlefield.

Table 1. Negligible Risk Values of Contamination (DA Approved Criteria).

CONTAMINANT	VAPOR/AEROSOL	LIQUID
	(mg·min/m^3)	(mg/70-kg man)
VX	0.25 (0.02 visual acuity for pilots)	1.4
GD (soman)	2.5 (0.5 visual acuity for pilots)	30
HD (mustard)	50	180 (0.01 mg/m^2)
Biological Agent	Minute quantity can cause incapacitation; proliferates easily.	
Radiological (nuclear)	25 cGy (rad)	

Mr. Joseph C. Nellis worked as Test Officer and Test Director in NBC Survivability Testing at US Army Dugway Proving Ground for 18 years, and is currently an NBC analyst for ARL/SLAD at Aberdeen Proving Ground. He earned his M.S. in Geochemistry of Uranium Radioactive Materials from the University of Utah, and an M.B.A. in Management Science from the University of California at Riverside. For the past 6 years, he has served as technical consultant for the Army Nuclear and Chemical Survivability Committee Secretariat on testing and decontamination survivability issues.

Endnotes

[1] The pH value refers to the hydrogen ion concentration in the solution, making it acidic or basic (alkaline). DS2 is highly alkaline (a super base) with pH above 14.

[2] Pot life refers to how long the mixed ingredients remain usable and reactive.

Nerve Agent Physiology

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United States Army Nuclear and Chemical Agency

Nerve agents are man-made chemical warfare agents. A very small amount of nerve agent can be toxic regardless of the route of exposure. The manifestation of toxic effects usually occurs within minutes. The intent of this article is to discuss the chemical properties, the physiology of nerve agent exposure, and protective measures to be taken against them.

"There must be an eerie quality to being under attack when there is no muzzle flash, raised bayonet, loud explosion, or charging infantrymen. To the ordinary horrors of battle is added the special terror of an attack that is not just silent (or nearly so) but invisible (or nearly so)."[1]

Introduction

Anytime the topic of nerve agent comes up in the context of chemical weapons (CW), it is important to understand, based on their physical and chemical properties, why they are so toxic and the mechanisms by which they attack our nervous systems. Let us look at some definitions related to nerve agent injury to understand what happens at the cellular level in the body.

The four groups of chemical warfare agents are: cholinesterase inhibitors, asphyxiants, pulmonary irritants, and vesicants. This article will briefly address cholinesterase inhibitors; more commonly known as nerve agents, symptoms of exposure; the impact of the nerve agent against time, and methods of treatment. Nerve agents fall into one of two groups: G-agents and the more persistent V-agents. The principal G-agents include tabun (GA), sarin (GB), and soman (GD). The most well-known V-agent is methylphosphonothioate (VX), the most toxic nerve agent in existence.[2,3]

Nerve agents, for the most part, are fat-soluble and readily absorb through the eyes, respiratory track, and skin. Without proper medical attention, less than a drop of VX (10-15 milligrams) on unprotected skin can kill a man of average weight. Still, this route of exposure can take up to several hours before severe symptoms present themselves. [4] The table below summarizes symp-

	DEFINITIONS
Acetylcholine	a neurotransmitter, which causes muscles to contract. It is found in the organs and tissues of the body.
Acetylcholinesterase	an enzyme produced in the cells, which inactivates the action of acetylcholine and breaks it down. This enzyme is key to normal autonomic functions of the nervous system, muscle contraction/relaxation.
Atropine	a chemical that blocks the action of acetylcholine.
Cholinesterase	(acetylcholinesterase) an enzyme that hydrolyzes acetylcholine into acetic acid and choline upon the chemical transmission of a nerve impulse across the neuromuscular junction.
Nerve agent	the most toxic of chemical warfare agents; inhibits the action of cholinesterase; when absorbed into the body affects the nervous system, respiratory system and various body functions. They include the G-agents –GA, GB, GD, GF and VX.
Organophosphates	a compound with a specific phosphate group, which inhibits acetylcholinesterase. Chemical structure of nerve agent and insecticides.
Oxime	a compound that can remove the cholinesterase inhibition from the enzyme if "aging" has not occurred. It is used in the therapy of nerve agent poisoning.

toms from exposure to nerve agents. The severity of symptoms depends on the amount of exposure and the route of entry into the body. Nerve agent antidote should be administered to victims immediately because time delays increase the cumulative dose they receive.

Nerve Agent Properties

In pure form, nerve agents are colorless, odorless, and tasteless liquids. They are the most toxic of CWs having an extreme and rapid effect on the respiratory system, causing central nervous depression, and muscle weakness. Most deaths from chemical exposure are due to inhalation, and far exceed deaths from ingestion or dermal exposure. Nerve agents are organic compounds of carbon containing a phosphorous or a fluorine bond. Because of their chemical characteristics, nerve agents slowly degrade in water, with half-lives from 5 to 40 hours depending on pH. [5]

Mechanisms of Action

The human body is wired much like an electrical network, and the process by which stimuli are transmitted to the brain is primarily chemical. Nerve cells (neurons) receive chemical signals from the outside world and carry the electrical impulse through its fibers (axons) to the muscle cells, releasing neurotransmitters. Neurotransmitters monitor all of our senses from hunger to pleasure to pain. The brain processes this information, fires signals across the synapses, acetylcholine signals the receptor at the nerve synaptic junction, stimulates the nerve fibers (neurons) across the synapse, which stimulates the action of the nerve. Acetylcholine is then rapidly destroyed by the enzyme acetylcholinesterase. Within one millisecond, 300 molecules of acetylcholine can be broken down by one unit of the enzyme into acetic acid and choline as depicted in Figure 1. These are important chemical reactions and

Table 1 Summary of Effects from Exposure to Nerve Agents

Route of absorption	Mode of contact	Type of effects	Description of effects	Time of effects	Duration after Mild exposure	Duration after Severe exposure
Eyes	Vapor or liquid	Local and systemic	Frontal headache, miosis, eye pain, hypersecretion.	Instantly to delayed depending on severity of exposure	24 hours to several days	2-3 days; CNS effects for days to weeks
Skin	Liquid	Local	Local sweating and muscular twitching	3 minutes to 2 hours	3 days	5 days
Respiratory	Vapor or liquid	Local and systemic	Tightness in chest, wheezing, muscarinic, CNS.	1 minute to 30 minutes	Up to 30 minutes after mild exposure	Acute effects: 2-3 days; CNS effects: days to weeks.
Ingestion	Liquid	Local	Gastro-intestinal	30 minutes after ingestion	Several hours to a day	Several hours to a day

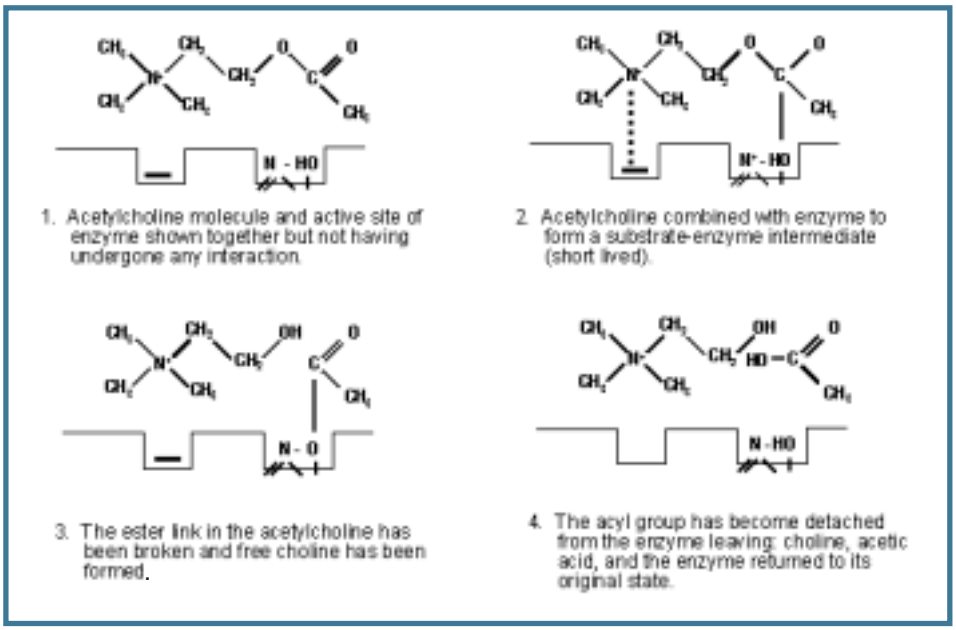


Figure 1.

are going on all the time at a very fast rate.

A build-up of acetylcholine occurs when nerve agents block this enzyme. It triggers violent reactions such as excess secretions from all orifices, constriction of pupils and weakening of skeletal muscles. Respiration becomes labored and the build-up of carbon dioxide in the blood leads to metabolic acidosis. There is rapid twitching of some muscles, paralyzed breathing, convulsions, and in extreme cases, death. Cholinesterase inhibitors have been used therapeutically for years to treat glaucoma, myasthenia gravis, and Alzheimer's disease. When the threat is real, carbamates are supplied in advance to nerve agent exposure to protect this enzyme.

Pretreatments

Carbamates offer some promising treatments to counteract the effects of nerve agents and protect the enzyme by binding to the active sites. This bond can later be reversed. Pyridostigmine bromide is a carbamate, which was provided to the US military soldiers (Iraq, 1991) in tablet form as nerve agent pretreatment. When used before exposure to nerve agent, it acts as an antidote-enhancing substance. Laboratory tests on animals, pretreated with pyridostigmine, showed no symptoms when exposed to tabun and soman nerve agents. This pretreatment reduced the effects of low-level exposure to nerve agents. However, it has its drawbacks: it has a short half-life and requires subsequent doses every eight hours to retain therapeutic levels. Additionally, it is ineffective against sarin and VX.

The 3 Apr 2003 issue of D.C. Military depicts researchers experimenting with butrylcholinesterase. It is an enzyme found in the body, although not in large amounts. When administered to animals as an antidote in appropriate dose levels, it protects from exposure to nerve agent for up to two weeks. Animals with an increased level of butrylcholinesterase in the blood showed no serious side effects from the higher than normal level of this enzyme in the blood. Human clinical trials have not yet begun.

There are antidotes and oxime therapy available, and treatment depends on the tactical situation, the mission, the area of contamination and the decontamination resources available. The bond between the nerve agent and acetylcholine takes time to mature into a chemically covalent bond. So, immediately after the nerve agent attaches, the bond is vulnerable to disruption by chemicals called oximes. It is this phenomena that pralidoxime was developed to be used as an antidote. Used early, it is effective in preventing a permanent bond from forming. Oximes are a class of antidotes capable of disrupting the bond of the nerve agent from the enzyme and reactivating the enzyme. Soman is resistant to oxime therapy, so carbamates and diazepam drugs work best for the pretreatment for exposure. When nerve agent attaches itself to the enzyme, it loses an alkyl group. With organophosphates, this is irreversible due to their chemical properties. Even in the presence of oxime therapy, the enzyme is incapable of being reactivated. Depending on the degree of exposure, cholinesterase levels may return to pre-exposure levels after a period ranging from several hours to several days for carbamate exposure, and from a few days to several weeks for organophosphate exposure. Blood cholinesterase returns to safe levels much more quickly after exposure to carbamates than after organophosphate exposure.

Methods of Treatment

Reversal of toxicity from nerve agents depends on prompt medical treatment and the administration of antidotes. Below are some of the common antidotes and treatments to nerve agent poisoning.

Atropine – the classical antidote in organophosphate poisoning, and works to counteract excessive amounts of acetylcholine by binding to the receptors for it.

ATNAA - Antidote Treatment Nerve Agent Auto-injection contains atropine and pralidoxime chloride (2-PAM); usually administered by the physician or a field medic for organophosphate poisoning; atropine is the only antidote needed to treat cholinesterase inhibition resulting from carbamate exposure. [7]

Pyridostigmine Bromide Tablets - 30 mg dose tablets, oral treatment for risks of imminent exposure to nerve agent; issued to all branches of the military. In studies using laboratory animals, this treatment was found to be effective against some of the nerve agents. This treatment is only to be used prior to exposure. It works by binding to the acetylcholinesterase for several hours.

Diazepam – administered intramuscularly; the earlier it is given after nerve agent exposure, the better the chances of preventing permanent damage to the central nervous system in patients with severe exposure.

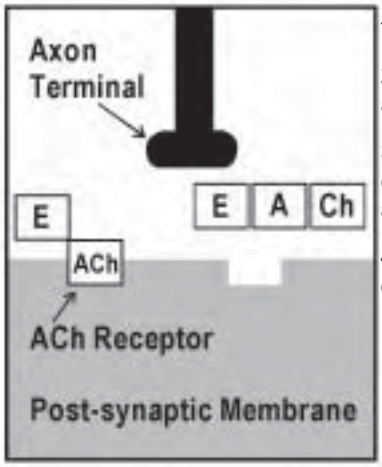
The Acetylcholine Synapse

Although there is no definitive proof of nerve agent use in Iraq, previous accounts from the Gulf War indicate the use of cyclosarin. US military commanders were concerned about the threats of chemical agents to military forces. The precursors for the production of nerve agents are chemicals found

Normal transmission of Acetylcholine

Ach = Acetylcholine

Enz = Acetylcholinesterase



1. Ach is released at the axon terminal.

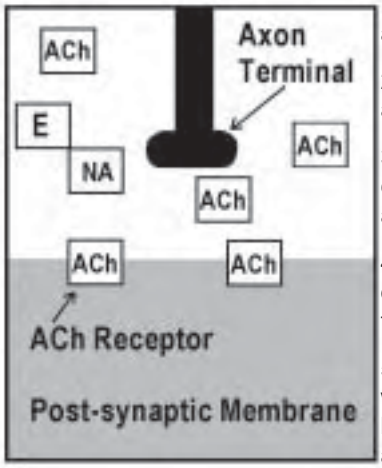
2. Ach crosses the synaptic cleft.

3. Ach binds with a receptor on the post-synaptic membrane.

4. Enz stops the action of Ach.

Nerve agent poisoning

NA = nerve agent



1. Ach is released at the axon terminal.

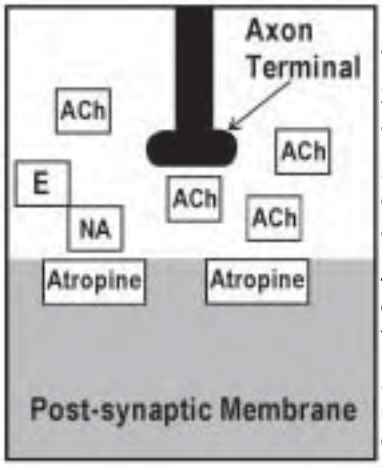
2. Ach crosses the synaptic cleft.

3. Ach binds with a receptor on the post-synaptic membrane.

4. NA blocks the ability of AChE to stop the action of Ach.

5. Ach continues to work and more Ach builds up in the synapse.

Effect of Atropine on transmission of Acetylcholine in the presence of a nerve agent



1. Ach is released at the axon terminal.

2. Ach crosses the synaptic cleft.

3. Ach binds with a receptor on the post-synaptic membrane.

4. NA blocks the ability of AChE to stop the action of Ach.

5. Atropine blocks the receptor so that Ach cannot work. There is no direct effect on the nerve agent or the enzyme.

in most industrial, environmental and research facilities. There are over 500,000 chemical substances used for industrial, medical, agricultural, research, and pharmaceutical purposes, but only about 70 of these fit the criteria of being highly toxic, stable in storage, relatively cheap and easy to make. With many of these simpler compounds, the export of these dual-use chemicals is not controlled; they are fairly inexpensive and readily available from commercial sources. Many are only one step away from being manufactured into a chemical warfare agent.

As General John J Pershing wrote after WWI: "Whether or not gas will be employed in future wars is a matter of conjecture. But the effect is so deadly to the unprepared that we can never afford to neglect the question." [9]

Detection and Monitoring

There are a number of kits and special papers fielded, however, false positives cannot be ruled out. Detection equipment with improved capabilities and greater sensitivity is on the market. Large medical centers, health clinics and emergency responders use more sophisticated instruments like the GC-MS and High Pressure Liquid Chromatography. In future articles, I will explore next-generation chemical detector platforms, correct procedures for field decontamination, and mass decontamination of civilians should a terrorist incident occur using chemical warfare agents.

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An Experimental Design for Measuring In-Situ Radiation Damage to a Piezoelectric Transducer

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"The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Air Force, the Department of Defense or the U.S. Government." (AFIT 35-101, para 15.5)

The Graduate Nuclear Engineering (GNE) program at the Air Force Institute of Technology (AFIT) is an intensive 18 months of study and culminates in the presentation and defense of a thesis. There are many topics available to research, but generally the thesis can be categorized as either computational or laboratory centered. This thesis is based on laboratory research and investigates radiation effects on an electronic device.

The thesis topic I chose was in collaboration with the Los Alamos National Laboratory (LANL). LANL has been performing experiments related to the Defense Threat Reduction Agency's (DTRA's) nuclear stockpile stewardship program using acoustic emission (AE) piezoelectric transducers and the annular core research reactor (ACRR) located at Sandia National Laboratories. The ACRR provides a high intensity pulsed radiation environment in which the AE piezoelectric transducers are being used. The transducers convert acoustic vibrations into electrical signals and are useful for measuring wave propagation in materials. Unfortunately, the radiation environment generally degrades the performance of many electronic devices and sometimes even causes complete operational failure. The effect of radiation on the performance of AE transducers is not well understood and requires further investigation.

This research was an initial investigation into the behavior and performance of AE piezoelectric transducers in a non-ionizing (neutron) radiation environment. It examined the relationship between neutron radiation dose and its impact on the performance of a particular AE transducer. The transducer investigated uses a piezoelectric ceramic made from lead metaniobate ($PbNb_2O_6$).

Problem Statement

The goals of this research were to: (1) construct an experimental apparatus that generates reproducible in-situ response measurements to a range of acoustic pulse transmissions using lead metaniobate AE transducers in close proximity to the core of a nuclear reactor, (2) characterize the relationship between neutron radiation exposure and frequency sensitivity of the transducers, (3) determine if there is a radiation dose limit where the transducers fail to give a reproducible response with a standard deviation less than 10% of the mean response value, and (4) investigate the annealing behavior of the transducers that were exposed to neutron radiation damage.

Piezoelectric Transducers

Piezoelectric transducers are useful as sensors because of their ability to couple with a physical pulse and translate it into an electric signal with amplitude proportional to the pulse. They are rugged, smaller than traditional pressure sensing devices, require little power (they generate their own response voltage signal), and respond at very high speeds. These qualities make them an excellent choice in the ACRR where they must function in a small space, over a wide range of pressures, under extreme heat and vibration and detect pressure events which last about 7 milliseconds. The transducers used in this experiment are shown in Figure 1. The larger transducer on the left provided the acoustic pulse signals and the one on the right was the subject of the radiation testing.

Figure 1. Relative Size of Pulser (Left) And Transducer (Right)

The piezoelectric effect is caused by the application of stress on a crystal with no center of symmetry. The stress induces an asymmetric separation of charges along the crystal forming a dipole moment (Figure 2). When a piezoelectric material is constricted by a periodic force, it produces a voltage that is proportional to the applied force applied at the same frequency. Alternatively, the piezoelectric effect can be used to convert electric potential into mechanical vibrations. By applying an alternating potential across the material, the molecular dipoles align, causing the material to expand or constrict. This is known as electrostriction and can be used to drive a vibrating signal such as an acoustic wave.

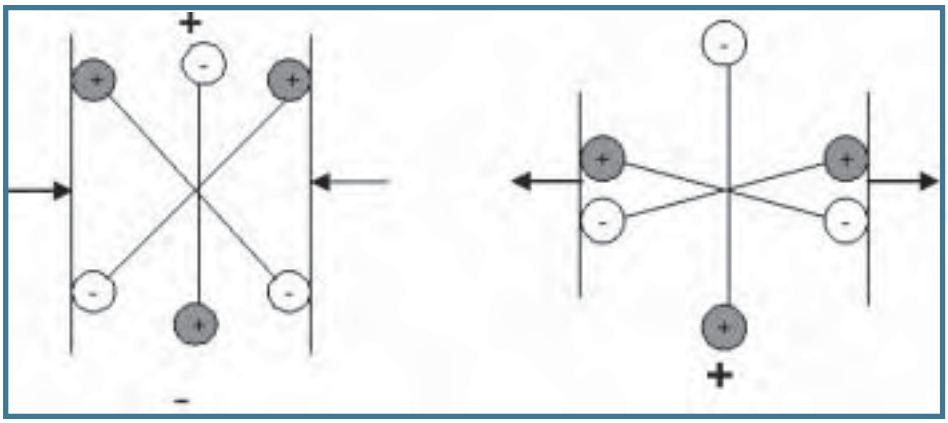

Figure 2. Induced Dipole in Piezoelectric Material.

The transducers tested in this work were even more complex because they involved AE. Metals under stress will release stored energy as acoustic waves from the lattice as deformation occurs. AE sensors function by converting the acoustic vibrations of a metal coupled to a transducer to create a periodic signal. By using multiple sensors at various locations, it is possible to determine the location of an AE source by using frequency/time-of-arrival and mathematical triangulation techniques. Normal frequencies for AE range from 30 kHz to 30 MHz (Acoustic Emission, 2004).

Experimental Design

The intent of this experiment was to simulate the conditions in which the transducer was to be used and measure how the transducer's response changes as it was exposed to an active neutron flux. This has not previously been done because of the difficulty with providing a pulse from an unaffected transducer to a transducer in a high radiation area.

Prior to irradiation the entire system was built and bench-top tested at the AFIT Nuclear Research Facility. This was done to precharacterize the transducers and to measure the effects of heating on the response (Figure 3).

The irradiation took place at the Ohio State University Research Reactor (OSURR) facility. Although this reactor did not produce the high neutron flux radiation pulse like ACRR, the device was measured in-situ and the effect of the neutrons inferred. Acoustic waves were sent into the OSURR to the transducers through the main beam port via an aluminum rod which acted as an acoustic waveguide (Figure 4, page 54). The rod was fashioned to propagate the wave with the least loss and to reduce activation, which was necessary for safety reasons. An acoustic pulser was placed at the end outside the reactor and driven using case level electronics.

The resultant signal was measured using a sensitive Source Measurement Unit. The entire system

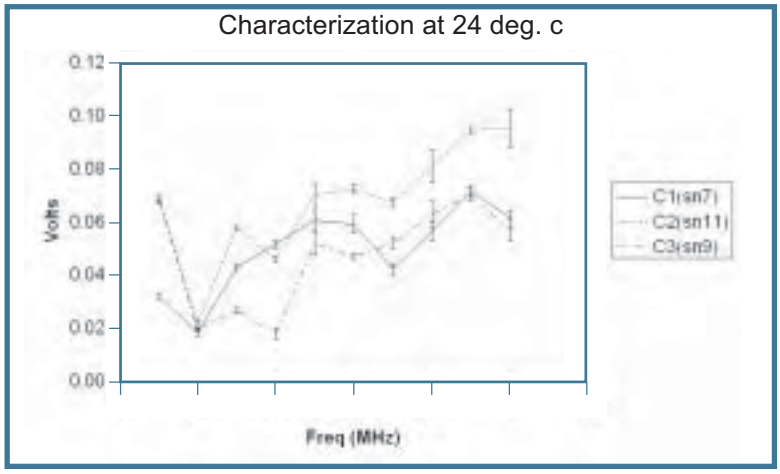

Figure 3. Transducer Precharacterization

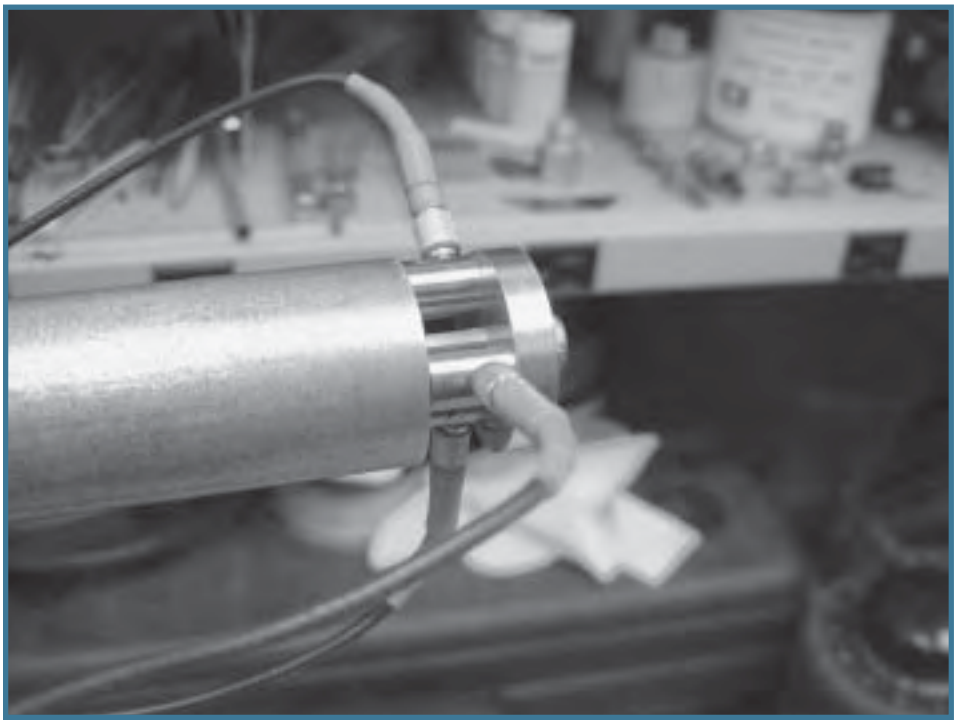

Figure 4. Wave Guide Apparatus

was remotely controlled using a computer interface, which allowed for long irradiation times while reducing exposure to any streaming radiation from the main beam port. Using this technique, it was possible to transmit a controlled signal from 100 kHz to 1 MHz using increments of 100 kHz to the set of transducers and measure the response while they were being actively irradiated, Figure 5.

One sampling cycle consisted of 300 acoustic pulse events and required approximately 6 minutes to complete. The mean value was determined at each frequency using the 10-recorded max responses, and the standard deviation was calculated. Statistical analysis of this sampling method resulted in very reproducible pulse height measurements. The standard deviation ranged between 3% and 8% of the mean value for all frequencies.

During the first two days of irradiation, power was increased gradually to see how the transducers would respond. Since there was no published literature available on experiments of this nature, it was unknown as to how the transducers would be affected by either dose rate or total dose. The next two days were executed with the reactor running at full power (450 kW). The entire irradiation experiment was completed over the course of four days.

Table 1. Neutron Fluence as a Function of Time.

Time (hours)	Fluence (neutrons per cm^2)
6	1.04×10^{16}
31	4.64×10^{16}
53	9.8×10^{16}
78	1.5×10^{17}

When the reactor was shut down at close of business each day, sampling continued overnight to observe the annealing behavior that occurred in the transducers. Although it would have been ideal to remove the waveguide from the neutron port to eliminate residual gamma radiation effects on the recovery behavior, activation of the entire test apparatus made it too radioactive to handle.

Results and Analysis

Figure 6 presents the time changing response of the transducers at 400 kHz.

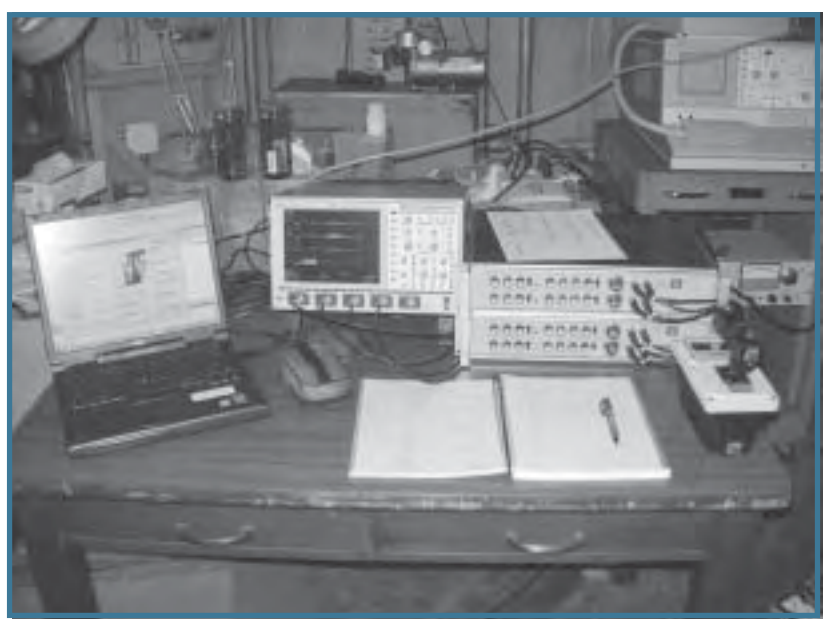

Figure 5. Experiment Test Station Configuration

The vertical lines through the graph delineate time when the reactor was powered and when the reactor was shut down. During the periods of reactor inactivity, the recovery behavior of the transducers can be measured. The abscissa represents the total number of hours transpired since initiation of the experiment. The ordinate contains the response of the transducers (measured in volts) to the acoustic pulse signal. Finally, the cumulative neutron fluence as a function of time is labeled at the end of each irradiation period and is summarized in Table 1.

Response degradation from irradiation is apparent at nearly all dose levels. Although each device response was unique, the general response to total dose was the same; a significant reduction in the response following a high fluence of neutron irradiation.

When the reactor was shut down, most transducers began to recover; however, the recovery was poor. This indicates that the damage to the transducer may be permanent.

Permanent damage is also observed when the device begins to be irradiated following a shut down period. The device almost immediately returns to the pre-shut down response, and begins to degrade from that point. Finally the device reaches a point of saturation where no more degradation is measured. This can be observed in the 60 and 90-hour response windows. Since the transducers recover to the response level established prior to that session of irradiation, no further permanent damage is being inflicted on them.

A general conclusion for all irradiated transducers is that response consistently degrades for all frequencies tested. The rate of degradation varies between transducers and with frequency.

A possible mechanism for the decrease in transducer response is illustrated in Figure 6. The elimination of a ferroelectric dipole in the ceramic crystal lattice is accomplished by a neutron colliding with one of the dipole molecule atoms and displacing it. The displaced atom is forced into the crystal lattice resulting in an interstitial and a vacancy. As the dipole damage accumulates, the potential difference (voltage) generated in response to the acoustic pulse begins to deteriorate.

Conclusions

Permanent damage to the transducers resulted from exposure to the neutron radiation inside the OSURR as noted by the degradation of response at all frequencies tested on each transducer. Assuming that gamma radiation effects are transient, the damage must be neutron induced and is therefore probably caused by displacement of atoms in the lead metaniobate crystal lattice.

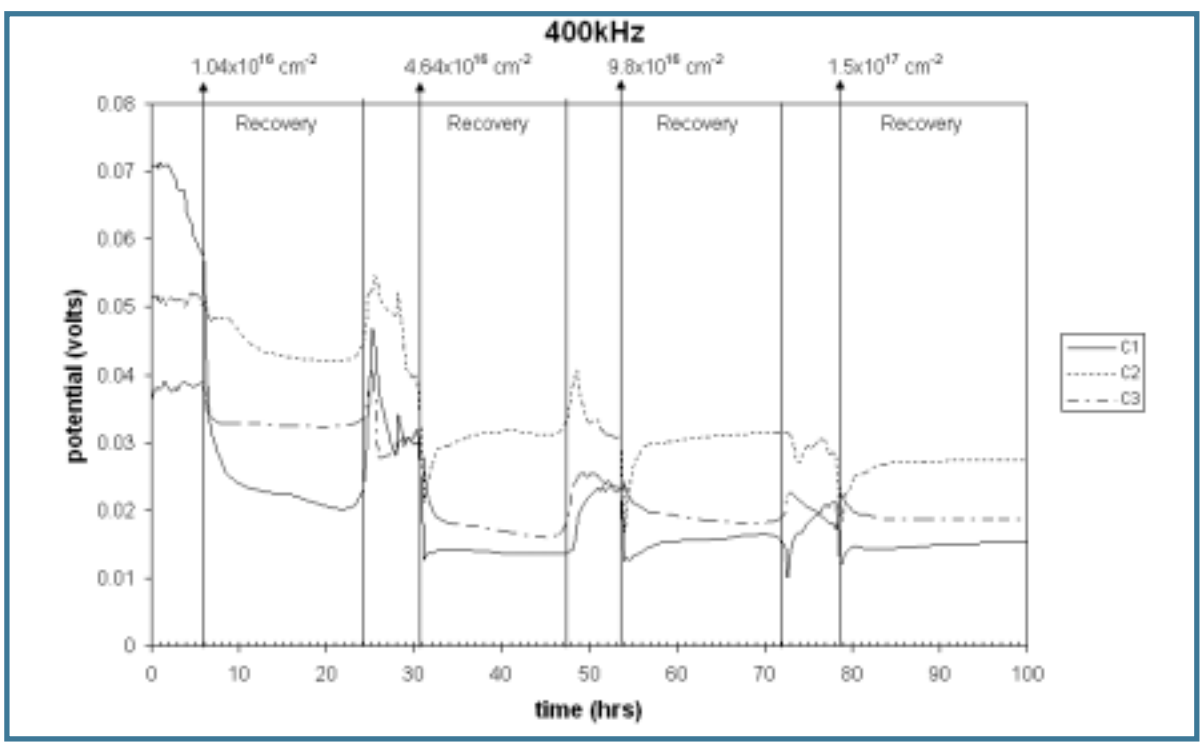

Figure 6. 400 kHz

The transducers were exposed to a total neutron fluence of 1.5×10^{17} cm^{-2}. Although response was significantly reduced, the transducers never reached a point where they failed to give a reproducible response with a standard deviation that was less than 10% of the mean value measured.

Recovery from displacement damage was not complete for any of the transducers. With additional time, the transducers may recover a little more but it is unlikely they will ever regain their original sensitivity.

Using an aluminum rod as a waveguide for in-situ neutron damage measurement was remarkably successful. The system was reliable and provided consistent and very reproducible results. It was rugged, reusable, and easy to construct.

The data sampling method was also very successful in producing measurements with a small standard deviation. Unfortunately, it required a considerable amount of manual data processing and consumed an excessive amount of time to prepare for presentation. Much more experimentation can be accomplished if a commercial acoustic emission measuring system is used.

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The German Democratic Republic (GDR) EMP Survivability Program in the 1980s

Mr. Robert Pfeffer
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It has been over a decade since the fall of the Iron Curtain and the eventual disintegration of the USSR, yet little has been written of electromagnetic pulse (EMP) programs conducted by Warsaw Pact nations. An earlier article in the Fall/Winter 2003 NBC Report is one of them: it described the author's visit to a Soviet-built EMP test facility just outside of Saint Petersburg, Russia. This second article provides a snapshot of the EMP survivability program sponsored by the East German (officially known as the German Democratic Republic (GDR)) government throughout the 1980s. Information came from various German documents translated by the author and others. From these translations, an attempt is made to describe the program structure, identify several of the primary organizations and their role in the program, and cite areas of cooperation between the GDR and USSR. The author then relates the GDR program to the US Army survivability program during the same period.

Program Goals

The primary goal of the known GDR EMP program was to protect National People's Army assets from the threat of EMP. A secondary goal was the protection of critical industry assets. For this reason, the GDR EMP program fell under the military umbrella and was an EMP survivability program.

Primary Players

Limited GDR government funds constrained the breadth and extent of the program. The GDR National People's Army had overall program control, but they did not have a large number of engineers and scientists devoted to EMP research, development, test and evaluation (RDT&E). Instead, they relied upon companies and universities to do most of the work. Listed below are several known government organizations, private companies and universities and their contributions during the last full decade of the program's existence. Unfortunately, some organizations are only known by their abbreviation.

National People's Army Military Technical Institute (MTI) – Apparently had overall EMP research responsibilities starting in 1981.

MfNV (Military Construction Administration) – Influenced the development of military EMP protection techniques, such as fiber optics, and the protection of what is referred to as the LAK-EMC portable receiver.

ISB (Institute for Special Constructions) – An MfNV organization concerned with the protection of stationary objects, such as buildings and long lines. They also worked with the Soviet Army on four technical subjects:

- Endo-atmospheric EMP (a.k.a. source-region EMP (SREMP).
- Cable coupling
- Protection techniques
- Shielding

In addition, the ISB developed the first high-level EMP simulator for testing cables and long lines.

VEB Rohrenwerk Rudelstadt – Produced surge arrestors for EMP protection.

VEB Kombinate Nachrichtenelektronik – Produced surge arrestors for EMP protection.

KOW – Worked with VEB to evaluate surge arrestors.

The Cerebus Company – Tested several different surge arrestors.

VEB Gleichrichterwerk Stahnsdorf – Produced epitaxial diodes (similar to US 1N 5629 and 1N 5635).

VEB Robotron-Büro-Maschinenwerk Sömmerda – Produced various EMP filters.

VEB Keramische Werke Hernsdorf – Developed metal oxide varistors (commnly known as MOVs) for government use.

Chief Administration Civil Defense – Concerned with protecting private industry from EMP.

The Deckwerth Company – Made shielded enclosures. Perhaps their most popular item was the sloped-roof enclosure called "Wurzen."

HfV (University for Transportation) – Investigated EMP and lightning protection of communication systems since 1970's under Professor Schüppler of the Communications Department. Specific research topics included:

- Space shielding
- The effects of lightning and EMP on telecommunication equipment
- The development of voltage protectors

The MTN section of HfV also looked at various EMP problems.

Several other universities carried out EMP-related work.

The ISB and the MTI had several high-voltage engineering firms involved in EMP testing. They were:

- VEB Transformatoren – und Röntgenwerk "Herman Matern," Dresden
- VEB Transformatorenwerk "Karl Liebknecht", Berlin
- VEB Keramische Werke, Hermsdorf
- Institut für Hochleistungspüftechnik, Berlin
- Adw, Zentralinstitut für Elektronenphysik, Berlin
- Institut für Hochenergiephysik, Zeuthen
- Zentrum für wissenschaftlichen Gerätebau, Berlin
- TU Dresden, Sektion Elektronik

Finally, there was an EMP Test Laboratory (possibly in Königs Wusterhausen) that carried out a number of coupling experiments using at least one small, bounded-wave simulator in their laboratory.

Speculation on GDR/USSR Cooperation

Very few details are known about joint GDR/USSR cooperation. What is available in the open literature indicates there were:

- Several USSR training and cooperative programs for the GDR military
- Various joint technical programs between ISB and the Soviet Army (see the above four EMP topics)
- Three USSR EMP simulators known and possibly used by the GDR:
  - GINT-4/1-4
  - GINT-4/1-11
  - EMI-M5
- Six GDR EMP simulators known and possibly used by the USSR:
  - ELSE
  - Simulator 1
  - Simulator 2
  - IPE 1
  - IPE 2
  - Simulator 3

A Comparison of GDR/US Army Survivability Programs of the 1980s

GDR Army –

By the late 1980s, the GDR EMP program was still a work in progress. Money constraints and the relationship they had with the USSR limited their program. Below is a list of the limitations:

- They could only address protection of GDR-built equipment (which used GRD-built semiconductors).
- They could not EMP-test USSR equipment; they also had limited communication with other Warsaw Pact nations.
- Most of their knowledge of high-altitude EMP (HEMP) and SREMP origin, coupling, hardening, and testing came from foreign unclassified literature or the USSR.
- Unclassified foreign literature was used to keep track of international (including NATO) trends and standards.
- They kept a library of foreign organizations conducting EMP-related work/studies.
- They used scale-model testing to address many coupling issues.
- Limited technical expertise led to the use of universities and companies to develop protection hardware.

US Army –

During this same time frame, the US Army was in its "Golden Years." By the end of the 1980s, they had hardened a large portion of the front line shooters and their associated C4I. They:

- Completed many military and private industry EMP vulnerability and hardening assessment programs.
- Evaluated foreign equipment and worked closely with NATO and the Quadripartite English-speaking countries.
- Developed environment codes that predict high- and low-altitude EMP based upon test data, conducted tests and then generated codes to predict system coupling and component and hardening responses.
- Participated in the development of US HEMP and SREMP criteria.
- Developed the NATO and Quadripartite standards for HEMP and SREMP criteria.
- Designed and built scale model, continuous wave (CW), current injection and threat-level EMP system test facilities and their protocols.
- Designed, built and installed, along with private industry, EMP protection concepts for mobile equip-

ment, including a package that addressed both near-strike lightning and HEMP protection.

Summary

The GDR EMP program was very weak, resulting in few hardened systems by the late 80s. Their program appears to have emphasized survivability test-related issues, due no doubt to limited funds as well as the constraints put on them by the USSR. Most theoretical or analytical work was obtained through the USSR or through open-literature searches.

Further Reading on Related Topics

Spring/Summer 2003 NBC Report, Electromagnetic Pulse Simulation in the USSR

Spring/Summer 2002 NBC Report, A Brief History of the Army Electromagnetic Pulse Program

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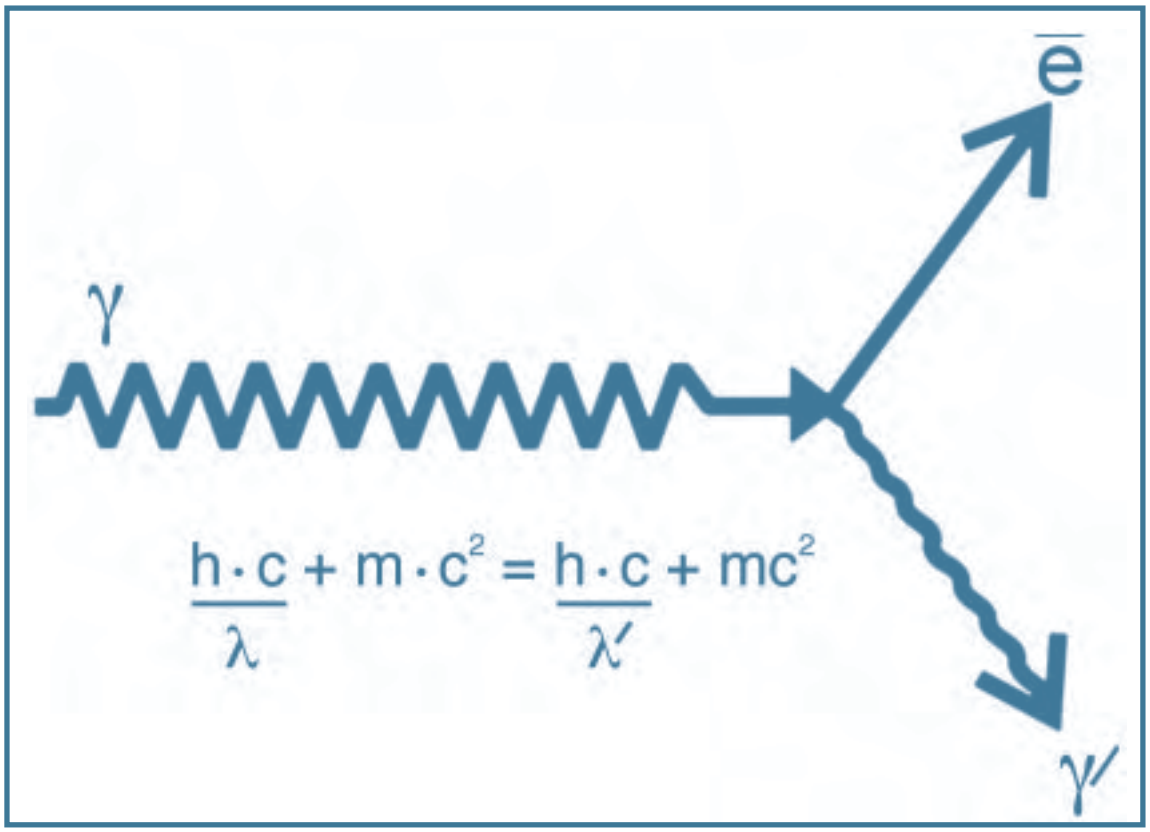
The primary goal of the known GDR EMP program was to protect National People's Army assets from the threat of EMP. A secondary goal was the protection of critical industry assets.



The Pentomic Era: The U.S. Army Between Korea and Vietnam

MAJ Bret Kinman
Naval Postgraduate School, Department of National Security Affairs

Overview

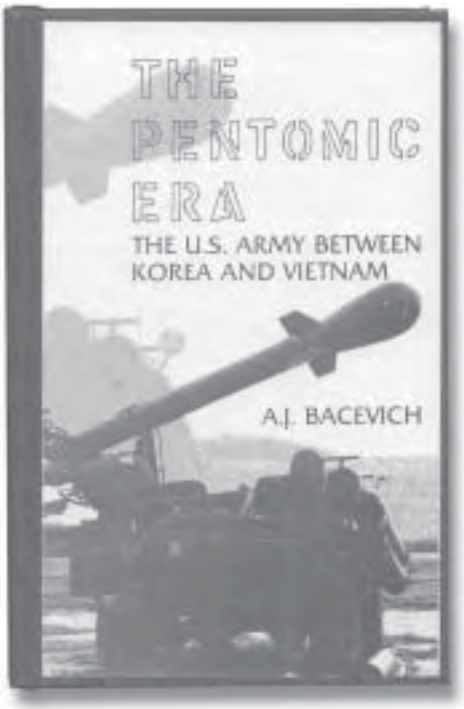
The Pentomic Era: The U.S. Army between Korea and Vietnam, reviews the changes the Army underwent during the early years of the Cold War and specifically the impact of nuclear weapons on the Army. A.J. Bacevich looks at how the Army responded to the emerging strategic balance between the Soviet Union and the United States. Additionally, he looks at how the Army interacted with the Joint Chiefs of Staff and the Eisenhower administration. Finally, the author outlines what changes the Army undertook during this period to adapt to emerging doctrine and technology. As he states in his introduction:

"Instead of the "good old days," the Army found the Eisenhower era to be one of continuing crisis. New technology, changing views of the nature of war, and the fiscal principles of the Eisenhower administration produced widespread doubts about the utility of traditional land forces…This essay explores the nature of those threats and of the Army's response to them.[1]"

The book is a useful history of the Army during this period, and how the armed forces struggled with the emerging reality of the Cold War.

Emerging Doctrine-Massive Retaliation

The book identifies the differences between the Army and the other Services, Joint Staff and the Eisen-



hower administration during this period. These differences were distinct and created major disputes, primarily over budgets as well as strategy, roles and missions. The Air Force, Navy and administration all believed in the utility of nuclear weapons to address national security concerns. During this period, the concept of "massive retaliation," which called for the overwhelming use of nuclear weapons against any Soviet aggression was developed, and became a cornerstone of national security policy. The Army believed that, while nuclear weapons could be used in some circumstances, Soviet aggression would come in the form of conventional war or guerilla action. Further, the possibility of large-scale strategic nuclear weapons use was not as likely as smaller scale "tactical" use. According to Bacevich:

"Instead, the Army postulated a spectrum of contingencies that it might face. At the far end of the spectrum was all-out nuclear warfare or a war featuring conventional forces on a scale approaching World War II complemented by the use of nuclear weapons. Of greater likelihood were lower intensity conflicts, wars that conventional forces fought with or without tactical nuclear weapons.[2]"

This spectrum identifies a continuing dilemma for the Army-what war should it prepare to fight? Should the Army develop units specifically to fight a certain type of warfare or have all units trained to conduct all types of operations?

The newness of nuclear weapons and the defining of their role in US strategy certainly contributed to some of the disagreements. Further, the experience in Korea had led the Army to draw different conclusions about the usability of nuclear weapons than the other Services. The Army had fought Communist aggression without nuclear weapons, contrary to the declared policy of the country. The Army had "argued that the strategic arsenals possessed by the United States and Soviet Union offset each other, thereby creating a condition of mutual deterrence.[3]" This condition placed the burden of a military de-

cision at the tactical and operational level.

Defining a New Role

Deterrence was the Eisenhower administration's national security strategy and consequently, the Defense Department saw its role as preventing war rather than fighting and winning a war. The Army, while disagreeing with the concept that it would not have to fight a war, began to embrace a deterrent role in US strategy. The Army did this by developing air defense missiles for use in the United States as well as battlefield surface-to-surface missiles of various ranges. Both types of systems utilized nuclear warheads. While these systems and programs ensured the Army could maintain an equal share of the budget, they also had the effect of distracting the Army from focusing on its warfighting mission. As the author continues:

"Yet taken as a whole the Army missile program reflects a preoccupation with an excessively narrow concept of war- despite the Service's theoretical appreciation for a broader spectrum of conflict. This enormous investment in missile development shows that in practice the Army assumed that atomic weapons would be used in any future war and would determine its outcome.[4]"

Despite the attention on missiles, the Army did have to face the reality of fighting on a nuclear battlefield. The Army's thinkers of the time envisioned an Army equipped with tactical nuclear weapons, prepared to fight a conventional war but able to transition to nuclear battle:

"To carry on with the proven methods of World War II and Korea would not do, especially since our adversary's ability and willingness to employ nuclear weapons would trail only slightly behind our own….the Army attempted to define the qualities that atomic age forces needed to survive and to prevail.[5]"

The Army began to embark on a series of changes in its force structure and doctrine to definitively ensure its success on a future battlefield.

Pentomic Organization

The Army believed that fighting on a nuclear battlefield would require a dispersed force that could rapidly reassemble to conduct a combat mission and then disperse again. These units would be alone on the battlefield and required organic sustainment capability. This led the Army to develop an enhanced battalion level organization called a "battle group."[6] A battle group had five companies with each company having five platoons; a division had five battle groups. The common use of five led to the "Pentomic" designation for these units.

This new organization led to adjustments in tactics and doctrine of how these organizations would fight. The Army doctrine during this period foresaw:

"Nuclear fires would blast a gap through the enemy front before movement on the ground even began. Swiftly concentrated maneuver units then would follow, dashing through the gap to perform the technical tasks and finishing touches of the attack as they rolled unimpeded into the enemy's rear.[7]"

This concept drew comparisons to similar tactics used in World War I. The force would not engage in heavy combat but rather conduct an exploitation of the enemy second echelon and rear areas. The Army also conducted tactical experiments in the Nevada desert with troops in close proximity to a tactical nuclear weapon detonation. These events were intended to display the new force and its compatibility with a nuclear battlefield. Despite these efforts, as the 1960s dawned, change was again upon the Army.

With the end of the Eisenhower Administration in 1961, most of the Army changes of the 1950's were disbanded. With Kennedy's shift to "Flexible Response", the Army began to look again, at how it might fight in a variety of scenarios. Coupled with the

nations' emerging involvement in Vietnam and other insurgent operations, the Army faced a new prospect of warfare. This was not to be the nuclear battlefield; in fact, nuclear weapons were not as much part of the new battlefield reality for the Army. The Army had come to realize that its efforts during the 1950s had been as much about preserving the institution as about preparing to fight a nuclear war.

The End of the Era

The Army began to look critically at how it viewed the 1950s and how it had made decisions and managed change. Clearly, the priority on nuclear weapons and missiles had diluted its focus on conventional capabilities. Further, the embrace of technology had developed a more managerial and bureaucratic culture in the Army. The Army no longer wanted warriors but rather technicians, who were capable of utilizing the new technology economically.

"The incessant emphasis on technology was little more than an artful dodge concealing the emptiness of the Army's thinking. The futurists who proclaimed that changing technology was reshaping the face of warfare succeeded only in laying the Service open to doctrinal fads. Captivated by the prospect of turning the latest technological breakthrough to the benefit of short-term institutional goals, Service leaders charged off to develop the doctrine, tactics, and organization needed to convert technological promise into combat capabilities.[8]"

As the 1960s began, the Army began to realize the folly of its efforts in the 1950s; the Pentomic units reorganized and many of the air defense units were slowly disbanded. The Army had to face the realities of combat in a guerilla environment or at least a conventional combat at a lower scale than it had anticipated.

Analysis

The parallels between the mid-1950s and today are in some cases uncanny. Much of Bacevich's writing reveals Army problems and thought that are similar to discussions of "Transformation" today. In fact, throughout much of his book, there is a striking resemblance of the experiences of the US Army during the 1950s and the current debate over Army Transformation. However, Bacevich's analysis has a few shortfalls. Primarily, he identifies the changes and programs the Army embraced during the 1950s without shedding much light on the exact impetus for these decisions. Surely there were extensive studies and experiments by the Army staff as well as other think tanks within the Department of Defense that led to the development of the Pentomic Division. How did these efforts influence the senior leaders in the Army to make their decisions?

Conversely, Bacevich does not identify any cases of the Services working together. Interservice rivalries are well documented in the years following the implementation of the National Security Act of 1947 and the Key West Agreement. Yet it seems improbable, with the exception of Korea, that there were no cases of the Services working together on systems, doctrine or programs. Bacevich does document Eisenhower's concern about the Department of Defense and how it was still Service specific in its thinking. Surely there must have been leaders who were committed to the concept of joint operations.

Bacevich has written an insightful review of a unique era in US military development. His book is prescient in its critique of how technology can be a detriment to military reform. This work is relevant today as the Army and the Department of Defense, in general, are transforming. The current mandate for change is centered again around technology and may mask organization and doctrine changes that are dead ends once embraced by the Services. The book is useful reading for FA52 officers, and indeed all Army leaders, who may find useful insight into the process of change in the Services based on technology alone.

Major Bret Kinman is a FA52 officer currently assigned as a student at the Naval Postgraduate School, Department of National Security Affairs. He was previously assigned to the USAREUR G3 Executive Office and USAREUR G3 Force Protection & Anti-Terrorism Division. He has a B.A. in Political Science from North Georgia College.

(Endnotes)

[1] Bacevich, pp. 3-4

[2] Bacevich, pp.60-61

[3] Bacevich, p 64

[4] Bacevich, p. 98

[5] Bacevich, p. 66

[6] Bacevich, p.105

[7] Bacevich, pp.108-109

[8] Bacevich, pp. 148-149

Do You Know…

R. Pfeffer

Physical Scientist, United States Army Nuclear and Chemical Agency

…how the unit for neutron interaction cross sections got its name?

Too often we fail to appreciate the fact that the giants of science, including nuclear physicists, were humans. This story was told to me by one of those early pioneers, Dr. Franco Rasetti, then Professor of Physics at The Johns Hopkins University during the 1960s.

In the 1930s and 1940s, a considerable amount of theoretical and experimental work was conducted to define the atom and its nucleus. Led by Dr. Enrico Fermi, this group (including Dr. Rasetti) concentrated on understanding the neutron. Though having a large mass and no charge, the neutron was integral to the understanding of the Bohr model of the atom. For his work on the existence of new radioactive elements produced by neutron irradiation, and for his related discovery of nuclear reactions brought about by slow (thermal) neutrons, Dr. Fermi was awarded the 1938 Nobel Prize in Physics.

During the latter investigation of slow neutron-induced reactions, Fermi's group experimentally validated his theory of the neutron. They also established and executed the early neutron interaction cross-section tests. An interaction cross section is a measure of the probability of a specific interaction occurring. Almost immediately their tests were successful, owing in part to the extremely large interaction cross sections for thermal neutrons…so much so that one day Dr. Fermi exclaimed the cross sections were so big it was like "hitting a barn."

Well, the unit stuck. Today, the unit of one barn is defined as being 10^{-24} square centimeters.

FURTHER READING:

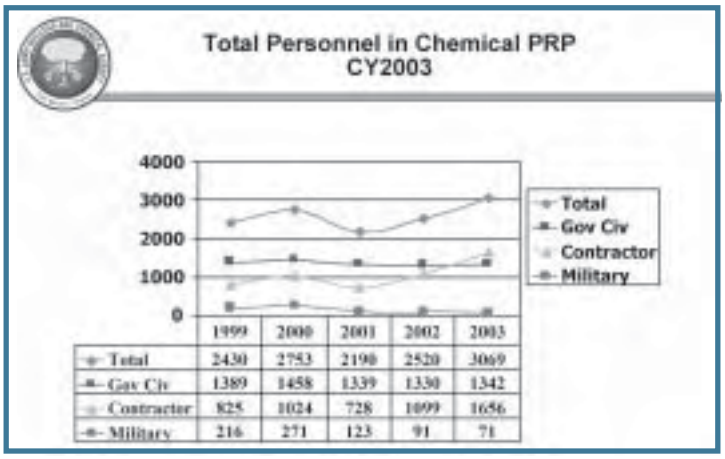
For a fascinating story on Dr. Fermi, Dr. Rasetti, and other Italian scientists of that time, read the biography on Dr. Fermi by his wife, called Atoms in the Family.

Surety Update

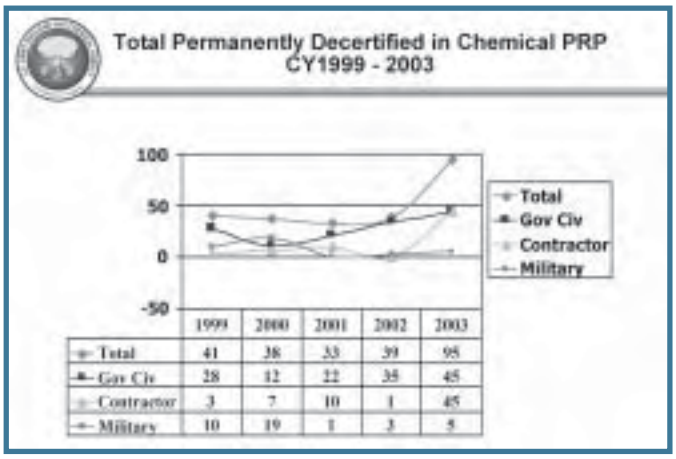
LTC Tom Moore
LTC Larry Jones
United States Army Nuclear and Chemical Agency

2003 Personnel Reliability Program Status Report

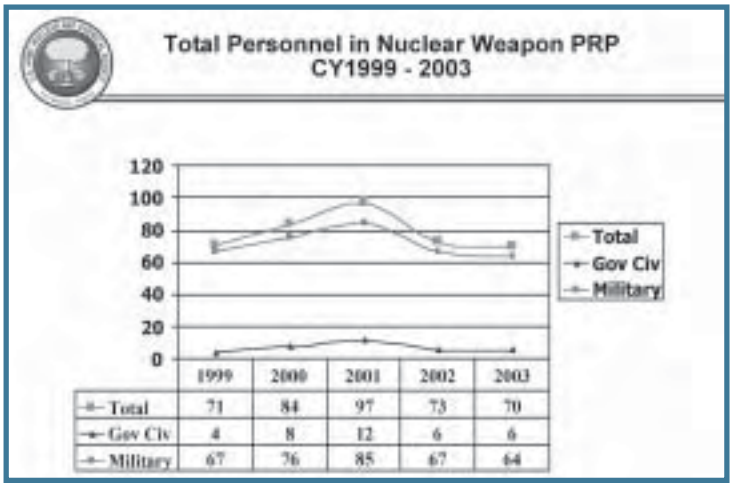
Department of Defense Directive (DoDD) 5210.42 requires each Major Command that has personnel in the Personnel Reliability Program (PRP) to submit an annual PRP status report by 31 December of each year. LTC Larry Jones and I would like to thank all surety offices for their timely response and submission of Department of the Army (DA) Form 7422. The USANCA surety office consolidated these inputs and submitted the 2003 Annual Personnel Reliability Program Status Report to the Undersecretary of Defense for Intelligence (USD (I)) in February of 2004. This report provides the USD (I) an annual snapshot of the number of positions as well as the number and types of disqualifications from the PRP. When compared to previous reports it serves as an indicator of trends in the program. The number



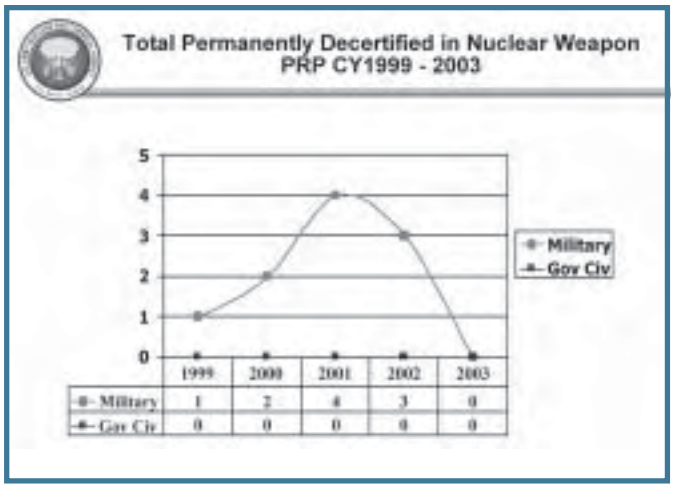
	1999	2000	2001	2002	2003
Total	2430	2753	2190	2520	3069
Gov Civ	1389	1458	1339	1330	1342
Contractor	825	1024	728	1099	1656
Military	216	271	123	91	71



	1999	2000	2001	2002	2003
Total	41	38	33	39	95
Gov Civ	28	12	22	35	45
Contractor	3	7	10	1	45
Military	10	19	1	3	5

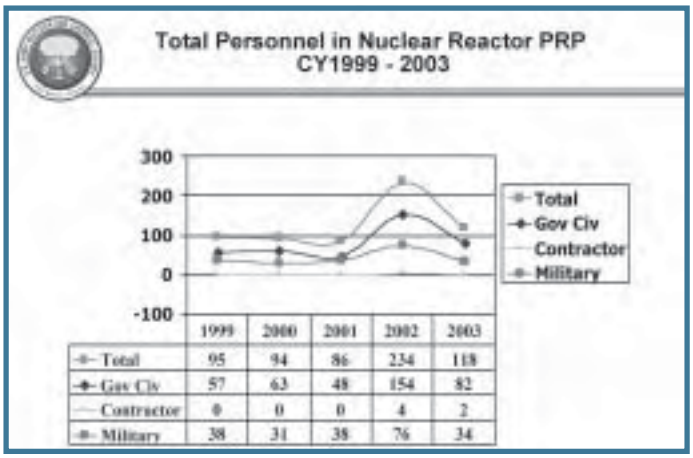


	1999	2000	2001	2002	2003
Total	71	84	97	73	70
Gov Civ	4	8	12	6	6
Military	67	76	85	67	64

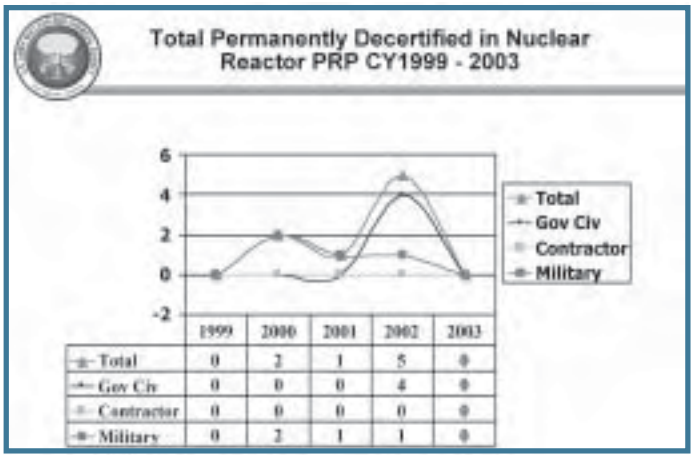


	1999	2000	2001	2002	2003
Military	1	2	4	3	0
Gov Civ	0	0	0	0	0

of PRP positions has grown considerably over the last year due in large part to requirements for chemical demilitarization activities and for new agencies that have a surety mission.



	1999	2000	2001	2002	2003
Total	95	94	86	234	118
Gov Civ	57	63	48	154	82
Contractor	0	0	0	4	2
Military	38	31	38	76	34



	1999	2000	2001	2002	2003
Total	0	2	1	5	0
Gov Civ	0	0	0	4	0
Contractor	0	0	0	0	0
Military	0	2	1	1	0

Surety Questions and Answers

The USANCA Surety office reviewed several surety questions over the last 6 months. We would like to share these questions and answers with you and encourage your continued surety queries. The answers provided below may be used as definitive guidance for your surety programs. All answers have been coordinated with the National Security Policy Division DCS, G-3 (DAMO-SSD) and forwarded to the Department of the Army Inspector General for review. Surety questions and answers will be posted to the following web site for future reference: https://www.hqda-odcsops.army.pentagon.mil/ssd/. You must have an AKO account to access the site. If you do not have an AKO account, you may request one by going to https://www.us.army.mil/portal/portal_home.html and clicking on Register for AKO.

Q. Many of our personnel in the PRP travel on official duty. Should we remove them from the PRP when they are in a TDY status or on leave?

A. No. Although Service members cannot be observed under the guidlelines of continuing evaluation when they travel, this is no reason to remove them from the program. During an extended TDY or absence (regulations set no fixed number of days, as circumstances differ) the Certifying Official (CO) can augment the self-reporting requirement by notifying the individual's new supervisor of their PRP status and ask that potentially disqualifying information be reported back to him/her. Additionally, "Individuals will advise their supervisors or certifying officials of any factors that could have an adverse impact on their performance, reliability, or safety while performing PRP duties, (AR 50-6 pg. 17, 2-22a). This quote is applicable to individuals in a TDY status or on leave.

Temporary disqualification may initially seem like a good solution for COs to employ when addressing this question. TD is not applicable, however, as it is designed "for cause" (either prolonged military illness or suspect reliability), not TDYs and leaves. Expect further procedural clarification on this question in the new AR 50-6 and AR 50-X.

Q. Can a Service member or civilian from another branch of Service be in an Army nuclear or chemical PRP?

A. Yes. This person must meet all screening and continuing evaluation requirements as depicted in Sections 4 and 5 of Army Regulations (ARs) 50-5 & 50-6. Additionally, DoDD 5210.42 & DoDD 5210.65 state that an individual must be a US citizen to be in the nuclear or chemical PRP. Army Commanders/Directors have flexibility to identify the most reliable person to fill a position on their nuclear or chemical duty position roster even if that person is not a Soldier or Department of the Army civilian.

Q. Is an individual permanently disqualified from the PRP when the Reviewing Official (RO) approves the CO's disqualification action in a written decision or when the CO provides the individual written notification of his determination?

A. An individual is permanently disqualified from the PRP when the RO approves the CO's action in a written decision. When a RO approves the disqualification the individual is disqualified from the PRP and the CO must complete the appropriate sections of the original DA Form 3180. Conversely, if the RO does not approve the CO's recommendation for disqualification the individual remains in the PRP and the CO makes no entries in the individual's records attesting to disqualification.

The time from CO's determination of unreliability to receipt of the RO's written decision may take up to 40 days. The CO alone is allotted 15

working days after his initial determination of unreliability to deliver a notification letter to the individual. It is therefore critical that once a CO determines an individual unreliable to perform PRP duties (IAW the reliability standards of Chapter 2 in ARs 50-5 and 50-6) he temporarily disqualifies him/her effectively precluding individual access to PRP facilities and agents and performance of PRP duties. No person will have access to or work in a PRP capacity while awaiting the RO's final action on a permanent disqualification decision. For a review of the nuclear and chemical PRP permanent disqualification procedures see pages 17 and 18 of AR 50-5 and pages 19 and 20 of AR 50-6 respectively.

Q. Under AR 50-6, the Commander that designates a CO becomes his RO. If that RO initiates permanent disqualification against the CO, who will act as his RO during this action?

A. IAW AR 50-6 page 7, 2-3, e., the RO certifies the CO into the PRP. Therefore, the RO's rater will act as the RO to review and adjudicate any action taken to permanently disqualify a CO from the PRP. This procedure may not be evident in the current (26 June 2001) AR 50-6 but will be formalized in the next revision.

Q. Can a surety officer or surety board direct a Competent Medical Authority to review my health records?

A. No. In accordance with (IAW) AR 50-6 page 14, para 2-15 b. "Certifying officials and reviewing officials may direct the review of health records of personnel being screened for the PRP or those currently in the PRP at anytime to make suitability determinations required by this regulation." Surety officers and boards help Commanders manage their PRP but do not have the authority to direct the review of health records. For a list of surety officer and boards responsibilities see AR 50-6, page 5, 1-6.

IAW AR 50-5 page 13, para e. "…authority for review [health records] extends only to certifying officials and reviewing officials. Certifying officials may not delegate this authority to contractor employees assisting the certifying official without the written consent of the employee."

Q: How do I make a correction to the DA Form 3180? Is "white-out" acceptable?

A: In making necessary corrections to data already entered on the DA Form 3180, line out the incorrect information in pen, make the correction, and initial and date the change. Do not use "white-out." (Pencil entries pertaining to temporary disqualification will be handled per paragraph 2-28.)

Individual Responsibility

The PRP is a Commander/Director program. They are similar to a chief architect for their PRPs. I would suggest that the foundation of the best programs use individual responsibility as their cornerstone. Many findings could be avoided, discrepancies allayed, and surety enhanced when individuals practice the words of AR 50-6 page 17, 2-22 a:

"Individuals assigned to PRP duties are responsible for monitoring their own reliability and the reliability of others performing PRP duties. Failure to discharge those responsibilities may cast doubt on an individual's reliability."

Individuals can help strengthen their PRP by remembering some of the other individual responsibilities:

Notification

"Individuals will advise their supervisors or certifying official of any factor that could have an adverse impact on their performance, reliability, or safety while performing PRP duties." AR 50-6, 2-22, a.

"Individuals will inform support agencies of their active PRP status before treatment or consultation…" AR 50-6, 2-22, a.

Monitoring others in the PRP

"(Individuals) will inform their supervisor or certifying official when another individual in the PRP appears to be involved in situations that may affect reliability." AR 50-6, 2-22, a.

Proficiency

"Training and/or experience applicable to the position assigned and verification that each individual in the PRP is proficient in the nuclear duties to be performed." AR 50-5, 1-5, (4) and AR 50-6, 2-6.

Security Updates

"Individuals requiring a periodic review (PR) should initiate the PR six months prior to expiration and will remain qualified while the PR is being conducted." AR 50-5, 2-26 d.

Nuclear Research and Operations Officer Council of Colonels

COL Rick E. Hill
United States Army Nuclear and Chemical Agency

The term "Council of Colonels" is utilized quite frequently in the Pentagon, as seemingly every significant staff action must wind its way from the action officer level through a Council of Colonels before approval at the General Officer level. Councils of Colonels are designed to give more experienced officers the opportunity to approve or modify an action before it goes forward to the next level, normally a General Officer Steering Committee (GOSC). In this capacity, a Council of Colonels acts as an advisory body to the GOSC. FA52 has its own Council of Colonels that acts in much the same manner as a Council of Colonels in the Pentagon. Membership of the FA52 Council of Colonels consists of the following:

- The FA52 Proponent (Director, USANCA)
- The FA52 Proponent Manager
- Each Active and Reserve Component FA52 Colonel or promotable Lieutenant Colonel
- The senior FA52 officer at commands/agencies not having an assigned FA52 Colonel

This article will describe the history of the FA52 Council of Colonels, its recent activities and its plans for the future.

The FA52 Council of Colonels has been in existence in one manner or another for quite some time.

Historical records at USANCA indicate that a Proponency Meeting at the O-6 level was held as far back as 1984. The first "modern" FA52 Council of Colonels was held at USANCA in 2000, meeting primarily to write the current functional area description contained in AR 600-3, The Army Personnel Proponent System. The Council of Colonels next met in July 2001 at Defense Nuclear Weapons School, Kirtland AFB, NM during the same timeframe as the Nuclear Research and Operations Officer Course (NROOC). The FA52 Council of Colonels met again at DNWS in July 2003 at which the council members developed a series of action items as a way ahead for the functional area. In addition, discussion was held on expanding the role of the FA52 Council of Colonels with the goal of making the Council an action organization vice a primarily informational exchange group.

The FA52 Council of Colonels next met in January 2004 at the Defense Threat Reduction Agency. At this meeting, the majority of the action items from the July 2003 Council of Colonels were validated, to include the need to change the functional area title from Nuclear Research and Operations to Nuclear and Counterproliferation. It was also decided that the FA52 Council of Colonels should meet semi-annually, either informally or formally. The informal Council of Colonels will be held in the Washington D.C. area since the majority of FA52 officers serve in the area and will normally be held in the January/February timeframe. The formal Council of Colonels will normally be held in conjunction with NROOC, conducted in July at DNWS.

The informal Council of Colonels is designed to be a meeting at which proposed action items are discussed and, if accepted, assigned to one of four working groups for further study. Working groups are made up of members of the FA52 Council of Colonels and selected personnel from within the FA52 community. The four working groups cover the topic areas of Force Management, Reserve Component, Strategic Vision, and Training/Professional Development. The intent is for the working groups to

study the proposed action item and present a recommendation to the Proponent Manager for decision at the formal FA52 Council of Colonels.

Every FA52 officer has a stake in the future of the functional area. As such, the four working groups will accept action items for proposed study from any FA52 officer. If the proposed action item is accepted for study, it will then be presented to the Proponent Manager for decision at the formal FA52 Council of Colonels. FA52 officers interested in submitting proposed action items for study should contact the leader of the appropriate working group. Below is the contact information for each working group.

Force Management

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E-mail: ricky.hill@us.army.mil

Reserve Component

COL Bobby Armstrong
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E-mail: armstrong@usanca-smtp.army.mil

Strategic Vision

COL Korey Jackson
Nuclear & Radiological Issues
Office of Defense for Homeland Defense
Phone: (703) 697-5142, DSN: 227
E-mail: Korey.Jackson@osd.mil

Training/Professional Development

COL Randle Scott

Chief, Operations Support Division, Combat Support Directorate

Defense Threat Reduction Agency
Phone: (703) 325-7177, DSN: 221
E-mail: randle.scott@dtra.mil

COL Rick E. Hill is currently serving as the Operations Division Chief at USANCA. He was commissioned as a Field Artillery Officer upon graduation from the University of Kansas with a B.A. in Education. He has served Field Artillery assignments at Fort Lewis, Fort Riley, and Germany, a FA52 assignment in the United Kingdom, were he led the joint targeting/battle damage assessment cell for Operation Allied Force, and an assignment at HQDA G-3 as a Transformation Force Management Staff Officer. He has a M.S. degree from Central Michigan University and is a graduate of the Army Command and General Staff College and the Armed Forces Staff College.

ARMY NUCLEAR KNOWLEDGE COLLABORATION CENTER (KCC)

Log on to "www.us.army.smil.mil"

In the "COMMUNITIES" column select "MACOMS," then "TRADOC," then "Nuclear"

Overview:
- Secret website on Army's AKO-S
- General "homepage" information and links with a nuclear collaboration center
- Facilitates collaboration on nuclear issues, products, exercises
- Database to retrieve information from any SIPERNET terminal
- Memory space to share and administrative rights to offer other commands, Services and agencies!
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Currently Posted:
- *Links to weapons information, nuclear sites, commands, and intelligence*
- *Nuclear products and information*
- *FA 52 Information; Jobs, Council of Colonels minutes, training opportunities*
- *Army Reactor Council information*
- *Past issues of the NBC Report*
- *DA PAMs, Regulations and Joint nuclear doctrine*
- *USANCA information and products*

Do you want your organization, Service, or agency represented?

Contact LTC Tom Moore @ 703-806-7856 (DSN 656) or thomas.moore@us.army.mil for information.

Joint Planner's Course for Combating Weapons of Mass Destruction

COL Rick E. Hill
United States Army Nuclear and Chemical Agency

Both the September 2002 National Security Strategy of the United States of America and the December 2002 National Strategy to Combat Weapons of Mass Destruction clearly recognize that one of the greatest security challenges to the US is the possession of weapons of mass destruction (WMD) by hostile states and terrorist organizations. Those two documents articulate three pillars for how the US will combat WMD. The three pillars are counterproliferation to combat WMD use, strengthened nonproliferation to combat WMD proliferation, and consequence management to respond to WMD use. The Department of Defense (DoD) will play an active role in all three pillars of combating WMD.

DoD is in the process of translating the national combating WMD strategy into doctrine through development of Joint Publication (JP) 3-40, *Joint Doctrine for Combating Weapons of Mass Destruction*. Joint Staff J-7, the lead agent for JP 3-40, will staff the revised Final Coordination Draft of the JP with the Services, Combatant Commands and other DoD agencies as this issue of the *NBC Report* is going to press. This critical JP should be in distribution by the end of this fiscal year.

In order to better prepare Combatant Commands, Services and other DoD agencies in executing the US strategy to combat WMD, the Defense Threat Reduction Agency (DTRA) is developing the Joint Planner's Course for Combating Weapons of Mass Destruction at the Defense Nuclear Weapons School (DNWS), Kirtland AFB, NM. DTRA has hosted a series of meetings with representatives from the Office of the Secretary of Defense, Joint Staff, Joint Forces Command, Services, USANCA, and contractors from Battelle, Northrop-Grumman, and Science Applications International Corporation to develop the course concept as well as to determine the course syllabus.

The course goal is to prepare DoD staff officers at all levels to review, revise, and coordinate plans related to combating WMD. The focus of the instruction will be on those personnel actually responsible for combating WMD planning at the Joint Staff, combatant and component commands, Services and combat support agencies. Although course and syllabus development is still ongoing, topics likely to be covered in the course include the following:

- National Combating WMD Policy and WMD Threat
- Doctrine for Combating WMD
- Joint Operations Planning and Execution System (JOPES) Overview
- Nonproliferation
- Counterproliferation
- Consequence Management
- Elimination Operations
- Weapon Effects
- End of Course Exercise

The current plan is to conduct a three-day "dry run" of the course sometime in mid-July at a location to be announced in the Military District of Washington (MDW) area with a five-day pilot course to be held in mid-August, also in the MDW area. Follow-on courses are likely to be held in the MDW area and at DNWS.

The Joint Planner's Course for Combating WMD will fill a void in DoD's preparedness to execute the US national strategy to combat WMD. Personnel interested in attending the pilot course to be held in mid-August should contact Lt Col Hiram Morales, DTRA CSOP, 703-325-1294.

COL Rick E. Hill is currently serving as the Operations Division Chief at USANCA. He was commissioned as a Field Artillery Officer upon graduation from the University of Kansas with a B.A. in Education. He has served Field Artillery assignments at Fort Lewis, Fort Riley, and Germany, a FA52 assignment in the United Kingdom, were he led the joint targeting/battle damage assessment cell for Operation Allied

Force, and an assignment at HQDA G-3 as a Transformation Force Management Staff Officer. He has a M.S. degree from Central Michigan University and is a graduate of the Army Command and General Staff College and the Armed Forces Staff College.

USANCA BULLETIN BOARD

THEATER NUCLEAR OPERATIONS COURSE (TNOC)

For all Joint Nuclear Operations Planners!
Army ASI 5H certifying training

TNOC is the only course offered by a Department of Defense (DoD) organization that provides training for staff officers who are required to conduct theater nuclear operations planning. The course is designed to provide students with the knowledge to make informed nuclear operations planning recommendations based on an understanding of nuclear fire planning and the integration of nuclear and conventional fires, weapon system delivery capabilities and limitations, determination of collateral damage effects, determination of force protection and warning measures, and nuclear plan approval and execution process.

Course Number: DNWS-R013 (TNOC)

26-30 Jul 04
Defense Nuclear Weapons School
Kirtland AFB, Albuquerque, NM
Quotas:
Call DNWS Registrar at
(505) 846-5666 or DSN 246-5666

NEED SURETY HELP?

USANCA is your one stop shop for:
Surety Assistance Visits
& Policy Interpretation

Call USANCA's Operations Division at:
DSN 656-7856/Comm (703) 806-7856

E-mail:
Chemical Surety: jones@usanca-smtp.army.mil (unclass)
Nuclear Surety: moore@usanca-smtp.army.mil (unclass)

NUCLEAR EMPLOYMENT AUGMENTATION TEAM (NEAT)

USANCA's NEAT stands ready to provide nuclear target analysis and nuclear operational support to supported Combatant Commands, Army Corps and EAC HQs.

Specific NEAT capabilities include:

- Theater nuclear planning
- Analysis of effects of nuclear weapons use on theater land operations (Consequences of Execution)

Units interested in scheduling NEAT support should contact USANCA's Operations Division at (703) 806-7857 or DSN 656-7857

Tell It To The Community

You may submit calendar items, small notes, items of interest, etc. to the USANCA Bulletin Board.

Email items to
The NBC Report Editor at
moore@usanca-smtp.army.mil
or call
DSN 656-7856/(703) 806-7856

The next issue of the NBC Report is scheduled for publication the first week of December 2004. Bulletin Board submissions for the issue should cover dated items from December 2004-June 2005 and must be submitted NLT 20 October 2004 for publication.

Note: The editor retains the right to edit and choose which submissions are printed.

SMR

Army Specific Military Requirements for Radiation and Nuclear Weapons Effects

Provides DA-G3 approved rank ordered list of requirements for information

- Nuclear Weapons Effects
- Related Electromagnetic Effects
- Related Directed Energy Effects

The FY05/06 SMR was disseminated December 2003.

For a copy of the FY05/06 SMR contact USANCA's Nuclear Division at (703) 806-7860 or DSN 656-7860

Nuclear Research and Operations Officer Course (NROOC 2004)

Functional area qualifying course for officers assigned to FA52.

NROOC 2004
12-23 July 2004
Defense Nuclear Weapons School, Kirtland AFB NM

Attendance:
Initial priority is given to officers TDY enroute to a FA52 assignment or currently serving in a FA52 position.

Additional information/availability:
Call the FA52 Proponent Manager, (703)-806-7866, DSN 656-7866

Upcoming NWE-Related Events

Non-ideal Air Blast Workshop: 20-24 Sep 04, Alburquerque, NM
EURO EM 2004: 12-16 Jul 04, Magdeburg, GE
Unified Approach to E3 Protection Workshop: 20-21 Jul, Mannheim, GE
Hardened Electronics and Radiation Technology Technology Conference: 21-25 Mar 05, Tampa, FL
For more information on these activities, address requests to:
Robert Pfeffer, Nuclear Div, USANCA, (703) 806-7801, pfeffer@usanca-smtp.army.mil

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