PIR

THE MAGAZINE FOR SCIENCE & SECURITY

Fall 2011 Volume 64 No 3

Evolving Infectious Disease Risks

Q&A: NEAL LANE

Sweeping Up Dirty Bombs

COUNTERING BIOTHREATS

BIOWEAPONS: THE PAST 100 YEARS

SECURING RADIOACTIVE MATERIALS

Biological Agents: In the Laboratory

AVOIDING THE ROAD TO NOWHERE: BWC 2011

2012 NUCLEAR SECURITY SUMMIT IN SEOUL

$12.95US

FAS

PIR

Fall 2011 Volume 64 No 3

FEATURES

FAS.ORG

FAS ONLINE

Secrecy News

Read reports on new developments in government secrecy and access resources on secrecy, intelligence and national security policy.

www.FAS.org/blog/secrcy

Iran's Nuclear Program

Read the FAS Special Report "Towards Enhanced Safeguards for Iran's Nuclear Program" and listen to a podcast of Dr. Ali Vaez explain the history of Iran's relationship with the IAEA and Iranian public opinion regarding nuclear pursuits. Read opinions and news stories about this issue.
www.FAS.org/policy/

BioBlog

Learn more about biosecurity issues and national policy as it relates to health, biological sciences, and dual-use technologies.

www.FAS.org/blog/bio

Demise of Osama bin Laden

Find the 1998 Grand Jury indictments of Osama bin Laden for his role in the bombing of the World Trade Center. The page provides links to CRS reports, speeches, and U.S. policy in the Middle East.

www.FAS.org/policy/binladen

SSP Blog

Expert opinions and analyses of important national and international security issues.

www.FAS.org/blog/ssp

WEAPONS of MASS DESTRUCTION AND THE POLITICS of CULTURAL DESPAIR

Anders Breivik conducted one of the most deadly terrorist attacks in history (out of more than 98,000 incidents of terrorism since 1970, less than 200 have been more deadly and all of those attacks involved multiple perpetrators).

Breivik left a 1500 page treatise, *2083: A European Declaration of Independence,* which FAS experts analyzed and concluded that the nature of the attacks, along with the contents of the treatise, raised great concern. Questions included Breivik's alleged connections to extremist cells and his assertions of forthcoming attacks involving chemical, biological, radiological and nuclear (CBRN) weapons.

- Brevik made claims that he is in league with extremist cells and that some of these co-conspirators "are already in the process of attempting to acquire chemical, biological, radiological, or nuclear materials."
- Brevik was motivated *and* capable of credibly pursuing low-end CBRN attacks—specifically those likely to result in mass *effect* as opposed to mass destruction

Charles Blair, director of the FAS Terrorism Analysis Project, was not convinced that Breivik acted alone.

"Given the operational sophistication of Breivik's attacks, and the overall operational security that he maintained for years, it is axiomatic that Breivik's threats should be considered in great detail," Blair said.

"Should Breivik be part of a cell of violent extremists, it is possible that his compatriots could have access to sophisticated CBRN materials. If this is the case, they could actualize Breivik's more ambitious plans for a CBRN attack and kill hundreds of individuals," said Kelsey Gregg, project manager of the FAS Biosecurity Program.

Given the nature of Breivik's attacks and the content of his treatise, should the security community seriously consider the possibility that cells of violent extremists were linked to Breivik and were in pursuit of launching an attack with a radiological and/or biological weapon?

Learn more at:
http://www.fas.org/blog/terrorism/.

PIR

CONTENTS

PIR

FALL 2011 Volume 64 No 3

ESTABLISHED 1945

LETTERS TO THE EDITOR

FAS Public Interest Report

1725 DeSales Street, NW

6th Floor

Washington, DC 20036

PHONE: (202) 546-3300

FAX: (202) 675-1010

EMAIL: pir@fas.org

The PIR welcomes letters to the editor. Letters should not exceed 300 words and may be edited for length and clarity.

Annual subscription is $50.00 per year. Archived FAS Public Interest Reports are available online at www.fas.org.

FOR ADVERTISING Call (202) 454-4680.

CONTRIBUTORS

NANCY CONNELL
Dr. Connell's major research focus is the interaction between M. tuberculosis and the macrophage. She is the director of the Biosafety Level Three Facility of UMDNJ's Center for the Study of Emerging and Re-Emerging Pathogens.

PATRICK D. COYLE
He has 15 years experience in the U.S. Army with extensive experience in training development, delivery and evaluation. He spent 16 years working in the chemical industry developing and improving chemical manufacturing processes with an emphasis on chemical and process safety.

RENEE DEGER
She is a member of the Media Relations and Communications Department at Sandia National Laboratories.

RICK HIND
Mr. Hind is the legislative director of Greenpeace. His work includes proposing solutions to the vulnerability of U.S. chemical plants and railroads to terrorism and accidents; chemical policy reform in the U.S. and European Union, U.S., ratification of the Stockholm treaty on persistent organic pollutants, and supporting environmental justice efforts world-wide.

P. ANDREW KARAM
Dr. Karam is a nationally and internationally respected board-certified radiation safety professional with particular expertise in issues related to radiological terrorism, the safe use of radioactive materials, and practical aspects of managing radioactive materials programs.

IGOR KHRIPUNOV
Dr. Khripunov joined the University of Georgia in 1992 after a distinguished career in the Soviet/Russian Foreign Service. His expertise includes nonproliferation export control, physical protection and vulnerability assessment, nuclear security culture, safety-security interface and organizational culture.

MILTON LEITENBERG
Mr. Leitenberg is a senior research scholar in the Center for International and Security Studies at the University of Maryland School of Public Policy. His research focuses on biological weapons; wars and conflicts of the past two decades; and the history of nuclear weapons between the U.S. and USSR between 1945 and 1995.

JEREMY "JEZ" LITTLEWOOD
He is the director of the Canadian Centre of Intelligence and Security Studies at Carleton University. His research interests include proliferation and counter-proliferation of WMD, terrorism, national and international security, and intelligence.

B. CAMERON REED
His is a physics professor at Alma College. Dr. Reed's research interests are galactic structures (hot, blue stars), and quantum and nuclear physics. He has published more than 80 papers in peer-reviewed physics and astronomy journals.

BILL RICHARDSON
The Honorable Bill Richardson is currently the chairman of APCO Worldwide's executive advisory service Global Political Strategies and Special Envoy for the Organization of American States.

REYNOLDS SALERNO
Dr. Salerno is the senior manager for Cooperative Threat Reduction Programs at Sandia National Laboratories.

MARGARITA SEVCIK
She is a project manager at the James Martin Center for Nonproliferation Studies at the Monterey Institute of International Studies.

CHARLES STREEPER
Mr. Streeper is a nonproliferation analyst and researcher. He received his MA in international policy studies at the Monterey Institute of International Studies

PRESIDENT'S MESSAGE

ADVERSE CONSEQUENCES OF IRANIAN-U.S. TENSIONS

Increasing tensions between Iran and the United States are having wide ranging effects including: increasing conventional arms sales to Arab allies of the United States, creating a drag on the U.S. economy through higher oil prices, increasing the demand for Canadian tar sands, consequently causing additional emissions of greenhouse gases into the atmosphere, spurring calls for U.S. missile defense deployments, harming the U.S.-Russia relationship, and slowing down or possibly derailing further U.S.-Russia nuclear arms reductions. The source of animosity between Iran and the United States is not just the Iranian nuclear program, but this is arguably the main point of contention. Other issues include Iran's influence on the Iraqi government, Iran's support of Hamas, and in general Tehran's power projection throughout the Persian Gulf region. While there are no easy solutions, the issues I want to call attention to here are the several adverse consequences that have already arisen because of the impasse between Iran and the United States.

U.S. government officials have encouraged and approved more conventional military sales to Arab allies such as Saudi Arabia and the United Arab Emirates in order to counter the perceived growing military and political threats from Iran. According to a recently published Congressional Research Service report, U.S. arms sales to Saudi Arabia grew from $4.2 billion in 2003-2006 to $13.8 billion in 2007-2010 and such sales to the UAE increased from $1.4 billion in 2003-2006 to $10.4 billion in 2007-2010.[2] While not all of these sales can be attributed to these states' concerns about Iran, the perceived threat from Iran increased during those time periods as Iran built up its uranium enrichment program and ballistic missile capabilities. The Iranian threat has resulted in a windfall profits for U.S. defense contractors.

While it is highly uncertain as to how much the Iranian threat has pushed up the price of a barrel of oil, it is better known how much an increase in oil prices affects the costs that U.S. consumers pay. Rather than give a full accounting of these costs here, I will simply point out that according to Chris Lafakis, an energy and financial markets economist at Moody's Analytics, that the $18.50 increase in oil in early 2011 if sustained over the full year would cost U.S. consumers $20.4 billion just in higher home heating oil and diesel prices and would cost an additional $46.3 billion in higher gasoline prices. This does not include higher food costs. Oil prices have recently been in the $90 to $110 per barrel range. Iranian leaders have warned that draconian sanctions imposed on their country would spike oil to $250 per barrel.[3] While most Western analysts disagree, there appears to be widespread agreement among energy analysts that a war with Iran could cause oil to double in price. This could have hundreds of billions of dollars worth of economic harm to the U.S. economy if sustained over a long period of time.

High oil prices have made the Canadian tar sands very profitable. It can cost about $30 per barrel to extract oil from these sands. Thus, the price for a barrel of oil has to be significantly above this threshold for this method to compete with so-called easy oil extraction. But "easy" oil has become scarce and has reached peak production in many parts of the world, especially the United States. And as worldwide demand for oil increases, oil companies are turning more and more to the hard to extract oil deposits. But oil sands extraction is an energy intensive process that releases more greenhouse gases to the environment as compared to "easy" oil extraction. Another environmental concern is that tar sands underlie more than 140,000 square kilometers of Canadian forests.[2]

Returning to the problem of direct threats from Iran, proponents of missile defense have called for a robust defense against Iran's ballistic missiles although Iran has yet to develop intercontinental range missiles. To begin to counter this threat, in March, the Obama administration deployed the USS Monterey, equipped with missile interceptors to the Mediterranean Sea. This deployment represents the initial part of phase 1 of the proposed four phase system. As Yousaf Butt and Theodore Postol have assessed in an FAS Special Report, the later phases could conceivably be perceived as a threat to Russian ballistic missiles although they caution that the missile defense system remains will likely confront major technical challenges against realistic missile threats.[3] Nonetheless, the deployment of a U.S. missile defense system has already stimulated heated rhetoric from Russian leaders, who may be mostly playing to a domestic audience when they have suggested that they may withdraw from New START, the latest U.S.-Russia nuclear arms reduction treaty. Even if Moscow continues with adhering to New START, further arms reductions are in jeopardy if the United States and Russia cannot work together to resolve the tensions over missile defense and Iran.

As you have undoubtedly noticed, the fall issue of the PIR is appearing just at the official start of winter. I apologize for this delay. The editorial staff at FAS consists of only two people and they have several other duties at FAS. They are committed to increasing the quality and length of the PIR. I hope you will have noticed that the length of each issue is two to three times the length of issues prior to 2011. On behalf of the editorial staff, I am very grateful for your support of FAS.

Charles D. Ferguson
President, Federation of American Scientists

[1] Richard F. Grimmett, "U.S. Arms Sales: Agreements with and Deliveries to Major Clients, 2003-2010," Congressional Research Service Report, December 16, 2011.
[2] Rick Gladstone, "Iran, Facing New Sanctions, Warns of Oil at $250 a Barrel," *New York Times*, December 5, 2011.
[3] Giuseppe Marconi, "Are Canadian Tar Sands Profitable?" Oil-Price.net, January 27, 2010.
[4] Yousaf Butt and Theodore Postol, "Upsetting the Reset: The Technical Basis of Russian Concern Over NATO Missile Defense," FAS Special Report No. 1, September 2011.

Q&A: Neal Lane

Many of the issues of concern to the FAS founders exist today. Neal Lane, senior fellow in science and technology policy at the James A. Baker III Institute for Public Policy at Rice University, is also the Malcolm Gillis University Professor. From 1998 – 2001, he served as Assistant to the President for science and technology and director of the White House Office of Science and Technology Policy. He is also a former director of the National Science Foundation (NSF).

Prof. Lane is a former FAS Board Chair and long time supporter of FAS and was interviewed and supplied his answers to FAS questions via email.

Learn more about Neal Lane by visiting: http://bakerinstitute.org/personnel/fellows-scholars/nlane.

In the Fall 2011 issue of Issues in Science and Technology, you wrote that to develop a more rational national science and technology policy, the federal government needs an interagency mechanism to coordinate science and technology related activities, share information, and work with Congress to fund interagency projects. How do you envision this interagency mechanism working?

There are a number of interagency cooperative activities and coordinating committees that operate under the umbrella of the National Science and Technology Council (NSTC), which operates under executive order. The NSTC is a high level committee (cabinet secretaries of all departments with significant S&T activities, plus several agency heads like the directors of the National Science Foundation and National Institutes of Health) chaired by the president. But, given how busy these officials are and the fact that S&T issues are usually not crises or high on the political agenda, this high-level body rarely meets. I think consideration should be given to obtaining Congressional authorization for the NSTC. This might elevate, somewhat, the important strategic S&T policy issues that top federal officials should be thinking about. Then, when the Secretary of Energy, for example, is testifying before Congress, he or she might get a question about how the DOE coordinates its R&D activities with NSF, NIH or other agencies. While there are many examples of interagency cooperation, such matters usually don't get the attention of the person at the top.

Today, Congress has no means of evaluating the entire science and technology portfolio or of having a serious discussion about national priorities. How would funding a renewed Office of Technology Assessment alleviate this void? Could a revived OTA review the entire federal science and technology portfolio and serve in an advisory capacity to Congress?

OTA was an important agency, and it served Congress well. It was responsive to questions from the Congress, called on experts in the S&T community for advice, and wrote balanced and well-researched reports. Once OTA was eliminated, Congress really had no place to go for that kind of advice.

I hasten to mention that the National Academies continue to carry out studies and write excellent reports on all manner of S&T (and health and medical) matters, through the Academies' operating organization, the National Research Council. Those reports are important and many of them have impact, e.g. the recent "Rising Above the Gathering Storm." But these studies usually take several years and are not an effort to answer a specific question from a member of Congress.

OTA should be funded. Its authorization legislation is still in force, so all it needs is an appropriation. Congressman Rush Holt (D-NJ) and colleagues have been trying to make that happen. A revived OTA could help analyze the federal S&T portfolio and give objective advice. The problem is that when an OTA report has findings that influential members of Congress don't want to hear, they begin to find ways to undermine its credibility and even kill its funding.

In addition, we do need to consider a new kind of organization to develop policy options for both the White House and Congress. I believe it will need to be a non-government, non-partisan policy organization, but supported by all three sectors: Government (federal), University, and Industry (GUI). It would not recommend policy, but rather collect and analyze data, provide information to all parties and the general public, and develop policy options (also shared with the public), based on the analysis, but that range over the political spectrum. It would be intended to complement, not replace, other policy centers and policy activities of various professional societies, the National Academies, American Academy of Arts and Sciences, etc. But as it builds wide ownership and credibility, it could compare policy recommendations from various organizations, using its data and analysis. All very tricky! I have described this proposed GUI policy organization in a recent article I wrote for *Issues in Science and Technology* (Fall 2011). The late John (Jack) Marburger, Science Advisor to President George W. Bush, noted that policy making is in need of serious research and called for a "science of science policy." Perhaps a new GUI policy organization along the lines I am suggesting could help move Jack's idea along.

What is your advice to scientists who want to get involved in policy?

My advice is —- get involved! But everyone doesn't need to try to do the same thing. Also, heavy involvement doesn't make sense for early-career researchers, unless they are considering a move into a policy career, e.g. by competing for a Congressional Fellowship. The latter is an excellent way to try total immersion for a year or so. And many Congressional Fellows end up in Washington - and the ones I know are very happy.

For scientists and engineers who are not ready for a career change, there are many ways to influence policy from outside government: visit agency and White House officials and members of Congress; conduct journalist interviews and write op-eds on important policy matters; write books for the general public, including some issues at the science/policy interface; serve on advisory committees; join studies by the National Academies' NRC, American Academy of Arts and Sciences, American Physical Society, American Chemical Society and other professional societies; engage in policy research, in collaboration with scholars at policy centers and institutes on many campuses; include a lecture (maybe visiting lecturer) on some aspect of policy in mainstream courses for SE majors as well as non-majors; visit K-12 classrooms (talk about science, but include some related policy topic); speak to clubs, community groups, churches (talk about science but touch on related policy matters).

This is the notion of a "civic scientist." And even if you don't have the time now, or are not inclined to do any of these things, encourage and support the efforts of others. It will pay off for science and for the American public down the road.

In 1945 Vannevar Bush stated that it is vital for the United States to renew its scientific talent. The Organisation for Economic Co-operation and Development (OECD) published a report in 2009 that ranked students' proficiency in mathematics and science from 65 countries. Students from China, Finland and South Korea were ranked in the top three respectively in math and science. American students ranked below the OECD average in mathematics with the United States at the 32nd spot. And in science, American students came in at 30th. What must be done to improve STEM education in the United States?

Widespread ignorance in the United States (especially in STEM, but in other fields as well) is the most serious challenge the nation faces.

If we are unable to produce large numbers of young women and men who are much better educated than their predecessors, it is difficult to see how America will continue to lead the world in important ways. There have been many efforts to reform K-12 education but few successes.

One president after another has had a plan, but the test scores remain embarrassing. And in our form of representational democracy, as soon as one political figure (at any level of government) has an idea, an opponent finds a way to keep it from moving forward. President Obama has an impressive strategy to improve STEM education and an outstanding team of experts to implement it, e.g, his Secretary of Education, Arne Duncan; Director of NSF, Subra Suresh; White House Science Advisor and OSTP Director John Holdren; OSTP Associate Director for Science Carl Wieman (Nobel Laureate); and many others. But, the opposition in Congress has made clear that it will block any progress that might be attributed to the president. Even if this were not the problem, there is no quick fix.

K-12 education is a local matter, by and large. My personal view is that colleges and universities should get far more involved in K-12 education than they do now. They have a big stake. They have to deal with large numbers of entering freshmen who do not have basic knowledge or skills. Meanwhile, there are many science, mathematics and engineering faculty who do spend time in K-12 schools, proving curriculum material, advising teachers, even giving classes. This is another important "civic scientist" contribution.

In 2008, you coauthored a report of science and technology recommendations for the next administration. One of the suggestions called to enhance federally funded science and engineering research and development. In light of a skittish economic recovery and contentious debate to cut the budget and reduce the U.S. deficit, how would you advise the United States in terms of its investment in science and technology? Where would you focus more money?

I'm not smart enough to answer this question, at least, with any confidence. Rather than try to pick out a field, let me refer to a report of the American Academy of Arts and Sciences, Advancing Research in Science and Engineering ("ARISE"), which you can find on-line at http://www.amacad.org/arisefolder/default.aspx. The study committee (chaired by Tom Cech) that wrote that report concluded that there were two big policy matters that needed attention: support for early-career investigators and support for high-risk, potentially transformational research.

I agree with those findings.

Also, I would say that by failing to coordinate the R&D programs of the various federal agencies (discussed in the first question above), we are likely missing some opportunities and efficiencies. For example, some of the most exciting fundamental research questions lie at the interface between the physical sciences and biomedical sciences. And while NIH (which allocates nearly 50% of all federal research funds) does cooperate with NSF, DOE and other agencies that support the physical sciences and engineering, there are many policy barriers to expanding that cooperation. This is a science policy topic that is ripe for serious study.

What issues should the Federation of American Scientists tackle in the next 65 years?

FAS has a long and distinguished record of achievement in areas of science and technology policy, especially nuclear arms control and non-proliferation, that are vital to the nation's security and other interests. National (and domestic) security will remain critically important policy areas far into the future.

In addition to expanding its programs to include cybersecurity and biosecurity, FAS can be the organization that identifies emerging technologies that pose, or could pose, future threats to the welfare of the United States and its people.

FAS has the "brand" and it should use that to expand the scope of its programs, as it takes advantage of new opportunites to fund its important work.

GOLD

General Atomics
HBO
Roger and Vicki Sant

SILVER

Residue Regency Pad Corporation
USA Science and Engineering Festival

BRONZE

Bellona USA
Lashof Family Charitable Gift Fund
Rodney W. Nichols
Arthur H. Rosenfeld
Sigma Space Corporation
Turner Foundation, Inc.

GREEN

The Federation of Electric Power Companies of Japan
Laura Turner Seydel

BACKGROUND

Within three weeks of the destruction of the World Trade Center towers on September 11, 2001, the United States experienced a second assault in the form of anthrax spores delivered through the U.S. mail. The event initiated widespread changes in the scientific enterprise of the United States, in its federally-based funding priorities and in the regulatory and oversight mechanisms that strive to keep laboratories and communities safe.

"The events of September 11, 2001, and the anthrax attacks in October of that year re-shaped and changed, forever, the way we manage and conduct work in biological and clinical laboratories."[1]

Biosafety and biosecurity have dominated the policy discourse and the two have been inexorably intertwined. Biosafety and biosecurity are defined by the World Health Organization (WHO):[2] Biosafety comprises "the containment principles, technologies and practices that are implemented to prevent unintentional exposure to pathogens and toxins or their accidental release"; biosecurity is defined as "the protection, control and accountability for valuable biological materials (including information) in laboratories in order to prevent their unauthorized access, loss, theft, misuse, diversion or intentional release." The two terms are related but often used interchangeably and, as noted by Casedevall and Relman, differ significantly by the "crucial criterion of intent."[3] The U.S. research and regulatory communities are engaged in a long-term, evolving struggle to reconcile these terms and establish acceptable oversight mechanisms that satisfy both biosafety and biosecurity concerns. Here, we offer a short history of oversight and regulation of dangerous biological research in the United States and the ongoing debate over how such oversight should be carried out.

BRIEF HISTORY OF BIOSAFETY

Innovation and development of biosafety in the United States is reflected accurately in the history and pre-history of the American Biological Safety Association (ABSA). The first unofficial meeting was held on April 18, 1955 at Camp Detrick (now Fort Detrick) and involved members of the military representing Camp Detrick, Pine Bluff Arsenal, Arkansas (PBA), and Dugway Proving Grounds, Utah (DPG). In those days, the offensive BW program of the United States was in full swing: the opening keynote address was "The Role of Safety in the Biological Warfare Effort." Beginning in 1957, the yearly meetings began to include non-classified sessions to broaden the reach of the Association; representatives of the USDA were regular attendees through this "transition period." [4] There were striking changes in the meetings in 1964-1965: the NIH and CDC joined for the first time, along with a number of other relevant federal agencies. All classified information was removed accompanied by a concerted effort to declassify safety studies and release them for public knowledge and advantage. By 1966, the attendees included universities, private laboratories, hospitals, and industry. Gradually, federal regulations began to appear. In 1973, the impact of new OSHA regulations was analyzed and debated at the ASBA meeting; interestingly, there was a range of responses to the new regulations:

"Some view it as the most important social legislation since social security, or Our Savior Has Arrived; whereas others term it the most un-constitutional freedom-interfering repressive legislation since prohibition,"[5] according to Manuel Barbeito and Richard Kruse's historical analysis.

[1] U.S. National Institutes of Health and the Centers for Disease Control and Prevention, 2007. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. L.C. Chosewood and D. E. Wilson, eds. Washington D.C. U.S. Government Printing Office; online version http://www.cdc.gov/od/ohs/biosfty/bmbl5/bmbl5toc.htm.

[2] (WHO. Biorisk management: Laboratory biosecurity guidance. *World Health Organization* [online] http:// www.who.int/csr/resources/publications/biosafety/ WHO_CDS_EPR_2006_6.pdf (2006).

[3] Casadevall, A and Relman, D.A. Microbial threat lists: obstacles in the quest for biosecurity? 2010. Nat Rev Microbiol Feb;8(2):149-54

[4] Manuel S. Barbeito and Richard H. Kruse, 1997, "A History of the American Biological Safety Association Part I: The First Ten Biological Safety Conferences 1955-1965." *JABSA, 2*(3): 7-19.

[5] Richard H. Kruse and Manuel S. Barbeito, 1997, "A History of the American Biological Safety Association Part II: Safety Conferences 1966-1977." *JABSA 2*(4): 10-25.

Biological Agents in the Laboratory - The Regulatory Issues

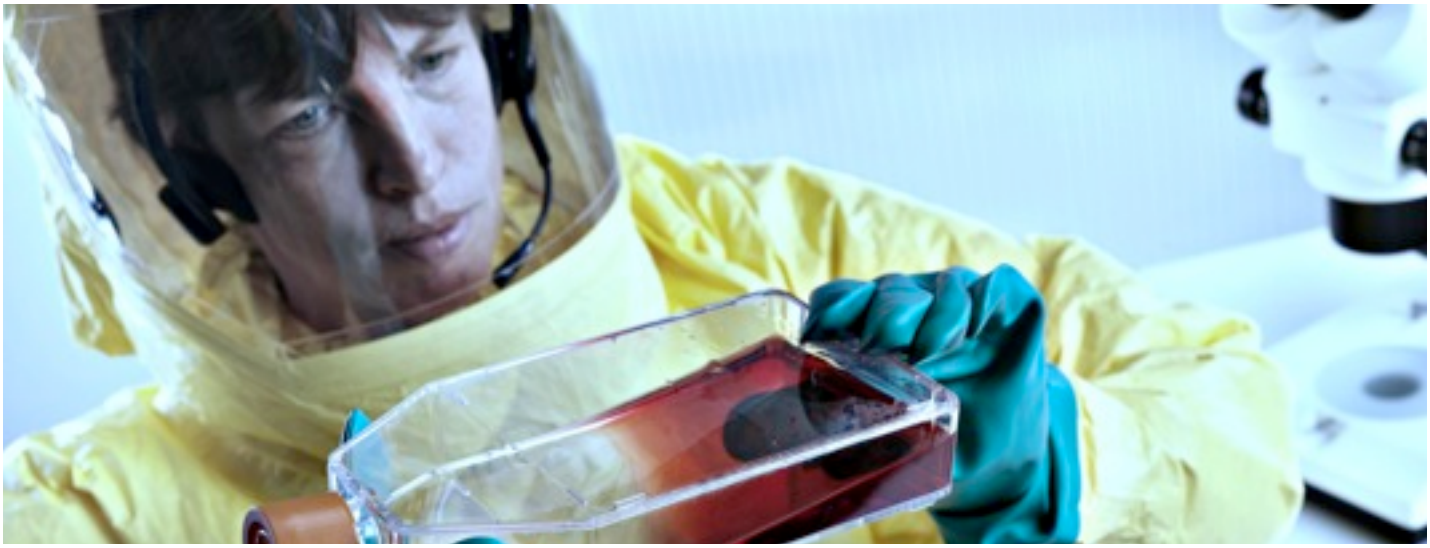
— BY NANCY CONNELL

In 1974, the United States Postal Service and Department of Transportation introduced regulations for shipping of etiologic agents (microorganisms and toxins that cause disease in humans). New safety programs and trainings were introduced. The designation of 4 levels of biosafety originated in the mid-1970s,[6] and the safety requirements for research with recombinant DNA were hotly debated. A survey of the ABSA meetings in the 1980s reveals increased focus on individual agents or groups of agents and coordination of international safety issues.[7] ABSA now represents biosafety professionals in 20 countries, and reflects the organic nature of the topic: biosafety is a fast-moving field with constant research into and reevaluation of its tenets as threat perception change and technologies advance.

CURRENT U.S. REGULATIONS FOR BIOSAFETY AND BIOCONTAINMENT

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002[8] required institutions to notify HHS and/or the USDA of possession of select agents or high-consequence pathogens and instituted increased oversight mechanisms for use of and access to the agents. Currently, multiple federal, state, local and institutional agencies are involved in oversight of dangerous pathogens and toxins, and the overlap of these oversight systems can be thought to ensure a positive outcome. The primary agencies involved are the Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), Health and Human Services (HHS) Centers for Disease Control and Prevention (CDC), and the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS).

[6] There are four basic biosafety levels as determined by CDC and NIH which describe the microbiological techniques, lab practices, safety equipment and lab facilities necessary to protect workers and the environment.
[7] Richard H. Kruse and Manuel S. Barbeito, 1997, "A History of the American Biological Safety Association Part III: Safety Conferences 1978-1987." *JABSA 3*(1): 11-25.
[8] 2002 ACT



The relevant regulations and guidelines are found in four places, listed below. Note that the collection includes one coded law, one set of standards, one set of regulations and a set of guidelines, not federally mandated.

(1) Code of Federal Regulations: Select Agent and Toxins Rule, HHS and USDA (42CFR part 73, effective March 2005)[9]
(2) OSHA: the *General Duty Clause*, *Bloodborne Pathogens Standard*, and *Personal Protective Equipment Standards*[10]
(3) CDC permit regulations for work with high-consequence pathogens
(4) NIH and CDC guidelines, entitled *Biosafety in Microbiological and Biomedical Laboratories*; and the *NIH Guidelines for Research Involving Recombinant DNA Molecules (*"the NIH Guidelines")[11]

There are a number of basic aspects to working with Select Agents that are codified under 42 CFR part 73: the Select Agent list, laboratory registration, laboratory security, personnel oversight, notifications of loss or theft, restricted experiments, incident response, training programs, records and inventory, and biosafety requirements.

THE SELECT AGENT LIST

The original list of select agents and toxins was published in the Federal Register in 1996 in Appendix A to 42 CFR part 72. In the wake of the anthrax mailings of 2011, the Public Health Safety and Bioterrorism Preparedness and Response Act of 2002 specified that HHS establish a list of biological agents and toxins that "have the potential to pose a severe threat to public health and safety." A list of approximately 80 bacteria, viruses, fungi and toxins was established by HHS and USDA. A combination of considerations is used to determine an agent's inclusion on the Select Agent and Toxin List (SATL): past or potential use as biological weapon, countermeasures available, infectivity, contagiousness, etc. Although the exact criteria are not part of the public domain, the public comment sections of the Code are a source of rich discussion of these matters.[12]

The status of the current SATL has been challenged in a number of venues since 2002, including scientific publications and U.S. government advisory bodies such as the NSABB.[13] For example, in a 2010 *Perspectives* piece in Nature Reviews Microbiology by Casadevall and Relman, the authors question the utility of the SATL and highlight the following paradox: if an agent lacks countermeasures, it is more likely to be included on the SATL; yet the increased regulatory burden placed on research with the agent might in turn prevent the discovery and development of effective countermeasures.[14] Similarly, while a mechanism is available to request the removal of an agent from the SATL, the regulatory burden associated with the experimental evidence required to support such an application may hinder initiation of the request.[15]

[9] HHS (Department of Health and Human Services). 2005. "42 CFR 72 and 73 and 42 CFR Part 1003: Possession, Use, and Transfer of Select Agents and Toxins; Final Rule" (FR Doc. 05-5216). *Federal Register* 70(52, March 18), pp. 12294-13325.
[10] OSHA Act of 1970 Section 5, The General Duty Clause Under the Clean Air Act Section 112(r)(1)
[11] U.S. National Institutes of Health and the Centers for Disease Control and Prevention, 2007. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. L.C. Chosewood and D. E. Wilson, eds. Washington D.C. U.S. Government Printing Office; online version http://www.cdc.gov/od/ohs/biosfty/bmbl5/bmbl5toc.htm.
[12] 42 CFR Part 73. Possession, Use, and Transfer of Select Agents and Toxins; Biennial Review; Proposed Rule Federal Register / Vol. 76 , No. 191 / Monday, October 3, 2011/ Proposed Rules
[13] NSABB (National Science Advisory Board for Biosecurity). 2007. *Proposed Framework for the Oversight of Dual Use Life Sciences Research: Strategies for Minimizing the Potential Misuse of Research Information.* Available at <http://oba.od.nih.gov/biosecurity/pdf/Framework%20for%20transmittal%200807_Sept07.pdf>
[14] Casadevall, A and Relman, D.A. Microbial threat lists: obstacles in the quest for biosecurity? 2010. Nat Rev Microbiol Feb;8(2):149-54
[15] Ibid.

If an agent lacks countermeasures, it is more likely to be included on the Select Agent and Toxin List, yet the increased regulatory burden placed on research with the agent might in turn prevent the discovery and development of countermeasures.

More recently, a Federal Experts Security Advisory Panel (FESAP) released its Recommendations Concerning the Select Agent Program (finalized June 2011) in response to Executive Order 13546.[16]

In the report, the following issues were addressed:

1. the designation of Tier 1 Biological Select Agents and Toxins (BSAT);
2. reduction in the number of BSAT on the Select Agent List;
3. the establishment of appropriate practices to ensure reliability of personnel with access to Tier 1 BSAT at registered facilities;
4. the establishment of appropriate practices for physical and cyber security for facilities that possess Tier 1 BSAT; and
5. other emerging policy issues relevant to the security of BSAT.

A set of proposed changes to every section of the Select Agent Rule was under consideration and posted by the CDC for public comment until December 2, 2011.[17] For example, several viruses, fungi and toxins are targeted for removal from the list, while two viruses are slated for addition.[18] Further, the proposed changes designate eleven agents ("Tier 1 agents") for increased oversight. The select agents and toxins in this subset are considered the greatest risks of deliberate misuse with the "most significant potential for mass casualties or devastating effects to the economy, critical infrastructure or public confidence." The proposed regulations contain options for "graded protection" for these Tier 1 agents and toxins to permit "tailored risk management practices based upon relevant contextual factors."[19] Entities with Tier 1 Agents[20] will be subject to additional requirements in personnel reliability, occupational health programs, and minimum security requirements.

LABORATORY SECURITY

In December 2002, a set of guidelines was prepared and released, addressing laboratory management and oversight, entitled "Laboratory Security and Emergency Response Guidance for Laboratories working with Select Agents."[21] These guidelines were built upon the 1999 guidelines ("BMBL") released by the NIH and CDC.[22] The following topics were addressed: risk and threat assessment, facility security plans, physical security, data and electronic technology systems, security policies for personnel, policies regarding accessing the laboratory and animal areas, specimen accountability, receipt of agents into the laboratory, transfer or shipping of select agents from the laboratory, emergency response plans and reporting of incidents, unintentional injuries, and security breaches. The complexity involved in launching a select agent reseach program is clear from this list of requirements, and highlights the enormous commitment of infrastucture and support personnel demanded of sponsoring institutions.

INVENTORY: ACCOUNTING vs. ACCOUNTABILITY

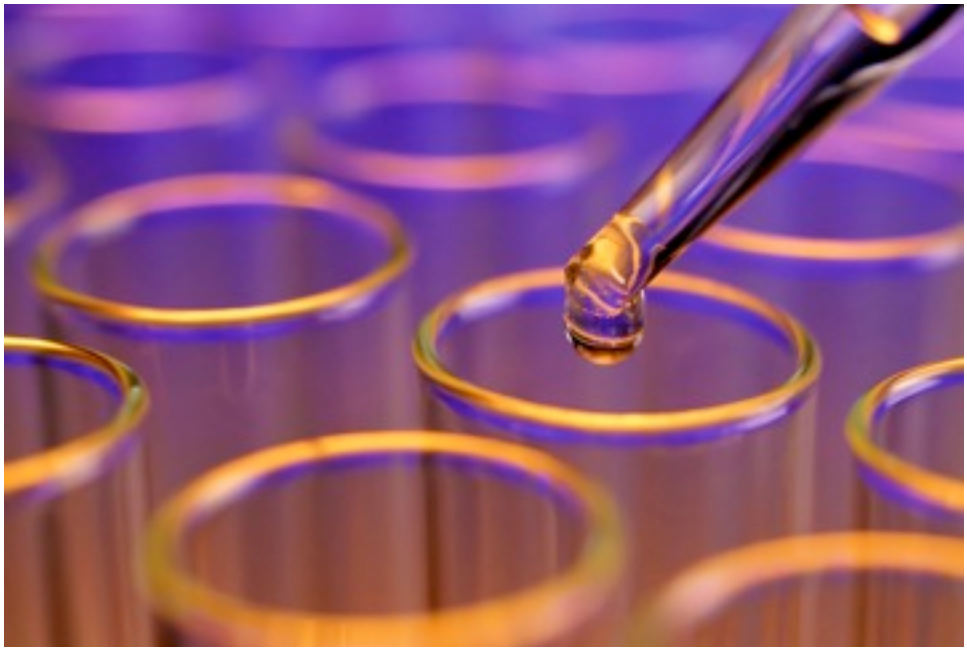
The current requirement for record keeping is found in 42 CFR part 73.17: "Accurate, current inventory for each select agent (including viral genetic elements, recombinant nucleic acids, and recombinant organisms) held in long-term storage (placement in a system designed to ensure viability for future use, such as in a freezer or lyophilized materials). Specific instructions are provided to ensure that adequate information (date, time, location and personnel involved) is available describing the agent, its use and purpose of use, its source, any transfers out, storage site, removal from or return to storage (and for what purpose). The

[16] Federal Experts Security Advisory Panel Recommendations Concerning the Select Agent Program. Nov 2, 2010, revised Dec 2, 2010 and Jan 10, 2011. http://www.phe.gov/Preparedness/legal/boards/fesap/Documents/fesap-recommendations-101102.pdf. Accessed Oct 30, 2011.
[17] 42 CFR Part 73. Possession, Use, and Transfer of Select Agents and Toxins; Biennial Review; Proposed Rule Federal Register / Vol. 76 , No. 191 / Monday, October 3, 2011/ Proposed Rules
[18] Ibid.
[19] Ibid.
[20] Proposed Tier 1 agents: Ebola, *Francisella tularensis,* Marburg virus, Variola major, Variola minor, *Yersinia pestis*, botulinum neurotoxins, toxin producing strains of Clostridium botulinum, *Bacillus anthracis*, *Burkholderia mallei, Burkholderia pseudomallei.*
[21] Richmond JY, Nesby-O'Dell SL. 2002. Laboratory security and emergency response guidance for laboratories working with select agents. Centers for Disease Control and Prevention. MMWR Recomm Rep. Dec 6;51(RR-19):1-6
[22] U.S. Department of Health and Human Services/CDC and National Institutes of Health. Biosafety in microbiological and biomedical laboratories [BMBL]. Richmond JY, McKinney RW, eds. 4th ed. Washington, DC: US Department of Health and Human Services, 1999.
[23] 42 CFR Part 73. Possession, Use, and Transfer of Select Agents and Toxins; Biennial Review; Proposed Rule Federal Register / Vol. 76 , No. 191 /

frequency of inventory review is not mandated by the Select Agent Rule, but is tailored to each program in consultation with the CDC.

The proposed changes to the Select Agent Rule do not include any modification of existing requirements, despite the fact that many commenters have pointed out that "requirement to account for individual vials of each pathogen is inappropriate for replicating biological agents" and "that this is a costly and burdensome responsibility for laboratories and their staff and that this requirement should be abolished except for Tier 1 agents."[23] The National Academies' Report entitled "Responsible Research with Biological Select Agents and Toxins," released in 2009, argues that while accurate accounting and inventory maintenance is essential for both safety and security, the current "requirements for counting the number of vials or other unreliable measures of the quantity of biological select agents are counter-productive, and lead to a false sense of security." The report suggests that the focus of inventory should be on controlling access while maintaining accurate records of the identity of all agents and toxins, who uses them and for what purpose.

The exact nature of inventory requirements going forward remains a contested issue within the research community. Indeed, the American Society for Microbiology has submitted several eloquent arguments during public comment periods, and Victoria Sutten of the Texas Tech School of Law's Center for Biodefense, Law and Public Policy argued that "the regulatory agency attempted to use a regulatory model that fit neither the target nor the outcome."[24] However, the CDC remains steadfast in its commitment to requiring certain kinds of quantification methods in maintaining current, accurate inventory,



stating "we are not proposing any changes to the select agent regulations based on these comments." [25]

PERSONNEL RELIABILITY

Personnel reliability remains a critical aspect of the U.S. Select Agent oversight program, especially in view of the FBI's conclusion that the bacterial strain used in the anthrax mailings likely originated in a government research laboratory.[26] The current screening process for employees to work with select agents involves an FBI background check for disqualifying behaviors and activites, relying on a wide range of databases.[27] Clearance, once obtained, lasts for five years. The terms in the 2002 Bioterrorism Response Act that related to the identification of restricted persons are the following, modeled on the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) when enforcing the Gun Control Act of 1968:permanent residence, mental institution, and unlawful user of any controlled substance."[28]

The proposed changes to the Select Agent Rule further clarify these terms, including, for example, how to interpret foreign criminal convictions and extending the conviction terms to include misdemeanors accompanied by imprisonment. In the proposed rules, institutional responsibility for personnel will be further increased by requiring (1) self and peer reporting of incidents or conditions that could affect a person's ability to safely access/ work with SA/ toxins; (2) procedures that ensure that those accessing Tier 1 agents are trustworthy and behaving in a manner that upholds public health and safety, security and the integrity of the scientific enterprise; and (3) "ongoing suitability assessments" of personnel with access, including shorter times between FBI clearance (i.e. at three year rather than at five year intervals). It can be argued that during a five or even three year period, an individual might experience significant personal changes, including those that might render him or her a security risk.[29]

[25] See 42 CFR Part 73. Possession, Use, and Transfer of Select Agents and Toxins; Biennial Review; Proposed Rule Federal Register / Vol. 76 , No. 191 / Monday, October 3, 2011/ Proposed Rules, p. 61213, paragraph 6.
[26] FBI (Federal Bureau of Investigation). 2008. Science Briefing on the Anthrax Investigation: Opening Statement by Dr. Vahid Majidi. Available at <http://www.fbi.gov/page2/august08/anthraxscience_081808.html>.
[27] A "restricted person" is identified as an individual under section 817 of the *USA PATRIOT Act* (18 U.S.C. 175b).
[28] 42 CFR Part 73. Possession, Use, and Transfer of Select Agents and Toxins; Biennial Review; Proposed Rule Federal Register / Vol. 76 , No. 191 / Monday, October 3, 2011/ Proposed Rules.
[29] Ibid.

Various approaches have been explored to ensure that laboratory workers do not engage in malfeasance while simultaneously guaranteeing safety and experimental standards. There are two approaches in use: one is to require that two people be present during all Select Agent work ("the two-person rule") and the second is the use of video monitoring. In 2009, the directors of all of the BSL4 laboratories in the United States met to discuss these and other options.[30] The consensus view was that video monitoring provided a marginal increase in safety and security over the two-person rule. The latter may decrease compliance with both safety and security requirement by placing undue pressure on the worker to finish quickly, and by exposing the observer unnecessarily to the containment environment. Again, the issue of the two-person rule and video monitoring remains under discussion within and between the research and regulatory communities.

Taken together, these proposed changes underscore the role of "laboratory culture" in the safe execution of Select Agent Research. Indeed, the National Academies' 2009 report on Responsible Research states that in order "to support active monitoring and management, laboratory leadership and the Select Agent Program should encourage and support the implementation of programs and practices aimed at fostering a culture of trust and responsibility," including "training in scientific ethics and dual-use research to foster community responsibility and raise awareness of available institutional support and resources."[31]

The NAS report provides the final word in this brief analysis of some of the regulatory issues involved in Select Agent research: "to provide continued engagement of stakeholders in oversight of the Select Agent Program, a federal Biological Select Agents and Toxins Advisory Committee should be established."[32] Such a committee would provide a mechanism to increase communication among all the stakeholders: funding and regulatory agencies and research communities, including, importantly, institutional management, safety and response personnel. ■

Dr. Nancy Connell is the Vice-Chair for Research in the Department of Medicine at the University of Medicine and Dentistry of New Jersey (UMDNJ), New Jersey Medical School. A Harvard University Ph.D. in Microbiology, Dr. Connell's major research focus is the interaction between M. tuberculosis and the macrophage. She is the director of the Biosafety Level Three Facility of UMDNJ's Center for the Study of Emerging and Re-Emerging Pathogens.

[30] LeDuc JW, Anderson K, Bloom ME, Carrion R Jr, Feldmann H, Fitch JP, et al. Potential impact of a 2-person security rule on BioSafety Level 4 laboratory workers [online report]. Emerg Infect Dis [serial on the Internet]. 2009 Jul [date cited]. Available from http://wwwnc.cdc.gov/eid/article/15/7/08-1523.htm (http://wwwnc.cdc.gov/eid/article/15/7/08-1523.htm)

[31] NRC 2009. *Responsible Research with Biological Select Agents and Toxins*. Washington, D.C.: The National Academies Press.

[32] Ibid.

Letters to the Editor

FAS wants to hear from you.

The PIR welcomes **Letters to the Editor**. Letters should not exceed 300 words and may be edited for length and clarity.

FAS Public Interest Report
1725 DeSales Street, NW
6th Floor
Washington, DC 20036
PHONE: (202) 546-3300
FAX: (202) 675-1010
EMAIL: pir@fas.org

Listen and Learn Podcasts

FAS records "Conversations with Experts" on a wide range of topics.

Download the interviews: www.FAS.org/podcasts/index.html

The Biological Weapons Review Conference 2011 -

Avoiding the Road to Nowhere

— BY JEREMY "JEZ" LITTLEWOOD

In December 2011, the Biological Weapons Convention (BWC) met in Geneva for the seventh review conference of the treaty. The BWC is now in middle age, having entered into force in 1975, and in the next few years will face some difficult issues. There is no immediate crisis on the horizon for the BWC in 2011. Rather, states parties must approach the review conference with three things in mind. First, how to manage their political differences about the future of the Convention: simply put this is the verification debate. Second, recognize that implementation of the Convention is now focused on the management of dual use technologies and knowledge, rather than preventing the proliferation of actual weapons. And, third, ensure implementation requirements permit the peaceful uses of science in all states: this is the disarmament-development dispute.

POLITICAL BACKGROUND

The acrimonious divisions evident in 2001 to 2005 resulting from the United States' decision to abandon negotiations on the additional protocol have been replaced by a grudging acceptance that a multilaterally negotiated agreement that contains compliance and/or verification provisions is highly unlikely to emerge in the near future (i.e. before 2020). Review conferences of the BWC usually determine the next phase of development of the treaty. Incremental evolution has been standard practice to date simply because states parties cannot agree on more ambitious proposals. Thus, in 1980, consultation procedures were outlined; in 1986, the confidence-building measures were first agreed; 1991 initiated a series of decisions that led to a more ambitious effort to strengthen the BWC, namely expanded confidence-building measures and a study on the question of verification. This in turn led to the decision to begin negotiations on the additional protocol in 1994. By the fourth review conference, in 1996, negotiations were ongoing, and the review conference marked time. By the fifth, in late 2001, the decision of the United States to scuttle the protocol negotiations and the attacks of September 11, 2001, as well as the anthrax letters in the United States, meant the tide had turned decisively against the multilateral approach embodied in the protocol. Indeed the fifth review conference in 2001 ended in an acrimonious dispute and had to be suspended until 2002.

A take it or leave it rescue plan in 2002 delivered the framework for the next decade: meetings of experts and meetings of states parties on specifically identified topics with the objective of developing

understanding of national practice in implementation and encouraging states parties to strengthen implementation of the BWC through decisions made nationally, rather than mechanisms agreed multilaterally. Simply put, meetings resembled "show and tell" sessions, but the substance, and benefits, existed not in the actual meetings, or topics themselves, but in the process of information sharing – and the national review of practices that sharing information required – and the continued regular contact among states parties. As a result, over time stalwart opponents of multilateral disarmament and arms control agreements in the United States recognized that the BWC was in fact useful and proponents of multilateral disarmament recognized the most fervid champions of verification after 2001 – Iran, Russia, Pakistan, Cuba, and Libya among others – were the very same states that had been lukewarm on compliance mechanisms in the 1990s and reluctant to demonstrate their compliance even in a non-adversarial meeting of experts post-2001.

Incremental gains were necessary, but left off the agenda in order to move gradually forward were substantive issues: compliance, transparency relating to biodefense and disarmament and development challenges. It will be increasingly necessary to tackle these over the next five years. How states parties face up to these big questions will set the tone for the next five years and determine how dual use technology is managed and peaceful uses of science is facilitated.

THE ROAD TO WHO KNOWS WHERE?

In very simple terms states parties have before them three choices. The first choice is to return to the approach of strengthening the Convention via a multilateral agreement akin to the Protocol negotiations of the 1990s. Calls for the resumption of multilateral negotiations on a legally binding instrument to comprehensively strengthen the Convention," which the Non-Aligned Movement claimed to favor at the Preparatory Committee meeting in April 2011, are increasingly rhetorical when in fact since 2001 no state has yet published a plan on how that could be achieved. In addition, the United States has closed the door on any negotiations for a legally binding additional agreement to the BWC in its Strategy of 2009 and subsequent statements. This renders futile attempts to parse terminology or undertake semantic gymnastics. Any route taken in 2011 that is intended to lead back to multilateral negotiations is a road to nowhere.

The second choice is to continue as over the last decade; namely meetings of experts and meetings of states parties that are tightly controlled – no decision making or power to agree even to politically binding commitments outside the review conference – and focused on one topic at a time with no year-on-year cumulating process. This entails, to use the mandate of the intersessional process, discussion at the meetings of experts, promotion of practices at the meetings of states parties, and action whenever any individual state party so decides. While the intersessional process since 2003 has been useful it is now perceived as having served its purpose. The next work program needs to move beyond talking and towards action. If the decisions in 2011 result in another show and tell approach, the route taken can only be described as the road well travelled.

Between negotiations on a legally binding agreement and discussion only is a new intersessional process that continues the best elements of the previous work programs and empowers states parties to determine their own fate and activities between review conferences. This is a road to who knows where because it holds both promise and peril for the Convention. The promise lies in freeing states parties to make decisions at the annual meetings of states parties without obligating them to do so. The latitude of such decisions is left up to the states parties, but might involve agreeing on new confidence-building measures, developing new methods of work to address discrete problems such as how to provide assistance and protection measures in the event of use, or simply altering the topics earmarked for discussion each year. The peril lies in the linkage issue and that freedom to make small-scale management decisions will always be held hostage to outrageous demands of other parties.

In substance a successful outcome to the 2011 review conference will result in activity across a number of areas. One aspect is the management of the Convention and its day-to-day implementation among states parties. This, to use the terminology of the former United States Ambassador to the Conference on Disarmament Charles Flowerree's, is about tending the Convention where the focus is not on extraordinary events but on day-to-day implementation and the challenges posed by technological developments, implementation requirements, fulfilment of legal and politically binding agreements, and providing a formal means of implementation of the BWC internationally. In short, staff in both national and international settings live with the obligations of the Convention full-time, all of the time.[2] In basic terms this is the current three-person Implementation Support Unit (ISU)

based in Geneva and the national points of contact within a state party. The second area of activity relates to stregthening the Convention. In partcular, agreeing upon and encouraging action on procedures and mechanisms that bolster the existing provisions of the BWC.

The focus here is likely to be on four issues: (1) assistance and cooperation provisions, (2) the implications of increasing convergence in the chemical and biological weapons spectrum; (3) providing for provisions for international cooperation and assistance; and (4) demonstrating compliance with the Convention's obligations. Activities in these areas need to be recognizable to states parties: thus, it should entail meetings of experts, or working groups, involving facilitated discussions that are purposefully not seeking binding arrangements on all parties. The aim is to develop existing practices and expand the latent possibilities within the Convention and its undertakings.

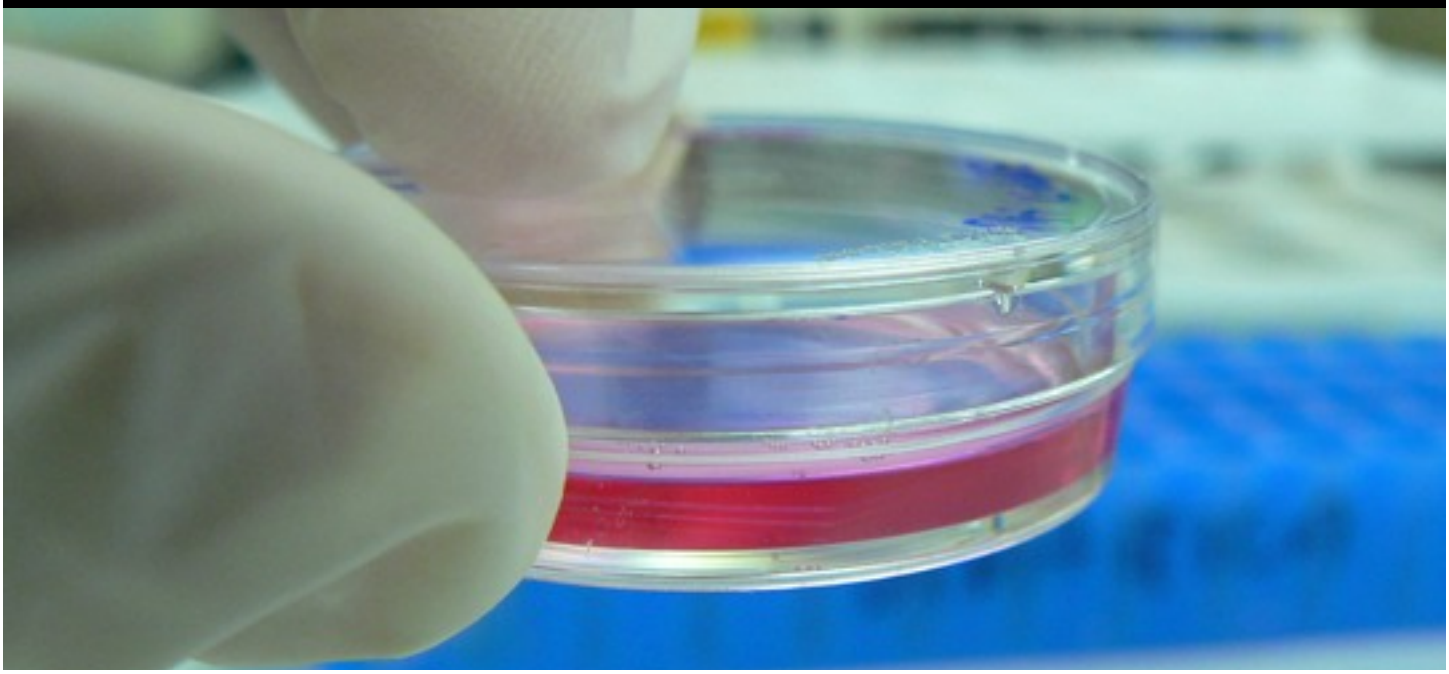
The third area of activity that should come out of 2011 is the most perilous but may be the deal-maker for the whole package: this would be the initiation of a discussion that maps out a strategy for the future. The second, third, and fourth issues above – science and technology, cooperation and assistance, and compliance – are the substantive challenges. Beyond day-to-day management and beyond enhancing implementation procedures, states parties must be forced to face the looming challenges on the horizon: what does compliance with the BWC actually require; how can confidence in compliance and national implementation be enhanced; how can information on compliance be shared in order to demonstrate compliance; how can potential risks of dual use materials and knowledge be managed without impeding legitimate peaceful uses internationally; and, what are states parties actually going to do if biological or toxin weapons are used in the future?

None of these questions are new to the BWC, but under the protocol negotiations there was room to discuss them in abstract and in concrete terms. The ensuing methods of work since 2002 have purposefully emasculated such discussions, but it is now counter-productive to try and keep substantive issues off the agenda and out of the Geneva meetings. The Convention and its next work program would benefit from some time being allocated to developing competing visions for the future and providing a forum where states, and perhaps non-state and non-governmental actors are forced to put serious proposals on the table.

In summary, the review conference should develop a program of activities that allow its states parties and the ISU to manage the Convention on a day-to-day basis, that continues to enhance understanding about the challenges of implementation and develop procedures and mechanisms to address those issues, and permit competing visions about the future of the Convention and the most invidious issues –compliance, the relationship between disarmament and development, and scientific developments and their impact – to be aired, tested and refined by a community of experts who understand the realities of biological weapons and the requirements of biological disarmament. ■

Dr. Jeremy "Jez" Littlewood is the director of the Canadian Centre of Intelligence and Security Studies (CCISS) at The Norman Paterson School of International Affairs (NPSIA) at Carleton University. His research interests include proliferation and counter-proliferation of WMD, terrorism, national and international security, and intelligence.

Negotiations for the protocol to the BWC began in 1995, based on the decision made in 1994 to strengthen the Convention. What "strengthen" meant was open to interpretation, but a legally binding protocol was envisaged that would contain definitions of terms, confidence-building measures, compliance measures, peaceful cooperation provisions, and an organization to implement the new arrangements. Analogous examples would be the International Atomic Energy Agency (IAEA) and its safeguards regime or the Organiasation for the Prohbition of Chemical Weapons (OCPW) and the implementation of the Chemical Weapons Convention. Verification was a term deliberatrly avoided in the mandate of the Ad Hoc Group charged with negotiations, however most commentators and diplomats referred to the envisaged agreement as a verification protocol.



Biological Weapons:
Where have we come from over the past 100 years

BY MILTON LEITENBERG

Biological weapons (BW), in the form of an alleged threat of "bioterrorism," have been much discussed in the past 20 years, most particularly since the distribution of spores of *B. anthracis* through the U.S. postal system in September and October 2001. This specter has been touted by the vociferous efforts of a small number of individuals. They have been aided by the "stakeholders" whose numbers grew dramatically following quite substantial Federal expenditure after 2002. The subject of "bioterrorism" became the tail that wags the BW dog. But what in fact is the status of BW and what has it been for the past 40-50 years, in particular since the Biological and Toxins Weapons Convention (BTWC, or BWC) was signed in 1972?

During the First World War, the pathogen that produces glanders was used by Germany in an attempt to infect allied horses, on which the war's logistics depended. The effort failed and had no military consequences. France initiated a BW program in the early 1920s, and the Soviet Union in 1928. Japan followed around 1933. Canada and the United Kingdom were next in 1937 and 1939, and the United States in 1943. Japan was the only country to use BW during the Second World War in China. But the Japanese program was again a failure and had no military consequences.[2]

The United Kingdom, United States, Soviet Union, France, and Canada all continued their programs after the war, and Israel initiated a BW program in the early 1950s. By 1956 Britain essentially terminated its offensive BW program without any public statement to that effect.[3] In a move that produced far greater political consequences and that was publicly disclosed, the U.S. government unilaterally decided to end its offensive BW program in November 1969. This occurred as a consequence of pressures produced by the United States' use of incapacitating chemical agents in combat in Vietnam, and chemical herbicides to destroy food crops and forest cover. In the course of the deliberations to reach this decision, a significant consideration was an argument based on a concept dating from 1961 concerning nuclear proliferation referred to as "the N-th Nation Problem." The argument was that extremely few countries possessed biological weapons, and any further proliferation of them would be a military disadvantage to the United States. In addition, they were redundant and unnecessary in view of the U.S. possession of nuclear weapons. Other domestic political and military considerations, such as the administration's continued interest in an untrammeled pursuit of the war in Vietnam, and the insistence of the Joint Chiefs of Staff to retain chemical weapons, also played important roles. In the course of the next two years the United States also destroyed the relatively small stocks of bulk agents and biological weapons that it possessed.[4]

Up to this point, efforts to achieve an agreement on chemical and biological disarmament at multilateral negotiations in Geneva had always considered the two weapon types together, a precedent going back to the Geneva Protocol of 1925, which forbade their use in warfare. Following the U.S. decision to end its offensive BW program, the British government proposed a treaty concerning BW alone. Although the suggestion to separate BW from CW was initially opposed by the Soviet Union and its allies, agreement on a stand-alone ban on BW was reached by the end of 1971.

The BWC was signed on April 10, 1972, banning the development, production, acquisition, retention, stockpiling and transfer of infectious disease agents and natural poisons (toxins) for hostile purposes.

The BWC was signed on April 10, 1972, banning the development, production, acquisition, retention, stockpiling and transfer of infectious disease agents and natural poisons (toxins) for hostile purposes, and the weapons or other delivery systems for them. It applies to pathogens that could be used against people, animals, or plants. The United States, United Kingdom, and Soviet Union served as co-depositories for treaty signatures. The BWC entered into force on March 26, 1975. The Russian Foreign Ministry stated that Russian compliance with the BWC was "guaranteed by the appropriate institutions of the USSR" and that the Soviet Union did not possess any BW agents, toxins or weapons.[5] The Treaty did not, however, include any direct verification mechanisms, only "consultations."

Some twenty years later it would be learned that the Soviet Politburo decided exactly in 1972 to institute a massive expansion of its BW program that eventually involved dozens of research institutes, tens of thousands of scientific and technical workers in four ministries and several additional agencies: the Ministries of Defense, Health, Agriculture, Chemical Industry, and Medical and Microbiological Industries, as well as the Academy of Sciences. Massive "mobilization capacity" production facilities were built and proof-tested to be ready for production of BW agents when ordered in a mobilization period prior to an anticipated war with the West. At the end of October 1989, Vladimir Pasechnik, a senior research scientist and administrator in the Soviet offensive BW program, defected to the UK and was debriefed. For the next two years, Soviet President Mikhail Gorbachev either was unwilling or unable to put a final end to the Soviet program despite repeated efforts by the U.S. president, UK prime minister, their most senior foreign policy officials and their ambassadors in Moscow.[8] This was despite Gorbachev's enormous success in convincing or forcing the Soviet military leadership to accept a half dozen major arms control treaties that required them to destroy great quantities of Soviet conventional and strategic weapons. The entire system was in gross violation of the BWC, and it was not until early 1992 that Russian President Boris Yeltsin even admitted that it had existed.

Beginning in 1988, U.S. officials stated in congressional testimony that at the time of the signing of the BWC in 1972 there had been four nations in possession of offensive BW programs, and that this number had increased to ten by 1988. They identified nine of these countries by name: Iraq, Egypt, Libya, Syria, Iran, the Soviet Union, China, North Korea, and Taiwan. In 1997 the estimate of such countries was increased to twelve and in 2001 to 13, although no further public identification of which countries were being referred to was made. South Africa was not mentioned (nor Israel), although the U.S. and UK governments were instrumental in 1994-95 in pressuring South Africa's first post-apartheid government to abandon the offensive BW program that had been initiated in 1980.[9] Iraq's BW program was terminated as a consequence of its military defeat in 1991.

Officials, analysts and academics in the United States universally stated that BW proliferation was and had been a constantly increasing trend since the mid-1970s. This would turn out to be incorrect. BW proliferation had been very low, and the trend line through all of the period from the mid-1970s to 2000 was probably flat and then decreasing. Although there was no way to have understood this earlier on the basis of publicly available information, it was in striking contrast to decades of threat estimates. By 2006-07, official estimates by U.S. agencies of countries having or suspected of having offensive BW programs was reduced to six. In the most recent U.S. Department of State report on national compliance with arms control treaties in August 2011, the descriptive phrasing became completely nebulous. There was not a single explicit attribution of an offensive BW program to any state.[10] In addition, there has never been any evidence to this date of assistance from state-run BW programs being extended to non-state actors.

While the global status of offensive state BW programs seemed therefore to be notably constrained, there were beginning to be stirrings at the level of *non*-state actors. In 1984, the Rajneeshee sect located in The Dalles, Oregon spread salmonella over food in restaurant salad bars. The pathogen had been legitimately obtained from a culture collection. It was a test for an effort to use the agent as an incapacitant to prevent people in the community from voting in a local election. It succeeded in that over 750 people were sickened, but there were no fatalities and salmonella was not used again at the time of the election. Between 1990 and 1994 in Japan, Aum Shinrikyo, another religious cult group built and commanded by a single leadership figure, attempted to produce two BW agents, botulinum toxin and *B. anthracis* spores. The Aum's ambitions

were more grandiose and their efforts, facilities and expenditures much greater. It had been essentially undisturbed and had sufficient time in which to work. Significantly, the group was never able to obtain a pathogenic strain of either agent that they were interested in. Their BW effort failed.[8] The same group was able to produce an organophosphate chemical agent and release it in a relatively inefficient manner in two incidents in 1994 and 1995 with lethal consequences.

In the third significant effort by a non-state actor, the al-Qaeda organization based in Afghanistan, which successfully carried out the attacks on September 11, 2001 in the United States using civilian airliners as highly destructive missiles, also attempted to obtain biological weapons between 1997 and the end of 2001. Their effort, barely initiated with incompetent personnel and far more amateurish than that of the Japanese group, was also a failure. Like Aum, al Qaeda failed to obtain a pathogenic strain of the organism that it was interested in, which was again *B. anthracis*.[11] A very significant finding as to the impetus to the al-Qaeda BW effort was explained in a memorandum found on the computer of Dr. Ayman al-Zawari, the second in command of al-Qaeda. It stated "...we only became aware of them [biological weapons] when the enemy drew our attention to them by repeatedly expressing concerns that they can be produced simply with easily available materials."[12] Other reports widespread in the media alleging efforts by al-Qaeda affiliated groups located in Europe to produce the toxin ricin are all apocryphal. In addition, an extensive series of detailed studies was carried out and was intended as a sequel to the 2000 volume *Toxic Terror*.[13] The studies surveyed over a dozen active international terrorist groups – the PKK, IRA, Hizbollah, Hamas, Tamil Eelam, FARC, AIG (Kashmir), etc. In each case there existed a record in the public media claiming either interest in or actual use of biological or chemical agents by the group in question. The studies demonstrated that not a single group had attempted to produce biological agents.[14]

The events or efforts described above, in 1984, 1990-94, 1997-2001, were followed in September and October 2001 by the dispersal through the U.S. postal system of a purified dry-powder preparation of *B. anthracis*. The source of the preparation came from within one or more of three institutions at the very heart of the U.S. biodefense program: the United States Army Medical Research Institute for Infectious Diseases (USAMRIID), the laboratories of the U.S. Army's Dugway Proving Ground, and a DOD and CIA contractor, the Battelle Corporation. The person or persons who carried out this work was highly qualified, with decades of technical experience, access to the most virulent *anthracis* strains, and optimum working conditions of containment. The FBI has identified a 27-year veteran of USAMRIID as the perpetrator, an identification that is plausible and likely.[15] If not for this event the world would still be waiting for a true national or international terrorist organization to be able to produce and use a BW agent. The 2001 events in the United States were not on a continuum with the efforts of Aum Shinrikyo and al-Qaeda. The Amerithrax perpetrator(s) was an outlier, both in source and in competence; it was not the "terrorist" actor everyone had been invoking and predicting.

Between 1990 and 1995 the U.S. government learned of the very significant Soviet and Iraqi BW programs, as well as the efforts of the Aum group. And after Craig Venter provided President Clinton with a fictional "Biothreat" thriller and enjoined him to read it, the president convened a panel of experts in 1996 to advise him regarding the threat of bioterrorism. Nevertheless, between FY 1997 and FY 2001 the federal biodefense budget was only increased by about $100 million per year, doubling from roughly $440 million to $880 million. However, following 9/11/2001 and the Amerithrax events in the two months that followed, Congress raised that expenditure in FY 2002 to some $4 billion per year.

Between FY 2002 and FY 2011, the U.S. government appropriated approximately $70 billion for this purpose, with routine increments of $6-7 billion per year.[16] The magnitude of the expenditure was largely unwarranted. At best only 18-20 percent of the sum can be considered applicable to "dual use" benefits, the refurbishment of the U.S. public-health infrastructure.[17] The rest is devoted to "select agents" – those pathogens historically or theoretically of use as BW agents. This is an enormous misappropriation of resources given the comparative statistics of mortality due to the incidence of chronic infectious disease in the United States and worldwide.[2] Nevertheless, a small coterie of individuals constantly calls for increasing these expenditures still further.

If we draw together some important points, we find that:

- The proliferation of state BW programs was relatively limited for 40 years. Although much is known about the nuclear weapon development and acquisition programs of countries like North Korea and Iran, virtually nothing is known about what they may or may not have been doing in regard to biological weapons.
- The Iraqi BW program failed between 1975 and 1986-87 until researchers who had been sent to Europe to obtain graduate degrees returned.
- The BW development efforts of Aum Shinrikyo in Japan failed.
- The BW development efforts of al-Qaeda in Afghanistan similarly failed.
- The *B. anthracis* spore preparation used in the United States in October-November 2001 was prepared by highly qualified professionals working in a U.S. government facility or facilities.
- The gross exaggeration of the threat of bioterrorism by U.S. government officials and biodefense advocates has done more than lead to the misappropriation of funds and misallocation of priorities. It is counterproductive in that it has led to *soliciting* the interest in BW by international terrorist organizations and the proliferation of BW expertise and infrastructure domestically.

Conferences of States Party to the BWC to review the functioning of the treaty have been held every five years since its entry into force in 1975, with an additional Special Conference in 1994. The Seventh Review Conference (RevCon) will take place in December 2011. As early as 1985, several West European nations sought to address the total lack of verification capability in the BWC. However, it was a prime tenet of DOD officials in the Reagan administration that verification of the BWC was impossible, and that establishing an inspection system would only "lull" the United States into a false sense of security. At the same time, the administration carried out its own small spurt of biodefense funding, overseeing a six-fold increase between 1980 and 1986. The result at the RevCon was the establishment of five voluntary Confidence Building Measures (CBMs) for treaty members in order to enhance "transparency." These came into play in 1987.

In 1991, with the massive changes taking place in the Soviet Union, West Europeans came to the Third RevCon even more determined to give the BWC strengthened verification capabilities. It was clearly understood by then that the Chemical Weapons Convention that was under negotiation would contain rigorous on-site verification procedures, and would include a Secretariat, just as the IAEA served for the NPT Treaty. However, the Bush I administration again blocked any serious moves towards verification, with the result this time of a two part "compromise": three additional non-binding CBMs were added, for a total of eight, and a three-year deliberation titled the VEREX (Verification Experts) was approved to investigate modalities that might be used to provide some degree of treaty compliance among its states parties. The 1994 Special Conference concluded this process and shifted to a negotiation phase labeled the Ad-Hoc Group, (AHG) which met from 1995 to 2001. By now it was well understood that the Soviet Union, Iraq and South Africa had all had offensive BW programs in violation of the BWC, in the Soviet case, a massive program.

During the AHG deliberations Iranian and Russian positions did little to facilitate the negotiations, and the United States, under the leadership of an ambassador to the negotiations in Geneva who was a holdover from the Reagan and Bush administrations and who fiercely opposed BWC verification, successively whittled away the strength of the verification provisions being negotiated. West European allies reluctantly acquiesced to every dilution in order to keep the United States "committed to the process." In a unified démarche to Washington in June 2001, the West Europeans stated: "The European Union has already accepted a lot of compromises in order to meet the concerns of the USA, especially on the declaration of biodefense programs and facilities, on the declaration of production facilities other than vaccine ones, as well as on the provisions related to the conduct of on-site activities."[15] The main U.S. consideration at this point was safeguarding the already burgeoning U.S. biodefense program, which was already initiating problematical research. In particular, genetic modifications and advanced dispersal techniques and delivery systems were investigated as "threat assessment." It was argued that the capabilities that might be used to attack the United States in the future by a BW possessor were being investigated. At times such work raised issues of BWC compliance within U.S. government agencies.[18] The European appeal was disregarded.

The Chairman of the AHG presented the negotiating states with a "Composite Text" for the verification protocol in a culmination of five years of negotiations. But in July and November 2001 under the new George W. Bush administration, the United States stated that it would not support the draft protocol and would not negotiate to arrive at a verification protocol any longer.[19] Ironically, the United States stated that the verification provisions arrived at were too weak to achieve their purpose, a situation that was the result of years of U.S. dilutions. Ten years of discussions were effectively scuttled. The West Europeans collapsed within hours. The most that they could achieve was to convince the United States to agree to a continuation of Review Conferences and an interim "intersessional process" of annual meetings, which would have no authority to take decisions. These meetings began in 2003 and took up numerous subjects that interact tangentially with the BWC but religiously avoided any discussion of the central issue of "verification" and compliance with the BWC. The achievements of this process have been marginal.

Ten years have now passed since 2001. The Obama administration has been timorous, if not disinterested in BW arms control. Most observers profess that tackling verification or compliance head on is too difficult. In 2009, Canada tabled a paper in Geneva on behalf of a group of seven nations referred to as the JACKSNNZ (Japan, Australia, Canada, Republic of Korea, Switzerland, Norway, New Zealand) that was far in front of the U.S. position on the question of compliance. BW arms control advocates struggle to formulate devices and new terminologies to approach the taboo but central issue of treaty compliance. In an address to the UN General Assembly's First Committee on October 4, 2011, the U.S. delegate stated: "Compliance with treaties and agreements is a central element of the international security architecture and critical to peace and stability worldwide."[20] However in regard to the BWC, the United States would "focus on new ways to enhance confidence and compliance through richer transparency, more effective implementation, an improved set of confidence building measures, and cooperative use of the BWC's consultative provisions." That is, the United States would approach BWC treaty compliance only through peripheral measures. If the U.S. government continues to avoid the central issue of BWC compliance, it will be a matter of what the Europeans and the JACKSNNZ are interested in or capable of achieving in the face of U.S. reluctance as well as obstruction by other states.

If the U.S. government continues to avoid the central issue of BWC compliance, it will be a matter of what the Europeans are capable of achieving in the face of U.S. reluctance.

Milton Leitenberg is a senior research scholar in the Center for International and Security Studies at the University of Maryland School of Public Policy. His research focuses on three disparate areas of study: biological weapons; actual wars and conflicts of the past two decades, and the issue of international intervention in these; and the history of nuclear weapons between the U.S. and USSR between 1945 and 1995.

REFERENCES AND NOTES

[1] Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare. Volume I: The Rise of CB Weapons*, Stockholm: Almqvist & Wiksell, 1971; Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare. Volume II: CB Weapons Today*, Stockholm: Almqvist & Wiksell, 1973; Erhard Geissler and John Ellis van Courtland Moon, *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, SIPRI Chemical & Biological Warfare Studies, no. 18, Oxford, UK: Oxford University Press, 1999; Mark Wheelis, Lajos Rózsa and Malcolm Dando, *Deadly Cultures: Biological Weapons Since 1945*, Cambridge, MA: Harvard University Press, 2006.

[2] Brian Balmer, *Britain and Biological Warfare: Expert Advice and Science Policy, 1930-65*, London: Palgrave, 2001.

[3] Milton Leitenberg, *The Problem of Biological Weapons*, Stockholm: National Defence College, 2004, pp. 56-61.

[4] Statement by A. A. Roshchin, *Conference of the Committee on Disarmament*, Verbatim Records 1975, Meetings 666 to 687, CCD/PV.666 (June 24, 1975), p. 13.

[5] Milton Leitenberg and Raymond Zilinskas, *The Soviet Biological Warfare Program: A History*, Cambridge, MA: Harvard University Press, 2012 (forthcoming).

[6] Chandré Gould and Peter Folb, *Project Coast: Apartheid's Chemical and Biological Warfare Programme*, Geneva and Cape Town: UNIDIR and Centre for Conflict Resolution, 2002.

[7] US Department of State, *Condition (10) (C) Report. Compliance with the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*, Unclassified, Washington, DC, August 2011.

[8] Milton Leitenberg, "The Experience of the Japanese Aum Shinrikyo Group and Biological Agents, " pp. 159-170, in *Hype or Reality? The "New Terrorism" and Mass Casualty Attacks*, ed. Brad Roberts, Alexandria, VA: The Chemical and Biological Arms Control Institute, 2000.

[9] Milton Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, Carlisle Barracks, PA: US Army War College, Strategic Studies Institute, 2005, pp. 28-39.

[10] Alan Cullison, "Inside al-Qaida's Hard Drive," *Atlantic Monthly*, vol. 294, no. 2, 2004.

[11] Jonathan B. Tucker, ed., *Toxic Terror: Assessing Terrorist use of Chemical and Biological Weapons*, Cambridge, MA: MIT University Press, 2000.

[12] John Parachini, "Putting WMD Terrorism into Perspective," *Washington Quarterly*, vol 26, no. 4 (Autumn 2003): 37-50.

[13] Martin Furmanski, "A Guide to the Amerithrax Documents," May 2010, http://www.fas.org/irp/eprint/furmanski.pdf.

[14] Center for Arms Control and Nonproliferation, "Federal Funding for Biological Weapons Prevention and Defense, Fiscal Years 2001 to 2009," May 27, 2008, http://armscontrolcenter.org/media/fy2009_bw_budgetv2.pdf.

[15] Scientists Working Group on Chemical and Biological Weapons, "A Matter of Balance," *Bulletin of the Atomic Scientists*, February 2, 2010, http://thebulletin.org/web-edition/op-eds/biological-threats-matter-of-balance.

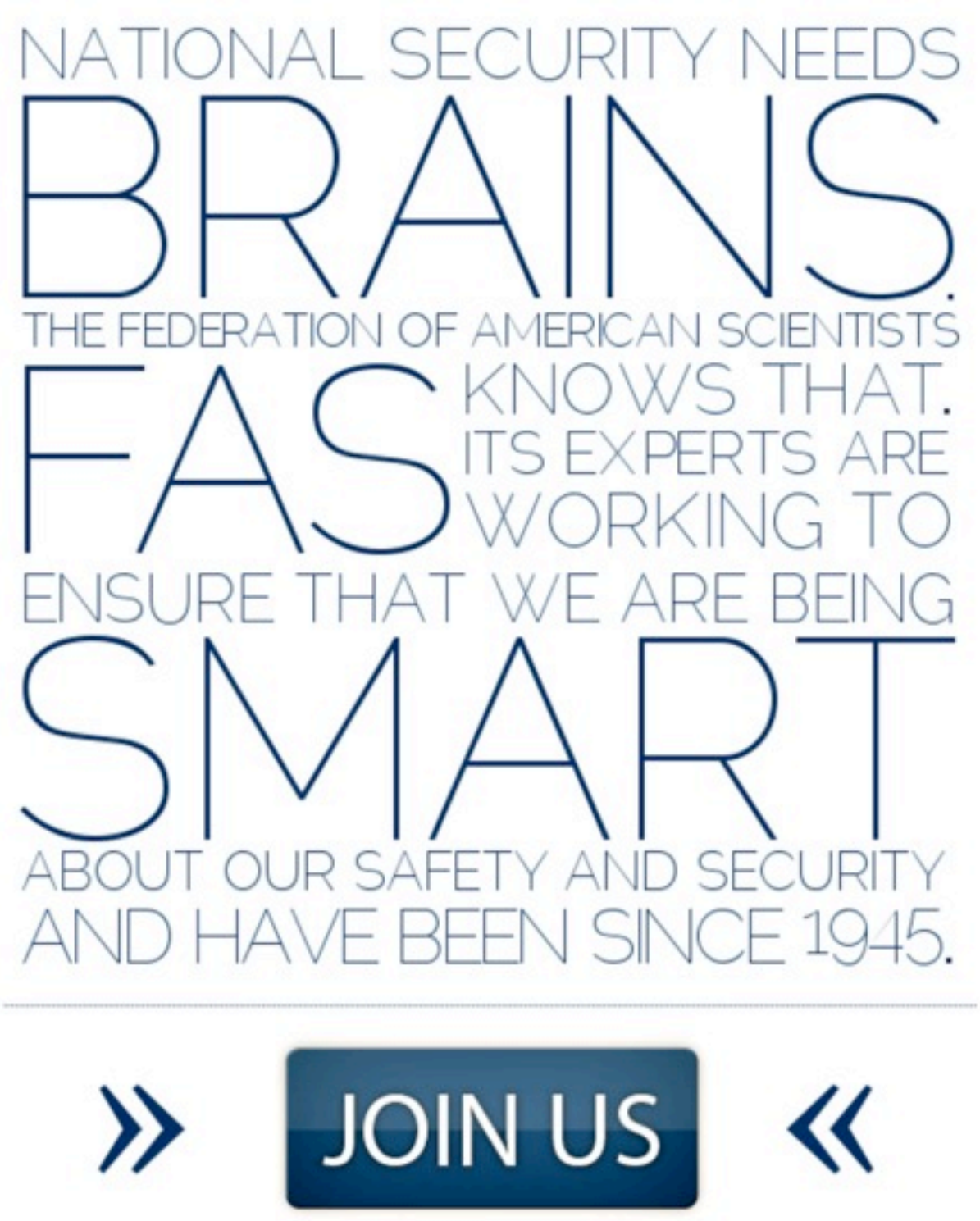
[16] Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, pp. 1-8.

[17] Untitled, text of EU Démarche, June 5, 2011.

[18] Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, pp. 68-85 and Leitenberg, *The Problem of Biological Weapons*, pp. 180-195.

[19] Milton Leitenberg, "Biological Weapons and Bioterrorism in the First Years of the Twenty-First Century," *Politics and the Life Sciences*, vol. 21, no. 2 (September 2002), pp. 3-27. See also Leitenberg, *The Problem of Biological Weapons*, pp. 97-114.

[20] Rose Gottemoeller, Assistant Secretary of State, Bureau of Arms Control, Verification and Compliance, October 4, 2011, http://www.state.gov/t/avc/rls/175000.htm



http://www.fas.org/member/index.html

Sweeping Up Dirty Bombs

A Shift From Normative to Pro-Active Measures

— BY BILL RICHARDSON, CHARLES STREEPER and MARGARITA SEVCIK

This summer the world witnessed acts of terrorism in Norway carried out by a self proclaimed crusader. The 2011 massacre in Norway, executed in the form of two attacks: one on an Oslo executive government building and another at a summer youth camp on the island of Utøya, resulted in egregious casualties and death in a nation recognized for its neutrality, economic stability, peacefulness, and civility. The perpetrator and meticulous mastermind of these attacks was not a member of a globally networked terrorist organization, but was a stereotypical Norwegian except with right-wing extremist ideologies.

The dramatic effect of these mass murders is heightened when one considers one of the other potential scenarios that could have occurred based upon the content of a manifesto posted on the internet by the attacker just a few days prior to the tragedy. The manifesto titled *2083-A European Declaration of Independence,* called for "creating, deploying and detonating radiological bombs in Western European capitals."[1]

This attacker demonstrated exacting planning and capability. Had he chosen the alternate route of acquiring radiological material it is not hard to believe he would have been capable of inflicting potentially severe economic and psychological trauma to Western Europe during an already staggering economic crisis.

"Source contamination and over-exposure incidents have occurred in both countries with well and poorly developed national regulatory systems. This is a sign that the problem is endemic to the large amount of sources themselves and requires international not ad-hoc intervention."

PROBLEM STATEMENT

Disused radioactive material, most active when found concentrated in radiological sealed sources (sources), poses significant threat potential when misused in a radiological dispersal or exposure device (RDD/RED).[2] In addition to inducing widespread public fear and panic, an RDD could cause severe economic impacts and denial of access to large urban areas (especially if lengthy decontamination is required). Sources are ubiquitous in numerous applications worldwide for which economically viable alternatives do not always exist. The global distribution of sealed sources is impossible to estimate although a couple attempts have assessed as wide a range as 8 million[3] to 1 billion.[4] There are likely more, many of which remain uncontrolled. These two factors, combined with the portability and low cost of most sources, greatly increase the likelihood of terrorist acquisition and misuse of radiological material.

In the last decade of the 20th century, the safety of sources, mostly in the form of radioactive waste, became an international norm strengthened by relevant international instruments and mechanisms (i.e., the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, the Convention on Nuclear Safety, the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, among others).

The security of sources has been addressed to a lesser extent and only recently. The International Atomic Energy Agency (IAEA) Code of Conduct on the Safety and Security of Sources (Code) suggests many vital measures that would help facilitate the security of sources, but few countries have the resources nor the necessity to implement all of the measures and the Code itself is voluntary. The lack of availability of safe transportation and disposition of sources at the end of their useful lives is a complicating factor, making it impossible for most countries to provide a safe and secure final pathway to remove disused sources at the most vulnerable end-point of their lifecycle.

Another concern is a lack of consensus among the expert community on the concept of what defines a radiological weapon or whether such a weapon even poses a threat. While there are several accounts of mal-intent of dispersing radiological materials by means of conventional explosive devices, fortunately, there are very few documented cases of a radiological device being used as a weapon.

There is no global institution or mechanism that supplies a comprehensive legal framework with binding implementation of the necessary measures to secure sources and curtail the possibility of a radiological attack.

Previous efforts at the UN, the IAEA and domestically in states have provided some of the key framework, but it is time for the negotiation of an internationally legally binding treaty or convention implementing essential recommendations of the Code with additional measures to prevent source diversion.

CALL TO ACTION

The threat of the use of sources by non-state actors in the aftermath of 9/11 sparked debates at the Conference on Disarmament (CD), which serves as a multilateral negotiating forum. The CD and its predecessors negotiated such prominent multilateral arms reduction and disarmament treaties such as the Treaty on the Non-Proliferation of Nuclear Weapons, Biological Weapons Convention, Chemical Weapons Convention, the Comprehensive Test Ban Treaty and others. Given its role in curtailing threats posed by various types of weapons, the CD would be a proper organization to facilitate the creation of a legally binding treaty or convention reinforcing a current ban on radiological weapons and holding states accountable for proper management of their radioactive materials. By focusing at the state-level, the CD will assist efforts already underway at the IAEA in supporting state regulatory authorities twith their sources. Preventive action at the state-level is the only barrier thwarting terrorist acquisition of RDD materials. Russia and Germany have both recently demonstrated leadership in this area; Russia by successfully promoting an international convention[5] in the United Nations General Assembly (UN-GA) banning radiological weapons and their use; and Germany by issuing support for revisiting the radiological topic as a non-strategic threat in the CD. A heightened radiological threat environment and only very recent emphasis of international normative approaches to radioactive material management[6] merit reflection by international bodies on strategies to improve the situation.

Deadlock in the CD on high-profile topics such as a fissile material cut-off treaty (FMCT), nuclear disarmament, prevention of an arms race in outer space, and effective international arrangements towards providing

Non-Nuclear Weapon States with negative security assurances[7] might be lessened through elevating the topic of the non-strategic radiological threat. Higher prioritization to the already introduced radiological topic in the CD agenda will also provide a double-benefit of addressing an urgent topic relevant to immediate and long-term global security without the added burdens typically associated with discussions on nuclear topics. For example, states wouldn't have as strong an obligation to negotiate strictly from a national security perspective in parallel with each substantive matter. Since nearly all countries have and use sources, the "haves/have-nots" dilemma that has plagued progress in many key sensitive areas of the nuclear nonproliferation regime would be irrelevant in the radiological realm. More importantly, it would provide a foundation and mechanism for ensuring verifiable compliance and implementation of the International Convention for the Suppression of Acts of Nuclear Terrorism. Negotiations and passage of an international convention among CD member-states on a subject with wide-ranging and serious consequences tied to an achievable goal would help build the necessary confidence and trust between states to finally address the more contentious and sensitive nuclear security related issues and would reaffirm the relevance of the CD as a negotiating entity on sensitive matters.

Whether or not one believes radiological weapons are a threat, what cannot be denied is the fact that the nearly unchecked growth in radiological source distribution has provided every state and non-state actor with at least the capability to easily develop a wide range of radiological weapons. That such material is common in beneficial uses can be seen by a cursory review of the IAEA's Directory of Radiotherapy Centers (DIRAC) data, as well as published reports by many national regulators. Arguments over the desirability of such material for deliberate misuse are rendered irrelevant after just one debilitating attack.

In June 2011, Kim Bon-hyun, South Korea's deputy foreign minister for multilateral and global affairs, specifically suggested inclusion of "radioactive sources" as a topic for the 2012 Nuclear Security Summit in South Korea. Sources were not included at the 2010 summit and thus would be an expansion of the summit's scope. Kim's reasoning for adding sources was the conclusion that an RDD is more likely to be used by a terrorist than a nuclear weapon.[8]

Sources were not included at the 2010 summit and thus are an ex-pansion of the summit's scope. A November 2011 Joint Statement of the Eminent Persons Group of the Seoul Summit makes the following suggestions: (1.) Universal application of the International Convention for the Suppression of Acts of Nuclear Terrorism; (2.) Calls for a world free of radiological terrorism; (3.) National/regional efforts to mitigate radiological accidents; (4.) Educate the public on radio-activity; and (5.) Detailed discussions and cooperative measures to reduce the radiological threat. The nuclear and radiological threats require unique approaches and so these topics should be addressed separately. There are many states participating at the summit and the addition of the radiological topic will ensure inclusiveness and broader participation.

Kim Bon-hyun, South Korea's deputy foreign minister for multi-lateral and global affairs, suggests adding radioactive sources as a topic for the 2012 Nuclear Security Summit because an RDD is more likely to be used by a terrorist than a nuclear weapon.

One potent reason for inclusion of the topic of radio-logical material in the summit is that in many countries the diversion of highly enriched uranium or plutonium is of lesser concern or availability than the much more prevalent and unsecured sources.

Some expert observers want to exclude the topic in the CD and in other fora.[9] Of course, dedicating time and energy in the CD to strategic radiological weapons would be nonsensical. However, terrorist threats have the potential for strategic impact, so the CD must demonstrate it can adapt to this novel and burgeoning threat environment.

At the state level, attention being given towards radiological security resembles a patchwork of effective efforts (harmonization of legislation/regulation, source removal/secure storage/import/export) along with near negligence (minimal legal/regulatory framework/disused or orphan sources/serious accidental exposures/impoverished source owners/general lack of accountability).[10] With the adoption by the UN Security Council of Resolution 1540 aimed at curbing the proliferation of weapons of mass destruction, their means of delivery and related materials, many countries are reevaluating illicit trafficking and related regulatory penalties associated with radiological material diversion. However, the international community is precariously reliant upon national authorities prioritizing this on their own, without verification and at their own pace. Unfortunately, in some cases this results in mod-ification to legislation or other source management methods as post-incident reactions rather than the more effective preventive measures.[11] The IAEA has provided many essential tools, methodologies, and assistance in this area, [11] including the Code, but is also limited in resources and has no mandated role to verify adherence to the principles that have been voluntarily agreed to by its member states.

CD's EARLY EFFORTS TO STEM "NEW TYPES OF WEAPONS OF MASS DESTRUCTION"

Early concerns in the CD about radiological weapons precipitated primarily

from threats posed by strategic delivery vehicles or direct attacks upon nuclear facilities so-called denial of access attacks that would make large areas unsuitable for habitation or commerce. This emphasis on strategic radiological weapons actually stemmed from a supply concern of an increasing amount of radioactive waste spread by reactor proliferation worldwide. [12] It has been decades since this initial concern was raised and radioactive waste and materials continue to accumulate and spread with reactor growth and a burgeoning market for many of the by-products (ie., radioactive sources).

Ironically, the rapid global growth of radioactive waste production and byproduct material usage along with a manifold increase of concerns about terrorism were followed by diminished attention and practical elimination of the entire topic of radiological weapons in the CD. The perceived decreased threat that nuclear weapons pose at the strategic level has had the opposite effect of equal or greater concerns of a new undeterrable nuclear terrorism. Shouldn't at least a similar emphasis be accorded to the more accessible and easily devised radiological weapon?

Much of the foundation for an international convention has already been accomplished in the CD. Attempts to ban radiological weapons on the strategic level date as far back as 1948, when it was proposed by the UN Commission on Conventional Armaments that "radioactive material weapons" be included in the definition of a weapon of mass destruction (WMD).[13] Resultant attention to radiological weapons was brought up intermittently in an ad-hoc committee, mostly under the auspices of arms control as "new types of weapons of mass destruction." Of note, draft CD language from the ad-hoc committee included general verification provisions such as the creation of a ten member rotating "Fact-Finding Panel and separate Consultative Committee" to investigate and resolve disputes among members of the convention. These provisions could be refined upon and elaborated in specific detail in a new convention. Regarding the definition of a radiological weapon the ad-hoc committee did not limit itself to dissemination of radiological materials associated solely with attacks on nuclear reactors or reprocessing facilities, that is, dispersal of highly radioactive fission products resident in irradiated or spent nuclear fuel and focused more on the general radiological effects.

There were several notable efforts by CD members to initiate discussion towards legally binding resolution of the early and current radiological problem. In 1969, Malta success-fully helped pass a resolution in the UN General Assembly, which called on the predecessor to the CD, the Conference on the Committee on Disarmament (CCD) to investigate "effective methods of control against the use of radiological methods of warfare."[14] This resol-ution addressed an issue that continues to make it imperative to re-raise the topic of radiological weapons as a non-strategic issue; *control* (regulatory, customs, detec-tion, storage, disposal, etc.). Subsequent discussions in the CCD resulted in a 1979 joint proposal by the United States and Soviet Union for a Radiological Weapons Treaty.[15] Decades of discussion resulted in a near final draft convention prohibiting radiological weapons.

Of note in 2002, through statements and discussion papers from the CD Secretariat and German delegation/new president (Ambassador Volker Heinsburg) to the CD; suggested the CD re-address the radiological topic. Germany's key reasons for "revisiting article 5 of the agenda (New types of weapons of mass destruction and new systems of such weapons: radiological weapons)" from a non-strategic perspective in the CD were the following:

1. The CD had the background work covered on much of the issue;
2. The post-9/11 threat posed by radiological terrorism had been recognized; and
3. Such a reassessment would demonstrate the ability of the CD to adapt and confront current political challenges and threats.

A suggestion was made by five former CD presidents to assign a special coordinator to this issue to help overcome deadlock in the CD. The informal discussions were broad and very active and according to Ambassador Heinsburg, exemplified the capabilities of a CD focused on "substantive" matters rather than deadlock. However, as was common in the past, the divergent views being expressed resulted in stagnation with some delegations attempting to further delegitimize the concept in general. The above approach by Germany must be commended in its adaptability to modern threats. All that it might have lacked was a slightly different tact focused strictly on implementable state measures towards the prevention of radiological terrorism rather than focusing solely on prohibiting just the weapon itself.

The history of the CD addressing radiological weapons from the strategic perspective demonstrates an early appreciation of the radiological damage that could be inflicted maliciously or accidentally. There is no reason that this same concept that merited discussion for decades at the highest levels of the CD as a strategic concern should not also be considered a topic relevant to the more likely non-strategic use of such a weapon in a globalized 21st century.

RECENT DEVELOPMENTS AT THE UN GA

Starting in 1996, the GA held multiple Ad Hoc Committee meetings, initially meant to suppress terrorist bombings, that later included focus upon the suppression of nuclear terrorism. As it was most relevant to its mandate, the IAEA was encouraged to attend and allowed access to the ad hoc sessions. The IAEA should be directly involved in the creation of a new convention.[16] In 2005, after many years of committee meetings, an amended draft convention, proposed by Russia in 1998, was adopted without a vote as resolution A/RES/59/290; annexed by the International Convention for the Suppression of Acts of Nuclear Terrorism. One aspect of this landmark achievement that has not yet been seized upon by the international community is that this is the first and only legally binding international agreement banning the acquisition and use of a whole category of nuclear energy-related[17] (radiological) weapons.

Through sufficient ratification, this convention entered into force in 2007. As of this writing, 115 states had signed, 77 of which have ratified and become party. Significant hold-outs of ratification by states that have manufactured sources are the United States, France, Canada, and Argentina. The Obama administration supported the convention in both the Communiqué and Work Plan of the 2010 Washington Nuclear Security Summit, and more recently submitted legislation for its ratification.

The convention is very specific in addressing threats and outlining some preventive, but mostly post-event responsibilities of a state. Among many topics covered, the following are the key areas covered by this convention (many of which address unresolved issues that had been raised in the CD for decades): The convention (1) defines radioactive materials and devices; (2) prohibits a non-state actor, accomplice, or organization from threat, blackmail, possession, or use of radiological material with malicious intent; (3) obligates states to adopt national laws that criminalize and mete sufficiently serious punishment; (4) encourages cooperation by states to "detect, prevent, suppress, and investigate" the above offenses within or outside of their territories; (5) through establishing accessible liaison points/competent authorities, encourages confidential and accurate information sharing among state parties and international organizations; (6) suggests the application of measures relevant to IAEA recommendations and standards of physical protection; (7) generally defines post-attack jurisdiction, detention, investigation, extradition, human rights, sovereignty and basic dispute concerns; (8) further obligates States must properly assess, handle, transport, store, radioactive materials; and (9) if assistance is requested, inform the IAEA of proposed method of disposition and storage.

Of particular importance are numbers 8 and 9. These are the areas that need to be focused upon and enforced more specifically and in detail in a new treaty/convention. Some states that have signed on to the UN-GA convention are already making significant legally binding commitments to these two key areas, but without a verification mechanism nor clearly outlined institutionalized requirements for implementation, it will be difficult if not impossible to demonstrate compliance with even the basic tenants of this convention. A new treaty/convention must fulfill both the purpose of providing the UN-GA convention a verification mechanism and establishing international norms for proper source management.

A SUGGESTED PATH

The CD inadvertently already provided much of the preliminary language, definitions, and associated work necessary to create a new convention. This near final draft convention language along with the Code and numerous other guidance, safety and technical documents relative to radioactive materials all create the necessary framework as a reference, but are not adequate in and of themselves without implementing or verification mechanisms. The international community need only take the extra step of heightened emphasis on and reformulation

of the topic with a non-strategic focus.

Should the CD be seen as an inappropriate venue for a convention there is another option with potential. Source regulators, manufacturers, and users, in addition to other government and non-governmental entities, now have a couple of decades of experience holding multiple international conferences on source management.[18] These conferences and meetings of source suppliers/regulators can bring in most of the stakeholders in source usage and regulation and typically result in final documents that help inform the IAEA's suggested guidance and subsequently each state's source management methodologies. If higher-level state representatives were to participate in such international fora, they could negotiate and draft an international accord with the same legal weight as a treaty/convention. This would be desirable in that it likely wouldn't require such contentious negotiations as might be necessary in the 65 member-state CD and would provide active contribution and buy-in to the text by those directly involved with sources. The Helsinki Accords are an example and provide precedent for achieving such an endeavor.

States must take a number of actions on their own. First, national regulators need to protect such material when it is in use, as recommended by the IAEA in the Code and other documents. Second and more problematic, an end-of-life disposition path must be created for disused or abandoned sources; whether it be recycling or permanent disposal. To create such a path, repatriation of these sources by manufacturing countries such as Russia, Canada, and the United States should be pursued and made legally-binding. One major barrier to this may be cost; due to the expense and difficulty of certifying a Type B container, international transport of a single high-activity source-containing device can cost upwards of US$100,000; far beyond the financial ability of most source owners or even some regulators. Additionally, some states would have to re-draft their regulatory language to enable the acceptance of imported radioactive waste in order to be able to accept some sources, transuranics or sources with long half-lives are the typical concern. One recent positive development was Russia enacting legislation (Federal Law 190F-3) that at least permits the import and recycle or disposal of spent sources; albeit selectively decided case by case by the government. Various entities within the United States and Canada have also taken some steps towards accepting disused sources that are either deemed still useful or a potential threat. Therefore, it should be incumbent upon manufacturing states that derive economic benefit from the export of such devices to agree to resolve pressing transportation issues and repatriate sources in such a way that will not negatively impact their beneficial use in applications such as cancer treatment, blood irradiation, and radiography.

Source owners and importing states should also bear some of the burden of repatriation; in fact, some already pay up-front disposition/repatriation costs when purchasing sources. The re-export or transshipment of sources from the end-user also poses problems because ownership can change without the knowledge of the local regulatory authority or original distributor of the source.

At no other time in history has it been more apparent that states must take on the responsibility for protecting and preventing the diversion of their sources. As evidenced by the events in Fukushima, the public is acutely aware and sensitive to the radiological threat. Now is a vital moment in which responsible decisions, communication, and education must be established with the public. Through historic meetings of the CD and the recent convention in the GA, the international community has unanimously voiced this concern and provided an outline for mitigation of a radiological contamination event. The urgency must not be lost from these efforts based on a lack of an attack and strained government resources. An international convention/treaty or accord must be negotiated and established as a foundation for responsible management of sources throughout their entire lifecycles. The threat is too accessible and consequences too high to continue to rely upon the status quo of applying mostly normative security to sources. ■

The authors would like to acknowledge Madame Yunhua Zou, member of first delegation from China to the CD and again from 1983-1996, negotiator of CD Agenda Item 6 (Radiological Weapons).

Bill Richardson was Governor of New Mexico from 2003 to 2010. He is a former U.S. Secretary of Energy, U.S. Ambassador to the United Nations during the Clinton administration, and U.S. representative from New Mexico. Currently, he is the chairman of APCO Worldwide's executive advisory service Global Political Strategies and Special Envoy for the Organization of American States.

Charles Streeper is a nonproliferation analyst and researcher. He received his MA in international policy studies at the Monterey Institute of International Studies.

Margarita Sevcik is a project manager at the James Martin Center for Nonproliferation Studies at the Monterey Institute of International Studies.

REFERENCES AND NOTES

[1] Berwick, Andrew, "A European Declaration of Independence," London, 2011. Accessed on September 23, 2011: http://truthfrequencynews.com/?p=6944

[2] An RDD is a device or mechanism that is intended to spread radioactive material from the detonation of conventional explosives or other means. RDDs are considered weapons of mass disruption; few deaths would occur nor would they be necessary because of the radioactive nature of the event. Significant negative social and economic impacts would result from public panic, decontamination costs, and denial of access to infrastructure and property for extended periods of time. A radiological exposure device (RED) is a device having the purpose of exposing people to radiation, rather than dispersing radioactive material into the air.

[3] Lee Leonard et al., "Plutonium-239/Beryllium Neutron Sealed Sources: Origins, Inventory, and Suitability for Disposal at the Waste Isolation Pilot Plant," LA-UR-04-4289, Los Alamos National Laboratory, June 1, 2004.

[4] Strub, Tiffany and Gregory J. Van Tuyle, "Large Radiological Source Production and Utilization and Implications Regarding RDDs," LA-UR-03-5432, Los Alamos National Laboraotry, July 28, 2003.

[5] International Convention for the Suppression of Acts of Nuclear Terrorism

[6] Streeper, Charles(2010) "Preventing Dirty Bombs," *The Nonproliferation Review*, 17: 3, 531-550, James Martin Center for Nonproliferation Studies, 2010.

[7] Negative security assurances are declarations that a country with nuclear weapons will not use them against a state without nuclear weapons. These are typically associated with being agreements between the official Nuclear Weapon States and Non-Nuclear Weapon States.

[8] Golan-Vilella, "Nuclear Security Summit's Scope May Grow," *Arms Control Today*, June, 2007. Accessed on July 23, 2011: http://www.armscontrol.org/act/2011_06/NuclearSummit

[9] New Types and Systems of WMD: Consideration by the CD," UNDIR Resources, United Nations Institute For Disarmament Research, May 2011. Accessed on August 31, 2011: http://www.unidir.org/pdf/activites/pdf4-act611.pdf

REFERENCES AND NOTES

[10] A poignant example of such negligence is the fact that in some states a criminal caught trafficking radiological materials has a much less severe punishment than that meted for drug smuggling. One criminal smuggling highly enriched uranium in the Republic of Georgia actually accused the arresting officers of planting drugs on him and that his only intention was to traffic radiological materials, thus intentionally attempting to avoid the stiffer sentence for drug trafficking.

[11] Kukhianidze, Alexandre, "Smuggling in Nuclear and Radiological Materials," Video Presentation, James Martin Center for Nonproliferation Studies, 2010 accessed on July 23, 2011: http://www.youtube.com/watch?v=xtT9t9SImnM

[12] Charles D. Ferguson, Tahseen Kazi, and Judith Perera, "Commercial Radioactive Sources: Surveying the Security Risks," Occasional Paper No. 11, Center for Nonproliferation Studies, 2003.

[13] Issraelyan, Victor and Charles Flowerree, "Radiological Weapons Control: A Soviet and U.S. Perspective," Occasional Paper 29, Stanley Foundation, 1982.

[13] With potential economic losses in the tens of billions of dollars or more, dependent upon contamination level and clean-up standards, a dirty bomb arguably has the potential to deny access to large urban areas, resulting in significant economic damage. The early consideration of radiological weapons as weapons of mass destruction and not just disruption arguably was a more accurate definition. Contamination of numerous city blocks could force the demolition of wide swaths of property.

[14] General Assembly, Question of General and Complete Disarmament. UN document A/RES/2602(XXIV)C. 12/16/1969.

[15] In 1980, a Convention on the Physical Protection of Nuclear Material (CPPNM) was signed and later ratified. However, it only addressed nuclear materials directly and mentioned radiological only in a side-bar "Developments" section.

[16] The IAEA, through its Nuclear Waste section, multiple guides and technical documents, and as the only international organization addressing the source threat has the necessary experience and trust with its member states to provide suggestions on exactly what would be best to include or exclude in a convention.

[17] Nuclear related because of the fact that most of the long-lived isotopes (i.e. ^{239}Pu, ^{241}Am etc.) used for sources were and continue to be produced as by-products in the same defense reactors used to produce weapons grade fissile materials for nuclear weapons.

[18] Some examples of these international conferences and source manufacturer meetings along with background can be found in the following publication starting on page 12: Streeper, Charles (2010) "Preventing Dirty Bombs," *The Nonproliferation Review*, 17: 3, 531-550, James Martin Center for Nonproliferation Studies, 2010.

2012 Nuclear Security Summit in Seoul:

Achieving Sustainable Nuclear Security Culture

— BY IGOR KHRIPUNOV

According to the International Atomic Energy Agency (IAEA), nuclear security culture is "the assembly of characteristics, attitudes and behavior of individuals, organizations and institutions which serves as a means to support and enhance nuclear security."[1] The concept of security culture emerged much later than nuclear safety culture, which was triggered by human errors that led to the Three Mile Island, Chernobyl and Fukushima accidents. Much as these incidents confirmed the importance of nuclear safety, security culture has gained acceptance as a way to keep terrorist groups from acquiring radioactive materials and prevent acts of sabotage against nuclear power infrastructures. Safety and security culture share the goal of protecting human lives and the environment by assuring that nuclear power plants operate at acceptable risk levels.

The 2010 Nuclear Security Summit held in Washington, DC, emphasized the importance of culture as a critical contributing factor to nuclear security:

Communiqué

- "We will work with the industry to ensure the necessary priority of physical protection, material accountancy and security culture."

Work Plan

- "Participating States will work … to promote and sustain strong nuclear security culture and corporate commitments to implement robust security practices."
- "Participating States encourage nuclear operators and architect/engineering firms to take into account and incorporate, where appropriate, effective measures of physical protection and security culture into the planning, construction, and operation of civilian nuclear facilities."
- "Emphasizing the importance of the human dimension of nuclear security, the need to enhance security culture, and the need to maintain a well-trained cadre of technical experts."

[1] "Nuclear Security Culture: Implementing Guide," *IAEA Nuclear Security Series* 7 (2008): 3.

The IAEA security culture design is based on the organizational culture model developed by Professor Edgar Schein of the Massachusetts Institute of Technology (MIT).[2] Schein's model was successfully used in the early 1990s to develop nuclear safety culture. In the security culture model it is founded on healthy respect for the threat. From the most senior leader to the technician, security measures must be a priority for the staff. This underlying conviction then permeates the way people work, driving their behavior under normal and abnormal conditions.

In a facility that enjoys a healthy security culture, personnel typically display a deep–rooted belief that there are credible insider and outsider threats, including theft, sabotage, unauthorized access, illegal transfer of material, and other malicious acts. They consider it their duty to counteract those threats. These beliefs form the foundation of nuclear security culture and are vitally important because they influence behavior to achieve objectives relating to nuclear non-proliferation and counterterrorism. Without this strong substructure of beliefs and attitudes, an effective nuclear security culture cannot exist. Efforts to instill such beliefs and attitudes must be carefully calibrated to reach everyone working in the facility and not only the organization's security professionals. The local community — a potential first line of defense against external threats — also must be familiar with the substructure of security ideology.

If beliefs and attitudes constitute the foundation of a security culture architecture, the next stage includes principles to filter beliefs and attitudes in order to develop sound policies and procedures.[3] These principles include motivation, leadership, commitment and responsibility, professionalism and competence, and learning and improvement. The entire workforce should be inculcated with these principles and—to show that leadership is dedicated to security—presented with proof that these principles are applied consistently across the organization. Three major elements exist at the administrative core of security culture development: facility leadership behavior and style, proactive policies and procedures for reaching the objective, and the ultimate goal, personnel performance. The promotion of an effective security culture will inspire characteristics of personnel behavior that include personal accountability, adherence to procedures, teamwork, and vigilance.

Leaders need to lead by example to forge the appropriate pattern of ideas and perceptions by staff.

The performance of leaders is the main element within the facility. They need to lead by example to forge the appropriate pattern of ideas and perceptions by staff. Managers must emphasize roles and responsibilities, visible security policies and cyber–protection. The role of the leader in promoting security culture is particularly important in societies with strong paternalistic traditions where the decision–making process is highly centralized.

The 2012 Summit in Seoul needs to focus on at least four specific measures contributing to the sustainability of nuclear security culture in individual countries and globally. The improvement of security culture is a continuous process. In the absence of a terrorist attack against nuclear power infrastructure, the element of sustainability plays a critical role in countering low motivation and complacency.

First: Two-Tiered Approach Anchored in National Values and Culture

The 2010 Summit encouraged the integration of security culture into general societal values instead of focusing on the facility–based model currently favored by the IAEA. Thus, a proposed two–tiered architecture would consist of (1) the facility–based model at the micro level, deriving its strength in part from national perceptions and relevant policies toward nuclear issues, and (2) general societal values at the macro–level. Ideally, these two levels combined will harness the human component to generate a more sustainable nuclear security culture.

If nuclear security represents a societal value, the macro–level input from national culture will reinforce efforts at the facility level. The input expected at the macro-level would include: a) nature of compliance with international legal instruments and participation in assistance programs; b) weight placed on nuclear security by the national leadership; c) consistency with which the nuclear industry focuses on nuclear security and related issues; d) criminalization and punishment of crimes associated with nuclear material and the security of nuclear installations; e) general public awareness of and involvement in security matters; and f) a greater role for educational institutions and universities.

[2] Edgar Schein, 3rd ed., *Organizational Culture and Leadership* (San Francisco: Jossey–Bass, 2004).
[3] Edgar Schein, 3rd ed., *The Corporate Culture: Survival Guide* (San Francisco: Jossey–Bass, 1999), 15–26.

The performance and sustainability of a nuclear security regime ultimately hinge on security perceptions shaped by national and industry leaders. Weak input from the macro level must not discourage efforts at the micro level. Ideally, the two levels should work together toward promoting and popularizing nuclear security culture.

A sustainable security culture will depend on the efforts of individual countries to assimilate generic international standards into their national culture as well as integrate it into their established organizational culture as a subset. In practice, this means that the ongoing IAEA Regional Training Workshops need to be followed by training events in individual countries that would attempt to adjust their generic standards to prevailing national practice, values and traditions. Such efforts may require a multidisciplinary approach involving a wide range of non-technical experts.

Second: "Selling" Security Culture

It needs to be recognized and widely publicized that security culture goes beyond traditional perceptions of physical protection and can yield numerous other benefits. Security culture would encourage the workforce to remain vigilant, question irregularities, execute its work diligently, and exhibit high standards of personal and collective accountability. While not a panacea, it can contribute to a vibrant and robust security regime and is applicable to the entire workforce. It is also responsive to a threat milieu in which risks are too numerous to predict, even for the most farsighted leader. Other potential benefits include better information technology security and protection of trade secrets; improved safety arrangements; reduced across–the–board theft and diversion; reduced risks of vandalism and sabotage by employees and outsiders; lower insurance rates; improved mechanisms for personnel control and accounting under emergency conditions; and better relationships with local authorities and surrounding communities. Also, an institutionalized security culture across the nuclear sector, introduced in coordination with the government, may facilitate auditing and inspections when government officials verify compliance with security and other standards.

The shift toward an effective nuclear security culture is characterized by the recognition of security as an investment rather than a burdensome expense. Also, the overall perspective of security moves beyond threats, vulnerability, and protection and integrates efficiency, organizational continuity, and the preservation of trust.

Third: Reinforcing Safety-Security Nexus

At the site of the 1986 Chernobyl disaster, U.N. Secretary-General Ban Ki-moon said, "We need to build a stronger connection between nuclear safety and security. Though nuclear safety and security are distinct issues, boosting one can bolster the other. At a time when terrorists and others are seeking nuclear materials and technology, stringent safety systems at nuclear power plants will reinforce efforts to strengthen nuclear security. A nuclear power plant that is safer for its community is also one that is secure for our world."

Safety culture is guided by the principle of transparency and across-the-board involvement, while security is focused on intelligence gathering and confidentiality, including post-event investigation. Leadership must arrange procedures so that security and safety measures reinforce, rather than handicap each other.

Safety and security measures need to be built into a plant throughout all phases of its service life, from design and construction to routine operation and decommissioning. Safety and security should begin at the drawing board, with assessment of candidate sites for the plant and the design of the installation itself. Assessing and continuously reassessing risk from safety and security angles is crucial throughout the plant's lifetime. Realistic safety and security risk estimates factor in a wide range of hazards, not to mention combinations of hazards, both natural and man-made. Confronted with complex disasters, nuclear managers must organize, recruit, train, and lead safety and security personnel in a way that helps the leadership react flexibly and quickly. Instilling the right habits and traits—the optimal overlap of safety and security culture—is critical.

Fourth: Evaluation of Nuclear Security Culture

The challenge in evaluating security culture is that culture is composed of intangible human characteristics like positive attitudes, high morale, ethics, teamwork, and the organization's reputation. Trends charted over a period of time can provide early warning to management to investigate the causes behind the observed changes and reinforce sustainability. In addition to monitoring changes and trends, it may also be necessary to compare the indicators against identified targets and goals, evaluating the staff's strengths and weaknesses.

There are two options to evaluate nuclear security culture:

1) *Basic: Positive Indicators*

- Percentage of employees who have received security refresher training during the previous month/quarter;
- Percentage of security improvement proposals implemented during the previous month/quarter;
- Percentage of improvement teams involved in determining solutions to security related problems;
- Percentage of employee communication briefs that include security information;
- Number of security inspections conducted by senior managers/managers/supervisors during the previous week/month (a security inspection may be combined with a housekeeping inspection);
- Percentage of employee suggestions relating to security improvement;
- Percentage of routine organizational meetings with security as an agenda item.

Positive security indicators serve as a mechanism for giving recognition to employees who improve security by thought, action or commitment. Recognition for achievement is a powerful motivating force to encourage continued improvement.

2) *Intermediate: Security Performance Indicators*

They are designed to show a level of performance that is deteriorating or not acceptable. Each facility can develop its own set of indicators which would best meet its needs. This methodology is currently used by the IAEA to enable state parties to evaluate nuclear security culture at their facilities. The actual values of the indicators are not intended to be direct measures of security, although security performance can be inferred from the results achieved. The numerical value of any individual indicator may be of no significance if treated in an isolated manner, but can be significant when considered in the context of the performance of the other indicators. The problem—recently discovered—with this approach is that it is difficult to develop predictive indicators as indicators are often either too easy to manipulate or are not sensitive enough to allow for early intervention.

The IAEA needs to develop a comprehensive and internationally acceptable methodology for evaluating nuclear security culture and widely disseminate it for practical use. In addition to strengthening sustainability, it will promote cooperation and the sharing of best practices.

Culture is composed of intangible human characteristics like positive attitudes, high morale, ethics, teamwork, and the organization's reputation.

The 2010 Nuclear Security Summit elevated the reliability of the human factor to the top of the nuclear security agenda. A vehicle to improve the human factor is security culture, which connotes not only the technical proficiency of the people but also their awareness of proliferation risks and motivation to follow established security procedures, comply with regulations, and take initiative when unforeseen circumstances arise. A workforce made up of individuals who are vigilant, question irregularities, execute their work diligently, and exhibit high standards of personal and collective behavior will maintain tight security. There is no way to make the world's expanding nuclear power infrastructure safe and secure other than to make allies of the people entrusted with operating nuclear power plants. The 2012 Summit in Seoul must go beyond the conceptualization of nuclear security culture and embark on the path of effective implementation. Given the cross-cutting role of the human factor, its successful outcome will largely depend on the extent to which it can formulate specific measures and recommendations which would ultimately contribute to a sustainable security culture. ■

Dr. Igor Khripunov is a Distinguished Fellow and Adjunct Professor at the University of Georgia Center for International Trade and Security. Dr. Khripunov joined the University of Georgia in 1992 after a distinguished career in the Soviet/Russian Foreign Service. His expertise includes nonproliferation export control, physical protection and vulnerability assessment, nuclear security culture, safety-security interface and organizational culture. He is also a consultant to the International Atomic Energy Agency (IAEA).

Evolving Infectious Disease Risks Call for New Collaboration Models

— BY REYNOLDS M. SALERNO and RENEE DEGER[1]

The revolution in biotechnology reached a major threshold last year with the creation of the world's first synthetic life form. Craig Venter and Hamilton Smith built the genome of a bacterium from scratch and incorporated it into a cell, creating a living creature with no ancestor.[2] As with most scientific accomplishments, this incredibly exciting development poses both great promise and potential problems. Advanced biology, in all its various forms, will likely improve our quality of life significantly in the future. However, these new capabilities in manipulating biological materials, accompanied by profound geographic, demographic, economic, and political changes, have also created a more dangerous infectious disease environment around the world.

The challenge for national and international policy makers is how best to address this new reality. How can we mitigate the risk of infectious disease outbreaks without stifling the science that, ultimately, is our best defense against those diseases? We argue that the answers to this question must be explicitly international and collaborative, requiring the United States government and many international organizations to change their traditional ways of doing business in this field.

INDUSTRY, SCIENCE UNDER TRANSFORMATION

Biotechnology is widely accepted as the transformative field of science of the 21st century, just as physics was in the 20th. Already, the first decade has produced an explosion of new developments. In 2003, for example, sequencing of the human genome was completed by a consortium of international scientists who worked for more than 13 years on the project. The Human Genome Project cost U.S. taxpayers approximately $2.7 billion.[3] Today, fewer than ten years later, it costs less than $20,000 to sequence an entire human genome, and some experts predict that cost to fall to less than $1,000 by 2020.[4]

Alongside genetic sequencing, the field of chemical synthesis has advanced at astronomical rates as well. In 2002, researchers at State University New York at Stony Brook produced a genetically engineered version of the poliovirus – the world's first synthesized virus. Since then, scientists have synthesized a variety of increasingly complex viruses, including the 1918 influenza virus, the Marburg virus, and the severe acute respiratory syndrome (SARS) virus.

These achievements help illustrate how capabilities that were once nonexistent and impossible have become almost commonplace, relatively speaking, among biological researchers. At the same time, the globalization and industrialization of the life sciences has fueled the growth and investment in biotechnology capabilities in every corner of the globe, but especially across Asia.

China, for example, has made biotechnology a national priority – not only for economic growth, but also as a source of fuels, food, and materials for its rapidly expanding population. China expects biotechnology to account for 5 percent to 8 percent of its gross domestic product by 2020. In Malaysia, biotechnology accounted for none of that country's GDP in 2005, but it was 2.5 percent in 2010.[5] The government of Singapore recently invested more than U.S.$3.9 billion (S$5 billion) to build Biopolis, a premier biological sciences research campus, and is expected to spend another US$12.5 billion (S$16.1 billion) to support its national biotech industry over the next five years.[6]

The level of sophistication among new biotechnology concerns is often cutting edge, even in the developing world. Noted author and consultant Rob Carlson conducted a study of the global distribution of commercial DNA foundries, and found a large number of suppliers of oligos across Latin America and Asia, as well as North America and Europe. India, for example, supports at least three commercial synthesis foundries.[7] More than 75 genome centers, many located in Latin America and throughout Asia, are currently involved in sequencing at least one of the 183 microbial genomes listed in GenBank, a database of publicly available DNA sequences operated by the U.S. National Institutes of Health.[8]

Also, the number of high-containment laboratories worldwide designed to support research or vaccine manufacturing that involves the most deadly of pathogens has skyrocketed. A decade ago, only a handful of Biosafety Laboratory Level 4 (BSL4) facilities, the highest level of biocontainment, existed worldwide. Today, there are dozens and more are planned.[9] India, for example, is in the process of tripling its BSL4 capacity from what it was only a few years ago.

China, for example, has made biotechnology a national priority – not only for economic growth, but also as a source of fuels, food, and materials for its rapidly expanding population.

INFECTIOUS DISEASES RAGING GLOBALLY

This surge in biotechnology and bioscience capabilities across the globe has coincided with a significant increase in the frequency of naturally occurring emerging and reemerging infectious disease outbreaks.[10] Between 1980 and 2007, 87 new human pathogen species were discovered – a rate of over three new diseases per year. Experts have identified 33 "medically significant" new infectious diseases in the last thirty years. Moreover, this emergence of new pathogens reflects a truly global pattern, with multiple incidents reported from every continent except Antarctica.[11]

Scholars agree that the increasing frequency of new and reemerging infectious disease is not a result of improved disease detection and diagnostics, but a consequence of a variety of demographic, globalization, and climatic trends. Agricultural practices have intensified to support the growing human population, leading to larger herds or the commingling of multiple species. Expanding populations have pushed humans to encroach upon more animal habitats, increasing the risk of zoonotic disease transmission, while increasing population densities in urban areas encourage disease incubation and spread. Meanwhile, globalization has led to more rapid and frequent movement of people, livestock, and products around the world, creating fertile opportunities for disease spread. And climate changes have facilitated favorable conditions for disease vectors, mutation, and propagation.[12] None of these trends show any sign of abating, and thus we must assume that the rate of infectious disease outbreaks will continue to accelerate, threatening public and agricultural health, global economies, and international security.[13]

In the last decade alone, the world has experienced major outbreaks with profound impacts on human health and national and international security, including SARS, H5N1 avian influenza, and H1N1 swine influenza.[14] Human behavior has also contributed to the rising risk of infectious diseases. The outbreak of Foot and Mouth Disease in the United Kingdom in 2001, after the virus was accidentally leaked from an infectious disease laboratory, caused an estimated $7 billion (£4.5 billion) in economic damages. The intentionally introduced anthrax in the United States in 2001, which killed five people and sickened 22, cost the U.S. economy more than $500 million just to decontaminate the affected buildings.[15]

All of these issues – the advances in biotechnology, the global expansion of the bioscience community, and the significant increase in the frequency of infectious disease outbreaks around the world – have created a dramatically changed global infectious disease profile. More life scientists are now working in more locations worldwide with more deadly, and potentially dangerous, pathogens and toxins that are now simpler to manipulate with today's readily available equipment. This means there's a much greater potential for accidents, theft, or other kinds of mishandling that could pose a serious public health or global security threat.

POLICY RECOGNITION

U.S. policy recognizes the potential security threats posed by the geographic and intellectual expansion of the biosciences. The *National Strategy for Countering Biological Threats* states: "Advances within the life sciences hold extraordinary potential for beneficial progress, but they also can empower those who would use biological agents for ill purpose."[16] At the same time, the *National Strategy* recognizes that many policy initiatives are necessary to counter the diverse spectrum of biological risks – from preventive measures to response preparedness. Importantly, the *National Strategy* articulates the promotion of "global health security" as its first of seven specific objectives:

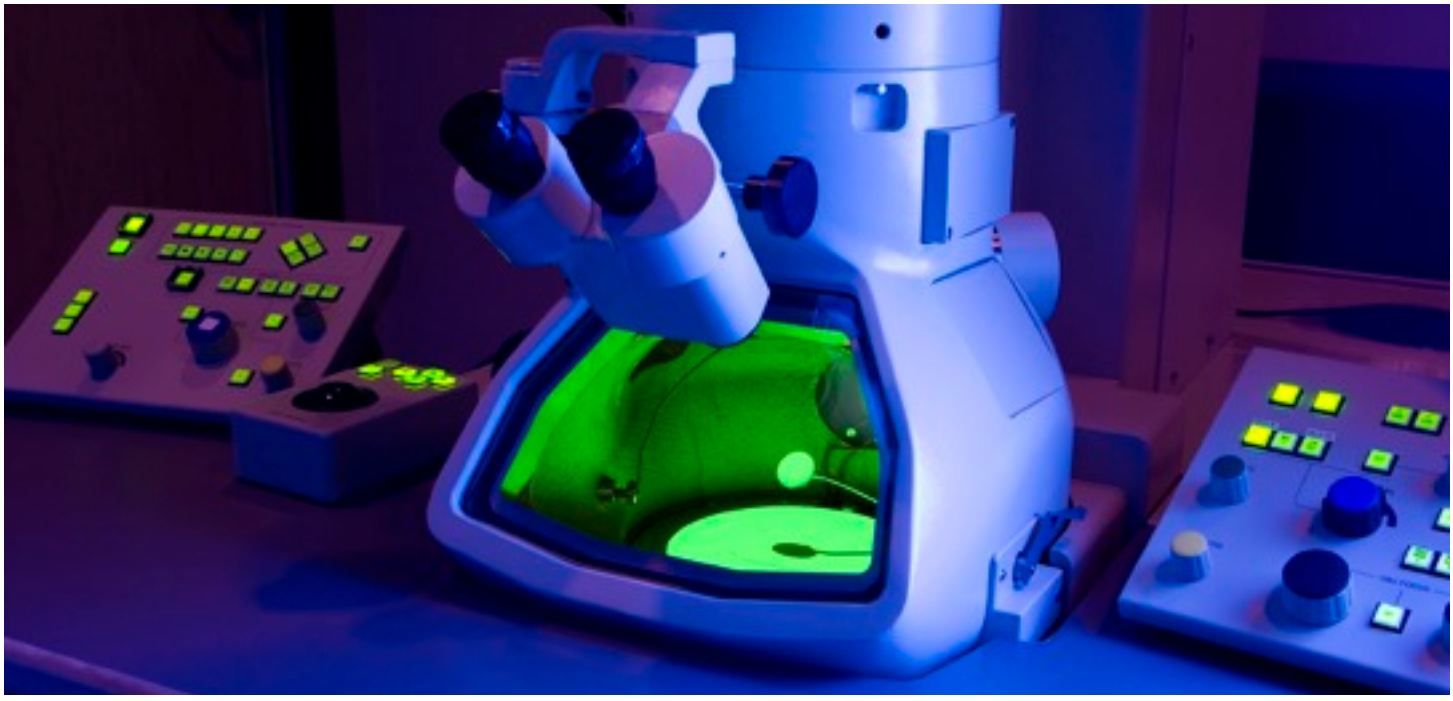
"We will seek to advance access to and effective use of technologies to mitigate the impact from outbreaks of infectious disease, regardless of their cause." This U.S. government intention is laudable, but *how* the U.S. government will build global capacity for disease surveillance, detection, diagnosis, and reporting is particularly daunting.

This challenge is most acute in the developing world – where many of the most dangerous infectious diseases tend to originate. Many developing countries lack the basic tools, expertise, or infrastructure to detect, identify, and contain outbreaks of infectious disease. Others may have the skills to identify disease outbreaks, but they lack the resources to contain and control the illness or monitor its spread. Without the ability to respond, to assure local and global populations an outbreak is contained, nations are reluctant to admit they have an outbreak, seek external assistance, or even to invest in monitoring capabilities. Effective response and monitoring capabilities would risk disrupting international trade or tourism. Further, such isolation and lack of resources help facilitate those with malicious intent and increase the vulnerability of the select pockets of professionals with sophisticated capabilities and equipment.

NEW CHALLENGES, NEW PARADIGM

Elevating or channeling the capabilities in the global life sciences and public health communities requires a new model for engagement. The current approach – exporting technologies and methods, and even containment laboratories, developed and used in the West to regions vulnerable to infectious disease outbreaks – has failed to markedly improve disease surveillance even in limited circumstances. The approach further fails to take into account the growing communities of life sciences professionals who are acquiring capabilities for very sophisticated science, but are not participating in the global public health conversation.

International aid programs that target anthrax detection are a good example. Anthrax has been identified as a disease that terrorists may target for malicious use, but it is not an especially common or consequential disease in much of the world. Still, many threat reduction programs distribute thermal cycler (PCR) machines with reagents for anthrax.



Stories abound of storerooms in developing world facilities filled with unused PCR machines still in their original packaging. In some cases, equipment was given to facilities that lacked trained staff, or trained staff had left the facility (such training is often hoarded and used to further job prospects). In other instances, facilities lacked the necessary reagents or even adequate or consistent power to operate the equipment. But more often than not, the scientific staff at the facility did not believe that modern technology – provided by an outsider and designed to detect a rare disease – could help them conduct their daily work or improve local conditions. They ignored the equipment or stopped using it when outside funding ended.

Not only do initiatives like this fail to target a problem of local concern, they are singular solutions – aimed only at identifying a single disease – that neglect to prepare communities for how to respond. And they often overlook the required supporting infrastructure, from electricity to the storage, handling methods, and transportation for the managing of samples, which developing world communities often cannot afford to maintain. But most importantly, these programs failed to engage local public or animal health professionals in a meaningful way. The local scientists were reduced to being recipients of aid rather than elevated into partners in identifying solutions to meet their immediate needs.

The challenges appear insurmountable, but the solution lies in how Western specialists, from public health experts to engineers, engage global communities. It means embracing a new, more collaborative development model. This new partnership framework would team Western specialists with local government, public and/or animal health, and medical and/or veterinary professionals. The immediate goal would be to develop solutions tailored for the immediate infrastructure that addresses the kind of local challenges that also pose a more widespread threat. The long-term goal would be to build the intellectual capacity within the community. Empowered with greater insight into the impact of an infectious disease outbreak on their communities, these front-line individuals, the doctors, veterinarians, nurses, technicians, and government and public health officials, would become more committed stakeholders in their solutions. Further, they would become more independent.

COLLABORATIVE SOLUTIONS

The "cooperative" concept is not entirely new. The academic community as well as biological threat reduction initiatives regularly partner with local individuals to conduct collaborative research. But these tend to focus on academic studies of a single dangerous, and often rare, disease. Also, the National Academies of Science recommended in 2009 that U.S. threat reduction programs "include broader international cooperation and partnerships, and increased international contributions."[17] But U.S. programs have not yet determined a model for achieving this. They continue to export U.S. or Western technology and expertise, evaluating their performance by the physical quantities of "stuff" they deliver, and not on effectiveness or sustainability.

Going forward, Western programs should endorse collaborative scientific research programs that tap local talent to develop solutions that improve local disease surveillance – detection, diagnosis, reporting, and control. Such partnerships should become the supporting foundation for local communities to identify their unique challenges, and to develop a solution that best suits local needs and resources. Powered by such autonomy, local specialists would become champions of their solutions, making them inherently more sustainable.

There are a number of critical, operational challenges to effective disease response in the developing world that collaborative research could immediately address. Leveraging emerging methods and technologies, such partnerships could target such needs as:

1. Point-of-care diagnostics that are less dependent on reagents, and are rapid, inexpensive, and can identify a range of diseases. Most detection methods require reagents that are disease-specific, expensive, perishable, often hard to come by, and require cold storage – all significant challenges in the developing world.
2. Self-contained sample preparation devices that eliminate the challenges of sample integrity and preservation during transport from the field to clinics and diagnostic laboratories.
3. Secure, remote access to advanced bioinformatics capabilities that would allow developing world laboratories to quickly compare local samples with public data banks to enhance disease detection and identification.
4. Mapping and analysis of historical disease conditions that could facilitate local diagnostic strategies and improve the ability of local health professionals to distinguish between endemic and emerging infectious diseases.
5. Decision support and risk assessment tools that could enable local decision makers to study appropriate response scenarios.

Each of these projects represents a gap in the developing world's disease surveillance needs, and could be addressed through cooperative technical projects staffed by both local and international scientists. Prototype results could be tested in the local community, and modified according to the local needs and shared with other, similar regions. Such collaborative research projects would integrate developing world scientists in the international scientific community, enhance local technical capabilities (regardless of the project's outcome), and potentially create a local solution that ultimately helps solve a global problem.

It may take a long time before the substantial benefits of the asvancing biosciences reach the front lines of the world's battle against infectious diseases. As long as these front lines are weak, the entire world remains vulnerable in the face of an increasingly complex and dangerous infectious disease environment. Western programs can take advantage of the global expansion of biosciences capabilities. But instead of transferring technologies and equipment to the developing world that are difficult for the recipients to use and maintain, Western programs should aim to create new science and technology alongside the scientists and officials on the infectious disease front lines. Adopting genuinely cooperative research and development partnerships that support the local development of tools and capabilities will significantly strengthen global public health communities – communities whose technical knowhow and operational competence are critical to reducing the today's global infectious disease risks. ■

Reynolds M. Salerno, Ph.D., is Senior Manger, Cooperative Threat Reduction Programs, Sandia National Laboratories.

Renee Deger is a member of the Media Relations/Communications Department, Sandia National Laboratories.

REFERENCES AND NOTES

[1] Reynolds M. Salerno, Ph.D., is Senior Manger, Cooperative Threat Reduction Programs, Sandia National Laboratories. Renee Deger is a member of the Media Relations/Communications Department, Sandia National Laboratories. We are extremely grateful for assistance provided by the following colleagues at Sandia: Halley Smith, William Arndt, and William Pinard.
[2] "And man made life: Artificial life, the stuff of dreams and nightmares, has arrived," *The Economist* (May 20, 2010). http://www.economist.com/node/16163154
[3] http://www.genome.gov/11006943, accessed on October 14, 2011.
[4] Alexander Crawford, "DNA Sequencing: The Next High-Growth Market in Biotech?" *The Motley Fool* (August 19, 2011) http://www.fool.com/investing/general/2011/08/19/dna-sequencing-the-next-high-growth-market-in-biot.aspx; Rob Carlson, *Biology is Technology: The Promise, Peril, and New Business of Engineered Life* (Cambridge, MA: Harvard University Press, 2010).
[5] http://www.biodesic.com/library/Biodesic_2011_Bioeconomy_Update.pdf; http://www.synthesis.cc/2011/08/biodesic-2011-bioeconomy-update-us-revenues-from-genetically-modified-systems-now-300-billion-or-gre.html, Accessed October 14, 2010.
[6] Glen T. Giovannetti and Gautam Jaggi, *Beyond Borders: Global Biotechnology Report 2011* (Ernst & Young), p. 35. http://www.ey.com/Publication/vwLUAssets/Beyond_borders_global_biotechnology_report_2011/$FILE/Beyond_borders_global_biotechnology_report_2011.pdf
[7] "A Genome Shop Near You," *Wired Magazine* 13.12 (December 2005). http://www.wired.com/wired/archive/13.12/start.html?pg=16; http://www.synthesis.cc/2005/07/global-distribution-of-commercial-dna-foundries.html, Accessed October 17, 2011.
[8] Information about GenBank can be found at: www.ncbi.nlm.nih.gov/sites/**genome**; www.ncbi.nlm.nih.gov/**genbank**/.
[9] Gigi Kwik Gronvall, et al. High-Containment Biodefense Research Laboratories: Meeting Report and Center Recommendations. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* (2007), pp. 75-84. http://www.upmc-biosecurity.org/website/resources/publications/2007/2007_article_pdfs/2007-04-04-highcontainmentbioresearchlab.pdf.
[10] Kate E. Jones et al., "Global Trends in Emerging Infectious Diseases," *Nature* (21 February 2008), pp. 990-994; Michael Greger, "The Human/Animal Interface: Emergence and Resurgence of Zoonotic Infectious Diseases," *Critical Reviews in Microbiology* (2007), pp. 243-299.
[11] Mark Woolhouse and Eleanor Gaunt, "Ecological Origins of Novel Human Pathogens," *Critical Reviews in Microbiology* (2007), pp. 231-242; V. Sintchenko, et al. "Laboratory-guided detection of disease outbreaks," *Arch Pathol Lab Med* (2009).
[12] Sally J. Cutler, et al., "Public Health Threat of New, Reemerging, and Neglected Zoonoses in the Industrialized World," *Emerging Infectious Diseases* 16:1 (January 2010), pp. 1-6; Michael Greger, "The Human/Animal Interface: Emergence and Resurgence of Zoonotic Infectious Diseases," *Critical Reviews in Microbiology* (2007), pp. 243-299.
[13] M.S. Smolinski, et al., *Microbial Threats to Health: Emergence, Detection, and Response* (Washington, DC: National Academies Press, 2003).
[14] World Health Organization, "Global Disease Burden" (2008).
[15] http://www.publicsafety.gc.ca/prg/em/ccirc/2006/ia06-001-eng.aspx; http://www.biotech-now.org/health/2011/10/bioterrorism-ten-years-later?utm_source=rss&utm_medium=rss&utm_campaign=bioterrorism-ten-years-later, Accessed October 17, 2011.
[16] The White House, *The National Strategy For Countering Biological Threats*, Presidential Policy Directive 2 (Washington, DC, 2009).
[17] National Academies of Science, *Global Security Engagement: A New Model for Cooperative Threat Reduction* (Washington, DC, 2009).

Reflections on Teaching the Manhattan Project

— BY B. CAMERON REED

The Legacy of Manhattan

In 1999, the *Newseum* of Washington, D.C. released the results of a survey of journalists and the public as to the top 100 stories of the twentieth century. Number one on the list for both groups was the atomic bombings of Hiroshima and Nagasaki and the end of World War II.[1] Journalists ranked the *Trinity* test in New Mexico as number 48, and the Manhattan Project itself as number 64. Nuclear weapons were arguably *the* single most important factor on the geopolitical stage for the last half of the twentieth century, and they will remain enormously influential for years to come. In the decades since the Manhattan Project, FAS and the organizations that gave rise to it have sought to provide the scientific community, legislators, and the public at large with reliable information on nuclear issues to help guide the development of national policies.

For most members of the public, however, nuclear physics comes to their attention only when the news seems dire: What are the Iranians and North Koreans doing? How concerned should I be about the disaster at Fukushima? What is reactor-grade plutonium and should I worry about who has access to it? Lack of basic knowledge in the area of anything "nuclear" contributes to public apprehension and impedes the development and implementation of broadly supported policies. The need for public education on nuclear issues is as pressing now as it has ever been.

For several years now I have taught a general-education course on the history of the Manhattan Project and its legacy to liberal-arts students at Alma College in an effort to address, in a very modest way, the lack of knowledge in this area. In this article I describe Alma College, the course and the student population it attracts, and offer some reflections on what I have learned about offering such a course and how it has evolved after what is now some half-dozen offerings.

Alma College

Alma College is a strictly undergraduate liberal-arts school of about 1,300 students located in central Michigan. In addition to choosing a major, every student must complete a requisite number of credits in the humanities, social sciences, and natural sciences. These general-education courses comprise about one-third of a student's overall credit requirements. Within the natural sciences is a physical-science requirement, with courses such as astronomy, geology, and general chemistry being popular choices. Alma operates on a "4-4-1" schedule: two traditional four-month terms (Fall and Winter), followed by a one-month Spring term. The latter is the time frame during which my course, "The Making of the Atomic Bomb," is usually offered. Spring term begins in late April and runs to just before Memorial Day. During this time students take one course intensively, often meeting five days a week for 3-4 hours; every student is required to complete two Spring terms within a four-year degree. Class size is typically 15-20 students. The rationale for this short small-class semester is to provide an opportunity for the College to offer courses that would not otherwise conveniently fit into a regular term. While many courses involve a field work or travel component, students with local jobs or who are on a sports team prefer on-campus classes, particularly ones that carry general-education credit and have no or minimal prerequisites. There is no formal prerequisite for my class, but students are encouraged to have at least taken if not placed beyond our basic algebra course. The course even attracts the occasional physics major. Indeed, how many college physics majors emerge from their curricula with much better ideas of the details of nuclear weapons than what they did from high school?

Teaching the Manhattan Project

The development of my class represented a convenient marriage of two factors: I wanted to be able to offer a general-interest class for non-science students, and for many years I have been publishing on the history and physics of the Manhattan Project. By 2002 I felt that I had acquired enough command of the topic to offer a course on it. I have now taught the course a total of six times during Spring terms plus a spin-off "First-Year Seminar" course which was offered in a regular Fall semester (2009) and is scheduled again for Fall 2011.

Since the very first offering I have begun with a survey that asks fundamental questions such as:

- Which country first developed nuclear weapons?
- In what year and during which war were they first used?
- On what cities were they dropped?
- What other countries subsequently developed nuclear weapons?
- What "explosive elements" do the weapons utilize?
- Name one person prominently associated with the Manhattan Project.

The war, country of development, and target cities are usually quite well known, but knowledge of other nuclear powers and identifying a leading personality tend to be extremely weak: most students think that nuclear proliferation is much broader than it is in reality, and Einstein frequently comes to the fore as the "father" of nuclear weapons. I always have my work cut out for me.

The text for the course is Richard Rhodes' masterful *The Making of the Atomic Bomb*. Our Spring term runs to about 19 instructional days, which corresponds to about one chapter per day. Students are expected to read a chapter the evening before each day's class. Lectures then consist of me explaining the material with the aid of numerous Power-Point slides, occasional videos, sample calculations involving reactions and isotopes, examining some classic original papers, and performing some simple demonstrations with equipment such as a Geiger counter and radioactive sources or a cathode ray tube to illustrate the idea of bending ion streams with a magnetic field. Students are often astonished to see that household smoke detectors, bananas, Trinitite, and old Fiestaware are mildly radioactive. Because the Manhattan Project is such a plethora of names, places, and concepts, students soon become hopelessly saturated if it is all presented in a traditional lecture style, so the videos, demonstrations, and photos of and anecdotes about the lives of the people involved are vital for breaking up the routine. I tweak the course every year in an effort to find an appropriate balance of hard-core and lighter content, and I suspect that I will never find the perfect one.

In the first incarnation of the class I stuck closely to the one-chapter-per-day prescription, but this proved somewhat awkward. Rhodes devotes considerable space to tangential issues which are relevant to setting the historical stage but are not directly germane to the science of nuclear weapons. We have a lot to cover in three and a half weeks, and deleting such material from the required reading has freed up time to go into more detail on the underlying science and current events. For example, in the most recent offering of the course (Spring 2011) I spent some time discussing radiation units and looking at maps of Fukushima fallout patterns.

The course content goes mostly in chronological order. The first half of the material takes us to 1939. We begin with the discovery of X-rays, radioactivity, and the electron as the opening acts of modern physics, then move on to the work of the Curies, Rutherford, and Bohr, artificial transmutation, the discovery of the neutron, artificial radioactivity, the work of Enrico Fermi, the tangled story of the discovery and interpretation of fission, the Szilard/Einstein/FDR letter, and the opening of World War II in Europe.

The second half of the course begins with the establishment of the Manhattan District and proceeds to a discussion of what was accomplished at Oak Ridge, Hanford, and Los Alamos; the *Trinity* test and the Hiroshima and Nagasaki missions then follow. As time permits in the last couple of days we look briefly at some selected topics such as the effects of nuclear weapons, the staggering number of postwar tests conducted by America and the Soviet Union, current deployment statistics (always a surprise), the concept of fusion weapons, and nonproliferation and arms-control treaties.

Weekly tests cover material at a qualitative level via multiple-choice and short-answer questions, while occasional homework assignments require students to balance reactions, predict the result of a decay process, compute the energy release in a reaction, or estimate a critical mass given a simplified formula. When I do the course during a regular semester the additional time allows me to add an extra reading/writing component: each student is randomly assigned a different book to read and on which they must prepare a report, with one cycle of submit-revise-resubmit. In most cases these are biographical or popular-level synoptic works; one cannot get into great technical depth with such a class.

Overall, my goal is for students to emerge from the course with fundamentally correct understandings of the history and basic science of nuclear weapons. I try to help them appreciate that nuclear weapons were in no sense pre-ordained and that even many of the leading physicists of the time scoffed at the idea of harnessing nuclear energy, *viz.* Ernest Rutherford's "moonshine" comment. I tell them that I consider the course a success if they can explain to a friend how the first nuclear weapons were developed, the essentials of how they function, what problems were overcome in making them, how a reactor differs from a weapon, how implosion creates a more efficient device, and why a subcritical mass of U-235 sitting on a desk would be perfectly safe. But I also want them to know something of the people involved: of Lise Meitner's flight from Germany just months before the discovery of fission, of Enrico Fermi and Hans Bethe, among others, making their way to America, of Oppenheimer's brilliant, eclectic, and tragic life. I want them to know that science and engineering are carried out and historic decisions made by real people.

LESSONS AND REFLECTIONS; STUDENT OPINIONS

With the Manhattan Project now a two-generation-old memory, a realization that hits me afresh every time I offer my course is that many of today's young people have only the vaguest notions of the course of World War II and the ferocity it had reached by the summer of 1945. Equally new for many of them is learning of the McCarthyist hysteria that swept America in the 1950s and the almost insane growth in the number of nuclear weapons since that time. As befits a liberal-arts environment, it is important that I teach some related history and sociology in addition to some physics.

Probably the most gratifying result for me is to see that many students are *very* interested in learning about nuclear history and issues. Many express a desire to do further reading on their own, so I learned early on to always devote some time to giving them some pointers on where to look for credible sources. These include the FAS site, the Los Alamos history site, the Washington and Lee University *Alsos Digital Library for Nuclear Issues* site, and some annotated bibliographies and a book that I have prepared.[2] Given that an online search on "Manhattan Project" or "Nuclear weapons" returns millions of hits, having good starting points is essential.

Mine will always be a small-scale contribution to public nuclear education. Alma is a small college; since 2002 about 120 students have taken the course. In 2007 I began taking an end-of-course survey, asking students to imagine themselves as President Truman in the summer of 1945 but with the benefit of some understanding of the functioning and effects of nuclear weapons. They are asked to choose, anonymously and with comments if they desire, one of six statements that most closely matches their own thoughts.

Paraphrased, these are:

- The use of nuclear weapons against Japan without prior warning was entirely justified.
- The use of the first bomb without prior warning was justified, but you would have allowed more time to elapse before the second (and any subsequent) ones were used, and a warning should have been issued.
- Even if you would have had personal moral reservations about using nuclear weapons, Hiroshima and Nagasaki were essentially foregone conclusions in view of the ferocity of the war, the looming post-war geopolitical situation with Russia, and the tremendous resources that had been devoted to the Manhattan Project. (I think of this as the "default" option.)
- Nuclear weapons should have been used only after the Japanese had been given a clear demonstration of their power, followed by a warning that they would be used unless Japan surrendered.
- Because the development of nuclear weapons could probably not have been kept secret for long, you would have supported their development but vetoed their use except as a last resort in case America faced an invasion or the imminent threat of nuclear attack by another country.
- Nuclear weapons are a moral abomination in any conceivable circumstance. You would have foresworn their development entirely even if it was known that other countries were working to develop and produce them.

Responses from 65 students have been collected so far; the results are shown in the figure. I never disclose individual-class or cumulative results to a current group of students, and the distribution of responses has remained fairly consistent over the years. Before distributing the survey I do show the class some casualty statistics from the Pacific island-hopping campaigns of 1945 to give a sense of the scale of the war; we also look briefly at the planned Olympic and Coronet invasions of Japan that were scheduled for late 1945 and early 1946. The results of the survey do not surprise me: Alma students are from smaller towns and tend to be conservative; they have likely had little exposure to revisionist history. It would be interesting to try the survey with another population at a larger, urban institution.

In an order roughly corresponding to the above options, here are some selected student comments (paraphrased and grammatically tidied):

" ... the anticipated casualties from an invasion made it so the bombs saved lives."

"... the bomb saved a lot of American lives and sped up the end of WW II."

"I do not believe that Japan was clearly headed for defeat ... America's position in the post-war world was determined by the vast destruction ..."

" ... after the drop on Hiroshima we should have given Japan the opportunity to reevaluate whether defending their honor would be worth further nuclear warfare."

"The use of the bombs was inevitable with all the resources and money that had been put into the Manhattan Project ... however, their power is horrifying, absolutely nothing about them is child's play."

" ... scientists all over the world knew of the potential for atomic weapons ... the creation of atomic bombs was inevitable ... but the use of these weapons without warning on a nation that did not also possess them was a very poor decision ..."

"After the debut of nuclear weapons there has not been a major war in Europe or between major powers in over 60 years."

"Attacking civilians is never sound military strategy. We are in the midst of a war on 'terror' – the use of nuclear weapons on a city is nothing but more efficient terrorism."

" ... these are weapons of genocide ... these weapons acknowledge, and even endorse, the loss of innocent life ..."

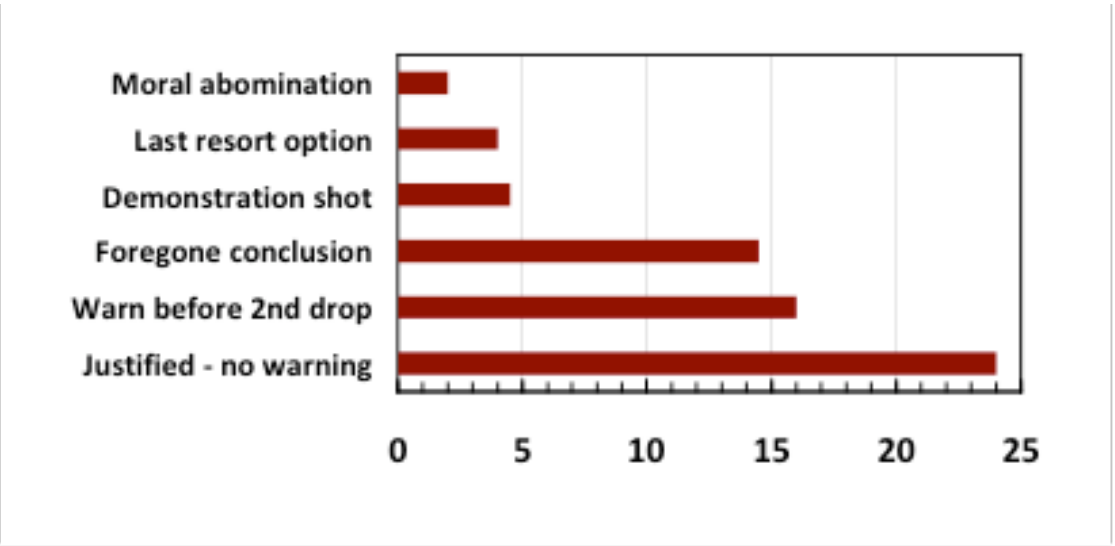
" ... the use of nuclear weapons against Japan was not a proportional response [but] as much as I would like to choose option 4 or 5, I really believe there was not much choice, or a more efficient way to end the war."

"I really feel that a weapon of such destruction should be used only as a last resort."

I know of a few faculty around the country who are teaching similar classes, and would encourage development of analogous courses at other institutions. Depending on the expertise of individual faculty, courses could take a variety of implementations and could develop into ideal vehicles for interdisciplinary offerings. We will never run out of customers.

The history and physics of the Manhattan Project is a virtually open-ended vehicle for teaching our students some physics, history, political science, and sociology. I see it as supporting, in a small way, the efforts of organizations like the FAS in their ongoing efforts to bring light to the debates on nuclear issues. ■

Dr. B. Cameron Reed is the Chair and Professor of Physics at Alma College. His research interests are primarily in the area of galactic structure (hot, blue stars) with occasional forays into areas such as quantum and nuclear physics. He has published more than 80 papers in peer-reviewed physics and astronomy journals.



REFERENCES AND NOTES

[1]. http://www.newseum.org/century/

[2] Reed, B. C. Resource Letter MP-1: The Manhattan Project and related nuclear research." American Journal of Physics **73**, 805-811 (2005); "Resource Letter MP-2: The Manhattan Project and related nuclear research." American Journal of Physics **79**(2), 151-163 (2011); See also B. C. Reed, *The Physics of the Manhattan Project* (Springer-Verlag, Heidelberg, 2010).

RESEARCH REPORT

Radioactive Materials Security

ANDREW KARAM *

INTRODUCTION

The focus of much of international terrorism in the last decade or so has been on causing mass casualties – trying to kill as many people as possible in as spectacular a manner as possible. This focus on deaths may be one reason that there have been no incidents of radiological terrorism in spite of evidence that such attacks have been contemplated. The fact that radiological terrorism has been repeatedly referred to as a "weapon of mass disruption" and that the science behind radiation health effects is so well-disseminated (and those health effects so easily calculated) may well have convinced terrorist groups that it simply is not an effective way of causing mass numbers of casualties, absent very high-activity sources and a plausible way to obtain and "weaponize" them. Through programs such as the National Nuclear Security Administration's (NNSA) Global Threat Reduction Initiative (GTRI) the United States is well on its way to securing the most dangerous radioactive sources, making them a much less attractive target for prospective terrorists or criminal organizations – even when they are held at so-called "soft targets" such as hospitals and universities.

There still remains the possibility that terrorist or criminal organizations might try to obtain radioactive materials to spread about as an agent of fear – using a style of attack that, while non-lethal, carries with it the ability to terrify the population. Attacks such as these might make radioactive terrorism more attractive because of the fear that radiation induces among members of the public. It may be appropriate, then, to characterize radioactive materials not only by the health threat they pose but to include the overall risk posed to society by the use of radioactive materials to deny access to important areas, to cause economic damage, or to sow fear in society.

Obviously, regardless of the "endpoint" aimed for by terrorist or criminal organizations, not all radioactive materials should be treated the same. Smoke detectors, for example, contain very low levels of radioactivity and the risk they pose – even considering their potential use in a terrorist attack – is dwarfed by their benefit to society. Similarly, the small quantities of radionuclides used in biological and medical research make for poor weapons while producing a tremendous positive value to society. Such materials should not be subjected to the same level of scrutiny as, say, radioactive sources used in well logging (radioactive sources are often lowered into boreholes to help locate water or hydrocarbon deposits and to determine the characteristics or the rock through which the hole was drilled). Along these same lines the low-activity radioactive sources that are locked within pieces of equipment (gas chromatographs or soil density gauges, for example) may not require the same level of security as sources used to calibrate some kinds of radiation detectors.

** Dr. Andrew Karam a respected board-certified radiation safety professional with expertise in issues related to radiological terrorism, the safe use of radioactive materials, and practical aspects of managing radioactive materials programs. He is the author of more than 20 peer-reviewed papers, three book chapters, and over 200 non-peer-reviewed technical presentations and publications. He occasionally works as a consultant to the International Atomic Energy Agency.*

On November 14, 2005 the Nuclear Regulatory Commission published an Order Imposing Increased Controls that specified security precautions aimed at reducing the risk that a dangerously radioactive source might be stolen and used for malicious purposes. These controls, however, do not address the large number of radioactive sources that can be used to frighten or to deny access to territory as opposed to causing physical harm. For these, the regulatory guidance is given in the Code of Federal Regulations, Title 10, Part 20:

10 CFR 20.1801 Security of stored material.
The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

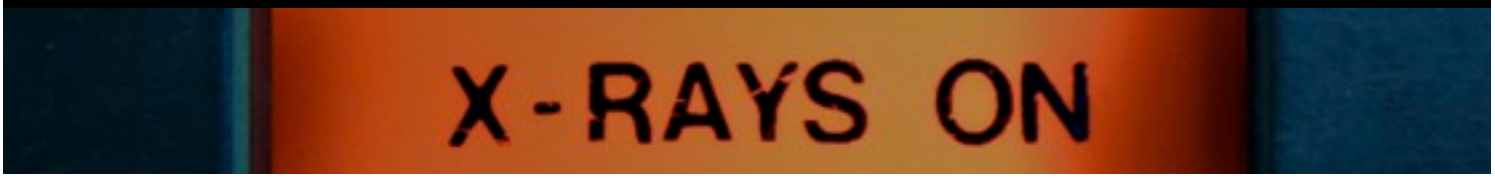
This regulatory requirement is admirably brief and non-prescriptive. Unfortunately it is also open to widely variable interpretation. For example, as an academic/medical Radiation Safety Officer my stance was that minor quantities of radioactive materials – quantities used in most research laboratories – needed to be kept in locked rooms or locked freezers as long as they were concentrated in small "stock vials" but that radioactive waste containers only needed to be stored in marked containers. My rationale was that the paper towels, latex gloves, test tubes, and other miscellanea that comprised the bulk of laboratory radioactive waste posed virtually no threat because it was so diffuse a source of radioactivity and because the containers were too bulky to easily smuggle out of the building. My regulators concurred with this assessment, but those of some of my RSO colleagues did not – there were some inspectors who felt that "every regulated atom" needed to be kept secured under lock and key. There was a similar difference of opinion when it came to low-activity radioactive sources contained within laboratory equipment such as gas chromatographs. This lack of consistency stems in part from the absence of agreement on what levels of radioactivity – and what form that radioactivity is in – pose a threat to the public health and welfare.

There are a number of factors that make a radioactive source more or less attractive to a malicious organization; which of these factors are most relevant depends on the use to which the source is to be put. For example, a group determined to cause radiation-related death and illness among many people would likely place more of an emphasis on the total amount of radioactivity in a source and on the type of radioactivity emitted; a group interested in denying use of an area might place more of an emphasis on dispersibility and ease of concealment. Some of these characteristics are described below and are summarized in the accompanying table. It may be prudent to consider these characteristics when developing more nuanced source security guidelines.

- **Source activity** – high-activity sources can cause more harm and can contaminate larger areas; but are more dangerous to work with and are more difficult to conceal
  - **High activity** – sources contain enough radioactivity to cause harm or death to those exposed under normal conditions such as taking a bus (e.g. 100 Ci Co-60 radiography source)
  - **Moderate activity** – sources contain enough radioactivity to cause lethal exposure under extraordinary circumstances or to cause injury (e.g. the Po-210 used to murder Alexander Litvenenko)
  - **Low activity** – sources are unable to cause injury (e.g. 1 mCi vial of tritium used for research)

- **Innate dispersibility** – sources that are powdered and soluble are more easily dispersible without processing; solid and insoluble radioactive materials are often easier to handle without spreading contamination
  - **High innate dispersibility** – source material is powdered or liquid and is easily accessible without specialized equipment (e.g. syringes filled with I-131 intended for nuclear medicine)
  - **Moderate innate dispersibility** – dispersing the source material requires specialized equipment or skills (e.g. Cs-137 in ceramic form inside a welded source capsule)
  - **Low innate dispersibility** – source material is in solid form (ceramic or metal alloy) that cannot be dispersed without substantial processing (e.g. a metal alloy Ir-192 radiography source)

- **Type of radiation emitted**
  - **Alpha radiation –** least penetrating and easiest to conceal, most damaging when in contact with living cells, lowest cleanup limits
  - **Beta radiation –** moderately penetrating (but still easily shielded), less damaging to living organisms, often has the highest cleanup limits
  - **Gamma radiation –** highly penetrating, difficult to conceal, cleanup limits similar to beta-emitting radionuclides



- **Ease of cleanup** – radionuclides with lower cleanup limits require a higher remediation effort and higher cost
  - **Easy cleanup** – cleanup limits are relatively high, typical physical and chemical form are amenable to remediation (e.g. spilled Tc-99m in a medical center, which can be easily wiped up or allowed to decay)
  - **Moderately easy cleanup** – cleanup limits are moderate, typical physical and chemical forms can be remediated, albeit with some difficulty (e.g. spilled I-131, which can seep into cracks or pores and chemically bonds to surfaces)
  - **Difficult cleanup** – cleanup limits are low, radionuclide adheres tenaciously to surfaces or saturates the volume of contaminated materials (e.g. Am-241, which has very low cleanup levels and is often in a physical form that is difficult to remediate)

- **Ease of concealment** – radionuclides that are easy to conceal can be smuggled more easily, but typically are more difficult to administer in a manner that will cause harm
  - **Easy to conceal** – radiation emitted is easy to shield, physical size of sources plus shielding is relatively small and innocuous (e.g. the Po-210 that was used to murder Alexander Litvenenko and could be concealed in a pharmaceutical capsule)
  - **Moderately easy to conceal** – radiation emitted is more penetrating and requires more extensive shielding (e.g. Sr-90, which requires at least 1 cm of plastic shielding)
  - **Difficult to conceal** – radiation emitted is very penetrating, requiring bulky or heavy shielding (e.g. Cs-137, which might require several hundred pounds of lead to reduce gamma radiation to undetectable levels)

- **Availability** – an isotope cannot be used unless it can be obtained; in general, the more readily available an isotope is, the less harm it can inflict (e.g. smoke detectors are readily available but are difficult to weaponize); sources that are in common use or that do not require a radioactive materials license to obtain are more available than those that must be licensed or stolen from secure facilities
  - **Easily available** – source is in common use (possibly at locations with minimal security), source is relatively easy to steal, can be obtained without a radioactive materials license (e.g. 1 μCi Am-241 smoke detector source)
  - **Moderately easily available** – source requires a radioactive materials license to purchase legally, is typically found in secured locations, but is not normally found in quantities requiring Increased Controls (e.g. 10 Ci Cs-137 well logging source)
  - **Available with difficulty** – source requires a radioactive materials license to purchase and falls under Increased Controls regulations, including need for background check and enhanced security precautions (e.g. 1000 Ci Cs-137 blood irradiator)

- **Potential lethality** – some sources are more likely to be lethal than others due to the type of radiation emitted, source activity, ability to become lost, etc. – for example, radiography sources have caused a number of deaths around the world while process control gauges typically have too little radioactivity to cause harm
  - **Highly lethal** – sources that, if dispersed maliciously, can cause hundreds of deaths (or more) and that likely have caused deaths in the past (e.g. high-activity sources of Cs-137 or of most alpha-emitting radionuclides)
  - **Moderately lethal** – sources that, if dispersed maliciously, can cause up to tens of deaths (e.g. moderate-activity sources of Cs-137, high-activity sources of Co-60)
  - **Low lethality** – sources that are unlikely to cause deaths (e.g. smoke detector sources, soil density gauges)

The following table gives some qualitative examples of a variety of types of radioactive materials and how they compare using the characteristics noted above. It must be noted that this table is qualitative in nature, primarily because there is tremendous variability within each category of sources. This table can help to compare categories of sources but a more detailed analysis is required to develop a quantitative assessment of the risk in each source category.

Source	Activity	Innate Dispersibility	Type of Radiation	Ease of cleanup
Smoke detector	Very low	Very low	Alpha	Moderate
Research stock vial	Low	High	Beta	Very easy
Lab equip.	Very low	Low	Beta, gamma	Moderate
Blood irradiator	Very High	Moderate – high	Gamma	Difficult
Industrial radiography	high	Moderate - high	Gamma	Difficult
Soil density gauge	Low	Low	Alpha, gamma, neutron	Moderate
Process control gauge	Low	Low	Beta, gamma	Easy
Well logging	Moderate	Moderate	Alpha, gamma	Difficult
Radiopharmaceuticals	Low – moderate	Very high	Beta, gamma	Easy
Radiation oncology	Moderate to very high	Low to high	Gamma	Difficult to very difficult

Ease of concealment	Availability	Potential lethality	Overall Threat
Very easy	High	Very low	Very low
Very easy	Moderate	Very low	Very low
Easy	Moderate	Very low	Very low
Difficult	Moderate	Very high	Very high
Easy	Moderate	High	Very high
Easy	Moderate	Low	Low
Very easy	Moderate	Low	Low
Easy	Moderate	Moderate to high	Moderate
Easy	High	Low	Moderate
Easy to moderate	High	High	High

Summary and conclusions

It makes sense to require the highest level of controls over the sources most likely to be targets for theft and that can do the most harm (or cause the greatest societal and financial impact) if stolen and used maliciously. Thus, a process control gauge, having a low level of radioactivity, low potential lethality, low innate dispersibility, etc. poses little threat and may not require the same level of security as a radiopharmaceutical delivery vehicle that is filled with highly dispersible radionuclides (albeit with shorter half-lives). Similarly, radioactive waste containers at most research institutions contain little radioactivity and the bulk of that is not highly dispersible – such containers may be aesthetically displeasing but do not pose a threat to the public health or welfare.

While there is general agreement among radiation safety professionals regarding the relative risks posed by various radioactive materials (including sources) those who are responsible for managing radiation safety programs do not typically report to supervisors who are as knowledgeable. In addition, the current regulations – as written – do not provide unambiguous guidance that can be used to help radiation safety professionals work with their management to provide appropriate security for an organization's radioactive materials. This same unambiguous guidance will also help to ensure a common set of standards among inspectors from regulatory agencies. Accordingly, it seems reasonable to suggest that clear and unambiguous guidance – perhaps in the form of a "Best Practices Manual" on this topic – be provided to radioactive materials licensees that provides advice on appropriate security measures for a variety of radioactive materials types and threat levels.

Terminology

Alpha radiation – heavy particles emitted from unstable atoms; alpha particles are a high threat if ingested or inhaled and are a low risk if they remain outside the body
Beta radiation – light particles emitted from unstable atoms; beta particles are a moderate risk if ingested or inhaled and can cause skin burns (but no internal injury) if they remain outside the body
Contamination – the presence of radioactivity in a place where it is neither expected nor desired; contamination can be cleaned up
Curie – a measure of the rate at which radiation is emitted from radioactive materials; 1 Ci of radioactivity will undergo 37 billion radioactive decays per second
Dose (radiation) – a measure of the amount of energy deposited in the body from being exposed to radiation; this energy can go on to cause radiation sickness or cancer
Gamma radiation – high-energy photons emitted by unstable atoms; gamma rays are highly penetrating and cause low to moderate damage to cells
Half-life – the amount of time required for 50% of radioactive atoms to decay; after 10 half-lives the remaining radioactivity is about 0.1% of the original radioactivity
Increased Controls – regulatory requirement for higher levels of security for radioactive sources felt to pose a greater risk of theft or use by terrorists
Rad – a measure of the amount of energy deposited in an object from radiation
Radiation – the transfer of energy from one place to another; in the case of radiation safety the energy is transferred from an unstable atom or a radiation-emitting device (e.g. x-ray machine) via the emission of particles (alpha or beta) or photons (x-ray or gamma ray)
Radioactivity – the presence of unstable atoms that achieve stability by emitting radiation; radioactivity is an inherent property of some atoms
Rem – a measure of the biological damage caused by radiation, accounting for the fact that some forms of radiation (e.g. alpha) are more damaging to the body than are others

References (last accessed August 18, 2011)

National Nuclear Security Administration, Fact Sheet, GTRI: Reducing Nuclear Threats, February 1, 2011. http://nnsa.energy.gov/mediaroom/factsheets/reducingthreats

Nuclear Regulatory Commission, 10 CFR 20 – Standards for Protection Against Radiation: http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/

Nuclear Regulatory Commission, NUREG 1556 – Consolidated Guidance About Materials Licenses: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/

Nuclear Regulatory Commission, Order Imposing Increased Controls, NRC Document EA 05-90, dated November 14, 2005 http://pbadupws.nrc.gov/docs/ML0531/ML053130218.pdf

DULY NOTED

Chemical Facility Security

Will Chemical Disaster Prevention Finally Be Implemented in 2012?

RICK HIND *

On December 3, 1984, the Union Carbide plant in Bhopal, India released tons of methyl isocyanate into the air killing thousands of people. Today, most major U.S. cities have one or more chemical facilities that are equally deadly. Together they endanger more than 100 million Americans.

Following the 9/11 attacks, security agencies listed chemical plants among the most vulnerable sectors of our infrastructure to terrorism. In 2006, then Senator Obama, called them "stationary weapons of mass destruction" and pushed for legislation to make them safer.

If you were tempted to believe the threat of terrorism had diminished after Osama Bin Laden was killed, think again. In July, the Department of Homeland Security (DHS) issued a warning about home grown threats to utilities including water treatment plants, which use large quantities of poison gases.

Given the number of facilities using these gases, it is not surprising that accidents kill plant employees on a regular basis. A fatal 2008 accident at Bayer chemical plant in West Virginia nearly repeated the Bhopal disaster. According to chemical plant reports to the Environmental Protection Agency (EPA), there are 483 chemical facilities that each endanger 100,000 or more people in surrounding communities. Ninety-two of these plants each put 1,000,000 or more people at risk. A tank car release of chlorine gas can endanger people in an urban area up to 14 miles away.

Regarding terrorism, the DHS warns that the magnitude of an attack on a plant would be worse than an accident. The U.S. Naval Research Laboratory estimates that such an attack could kill or injure 100,000 people within 30 minutes. The U.S. Army surgeon general estimated 900,000 to 2.4 million casualties.

Lethal gases were first used as a weapon in the First World War, when Germans killed thousands of French troops with chlorine gas in Ypres, Belgium on April 22, 1915. Today, these same gases are used by the chemical, petroleum, water treatment and other sectors. According to the EPA, just four poison gases (chlorine gas, anhydrous ammonia, hydrogen fluoride and sulfur dioxide) account for fifty-five percent of chemical processes that put communities at risk of a chemical disaster.

Following the Bhopal disaster, the Clean Air Act was amended to require chemical facilities to submit worst-case disaster reports to the EPA and to obligate plants to prevent catastrophic chemical releases. This obligation has never been enforced. In 2002 in response to 9/11, the EPA proposed enforcing this obligation with rules that would have reduced these hazards through the greater use of safer chemical processes. Unfortunately, the EPA proposal was scuttled by the Bush White House. This year, however, on October 26th an EPA federal advisory panel recommended that the agency enforce this obligation.

The only other law we have is a temporary security statute written on behalf of the petro-chemical lobby. That lobby is pushing Congress to make that law permanent. Doing so would lock in a provision that prohibits the DHS from requiring the use of safer chemical processes. It will also lock in loopholes that exempt most refineries and thousands of water treatment plants. As a result, the DHS program covers only 4,569 facilities, while the EPA has authority over 12,361 chemical facilities.

Guards, guns and gadgets won't protect communities at risk. (cont)

** Rick Hind is the Legislative Director of Greenpeace and has worked on chemical regulation for more than 30 years.*

Making the CFATS Program Permanent

PATRICK J. COYLE *

As the end of the year approaches, there is once again an important legislative task that is being postponed, the creation of a permanent chemical facility security program. People have long been aware that there are chemical facilities in this country that store large amounts of dangerous chemicals that could be turned into improvised chemical weapons. What has held up creation of a permanent security program to protect communities from such a terrorist attack is the lack of a consensus on how to best go about protecting those facilities.

The CFATS Program

In 2006 Congress created a temporary security program that would start high-risk chemical facilities on the road to a secure future while legislators worked out a political solution to create a permanent program. Added to the 2007 spending bill for the Department of Homeland Security §550 provided interim authority for a three year DHS program that:

- Identified chemical facilities that were at high-risk for terrorist attack;
- Required those facilities to conduct a security vulnerability assessment; and
- Required those facilities to develop a site security plan.

Since the December 2006 publication of the notice of proposed rulemaking for the CFATS regulations, DHS has accomplished a great deal, including the:

- Crafting of a working definition of 'high-risk chemical facility';
- Developing of a number of on-line tools to collect the information necessary to determine which chemical facilities fit that definition;
- Developing of a Risk-Based Performance Standard (RBPS) guidance document; and
- Training of a chemical security inspection force.

With the publication of the Site Security Plan in the spring of 2009, the program has slowed to a crawl as the Infrastructure Security Compliance Division's (ISCD) Chemical Security Inspectors do the hard job of determining if site security plans actually conform to the RBPS requirements.

Temporary Reauthorizations

Since the original authorization expired in October of 2009, Congress has extended that authority in each spending bill that provided funding for DHS. When continuing resolutions were used to continue the funding of the government those CRs specifically included temporary short term extensions of the CFATS program as well.

This year-to-year, and sometimes month-to-month, authorization process has led to some budgetary uncertainty at many high-risk chemical facilities. While there has been no Congressional opposition to the CFATS program per se, there still exists the possibility that the next extension of that authority will not happen and facilities will be stuck with compliance costs that they would not have undertaken were it not for the requirements of CFATS.

This is further complicated by the slow pace of compliance verification by ISCD. The vast majority of facilities have yet to have the preliminary evaluation of their security plans completed and there are only a handful that have completed the evaluation process. As a result many companies have budgeted large sums of money for security-related capital projects, waiting to determine if those projects will actually be necessary.

The Conflicts

The most basic reason for the congressional failure to approve a permanent chemical-facility security program comes down to a major philosophical difference between industry and environmental/labor organizations. Industry wants to be free to use a mix of classical physical and programmatic security measures tailored to their particular

** Patrick J. Coyle has 15 years experience in the U.S. Army with extensive experience in training development, delivery and evaluation. He spent 16 years working in the chemical industry developing and improving chemical manufacturing processes with an emphasis on chemical and process safety.*

DULY NOTED

Will Chemical Disaster Prevention Finally Be Implemented in 2012?

Fortunately, safer chemical processes are widely available. Washington, D.C.'s waste water treatment plant converted to a safer process within 90 days following the 9/11 attacks – yet today major U.S. cities, including New York, Philadelphia, Los Angeles, Miami, and Houston, remain at risk. Since 1999, more than 500 chemical facilities have converted to safer processes but many of these put few if any people at risk in the first place.

What's missing is a program that prioritizes the conversion of the highest risk plants to the safest processes available.

The Obama administration has consistently urged the Congress to require safer available chemical processes as part of its security legislation. Given the inability of Congress to break free of the petro-chemical lobby, it's time for the EPA to revisit its 2002 Clean Air Act proposal to protect the millions of Americans who live and work in the shadow of another Bhopal disaster. ■

Making the CFATS Program Permanent

facility to protect them against terrorist attacks. The activist community would rather see highly dangerous chemicals, particularly toxic inhalation hazard (TIH) chemicals, removed from the sites to eliminate the threat of aa terrrosit attack.

The environmentalists contend that there is no such thing as absolute security and that the consequences of a large-scale release of TIH chemicals are so severe that the only way to protect surrounding communities from those consequences is to remove the chemicals. Industry responds that aggressive security policies and procedures will deter and prevent attacks so that the probability of a successful attack is infinitesimally small.

Industry also maintains that the decision as to what chemical is appropriate for a particular chemical process is a complex technical and business decision that the government is ill equipped to evaluate and judge. The activists respond by pointing to the large number of facilities that have already shifted from TIH chemicals to less toxic alternatives as proof that the change can frequently be made at little or no overall cost increase.

Further complicating things is the fact that the two groups have been on opposite sides of so many disputes that there is little actual communications between them. The environmentalists actively mistrust industry because of a long history of chemical releases at some manufacturing facilities that appear to be a direct result of mismanagement or active disregard for safety. Many in industry feel that the activists won't be satisfied until the chemical industry is shut down. Neither side appears to be willing to discuss the legitimate concerns of the other.

Moving Forward

It seems likely that sometime next year the House will pass a multi-year CFATS extension; much the same way that the House in the previous Congress passed a bill that was supported by the environmentalists. The Senate will again be the likely stumbling block. The Senate rules will allow a dedicated opposition to prevent consideration of the bill.

Until legislators can reach a compromise between these two factions, it is unlikely that a bill establishing a long-term chemical facility security program will become law. ■

BOOK REVIEW

In *American Anthrax,* Jeanne Guillemin provides a page-turning account of the investigation into the 2001 anthrax attacks. This remarkable book combines history, politics, and science.

By MONICA A. AMARELO

American Anthrax - Fear, Crime, and the Investigation of the Nation's Deadliest Bioterror Attack by Jeanne Guillemin, a senior advisor to the Security Studies Program at the Massachusetts Institute of Technology, opens with an ambulance siren piercing the quiet of a residential neighborhood in Frederick, Maryland. Bruce Ivins, a microbiologist at the Army's Medical Research Institute of Infectious Diseases (USAMRIID) at Ft. Detrick, Md., was carried unconscious and taken to Frederick Memorial Hospital where he died two days later. Ivins was the prime suspect of the FBI's seven-year investigation into the deadly anthrax attacks of October 2001.

Guillemin's comprehensive story shows how it took the FBI hundreds of thousands of hours, coordinating with military and science experts, to trace and match the anthrax sample to a flask in Ivins's lab.

She revisits the case from the first anonymous letter containing anthrax to the ensuing public panic and the conspiracy theories that emerged after Ivins's suicide.

Her meticulous research illustrates how little was known about anthrax. Law enforcement and scientists were developing procedures and forensics techniques as the investigation unfolded.

While focusing on the criminal investigation, she also touches on U.S. policy towards biothreats - especially the prevalent idea of foreign bioterrorism. Guillemin recommends a long overdue evaluation of the entire U.S. biodefense industry. If nothing else, her review of the FBI's scientific evidence reveals the approach to biosecurity used by professionals at USAMRIID was stuck in the Cold War and that the Army's lack of vigilence regarding laboratory security was nothing short of dangerous.

This is a thoughtful examination of America's fight against biological warfare. While she details the often confusing chain of events, Guillemin never forgets the five innocent people who died from the anthrax spores floating in post offices, news media mail rooms, and the senate offices on Capitol Hill. ■

American Anthrax - Fear, Crime, and the Investigation of the Nation's Deadliest Bioterror Attack (Henry Holt and Company MIT Press, 2011).

Monica A. Amarelo is the director of communications for the Federation of American Scientists. She is also the managing editor of the Public Interest Report (PIR).

Jeanne Guillemin is a senior advisor in the security studies program at the Massachusetts Institute of technology. She is the author of Anthrax: The Investigation of a Deadly Outbreak *and* Biological Weapons: From the Invention of State-Sponsored Programs to Contemporary Bioterrorism.

FAS MATTERS

FAS NEWS FROM DC HEADQUARTERS

ScienceWonk

FAS launched a new blog, which features Dr Y - a certified health physicist, trained in nuclear power plant design and operations, with experience in nuclear power, environmental science, and planning for radiological and nuclear emergencies. FAS welcomes guest authors to submit thoughtful articles on science and security issues.If you are interested in contributing to the blog, please contact Katie Colten at kcolten@fas.org. Please visit: www.FAS.org/blogs/sciencewonk.

BIOLOGICAL WEAPONS CONVENTION IN GENEVA

Kelsey Gregg, project manager of the FAS Biosecurity Program, traveled to the 7th Session of the Biological Weapons Convention in Geneva, Switzerland. Gregg presented an update on the Virtual Biosecurity Center (VBC) and how it can be used as a resource and communications tool for members of the biosecurity community. To learn more about the VBC, please visit: http://virtualbiosecuritycenter.org/.

PODCASTS

FAS produced three new podcasts. Hans Kristensen, director of the Nuclear Information Project, dicusses the status of China's nuclear weapons arsenal. Dr. Ali Vaez, director of the Iran Project, talks about Iran's nuclear program and the IAEA report published on November 8, 2011. Vaez also focuses on the history of Iran's relationship with IAEA and Iranian public opinion regarding nuclear pursuits. Lindsey Marburger, manager of the Earth Systems Program discusses sustainable housing, water security and clean energy investments. Please visit: www.fas.org/podcasts/index.html.

WINTER ISSUE OF PIR

- The Threat of Space Debris
- The Legal Threats to Security in Outer Space
- The Implications of China's Space Program
- Upcoming UN Efforts to Address Transparency and Confidence-Buildng Measures in Space
- Space Security as National Security
- NATO vs. Russian Perspectives on the U.S. Missile Defense System

The PIR welcomes letters to the editor. Letters should not exceed 300 words and may be edited for length and clarity. The deadline for the fall issue is **February 1, 2012**. To submit a letter, please email pir@fas.org or fax 202-675-1010.

To learn about advertising opportunities in print and online please call (202) 454-4680 or email advertising@fas.org.

THE FAS AWARDS DINNER AND CEREMONY

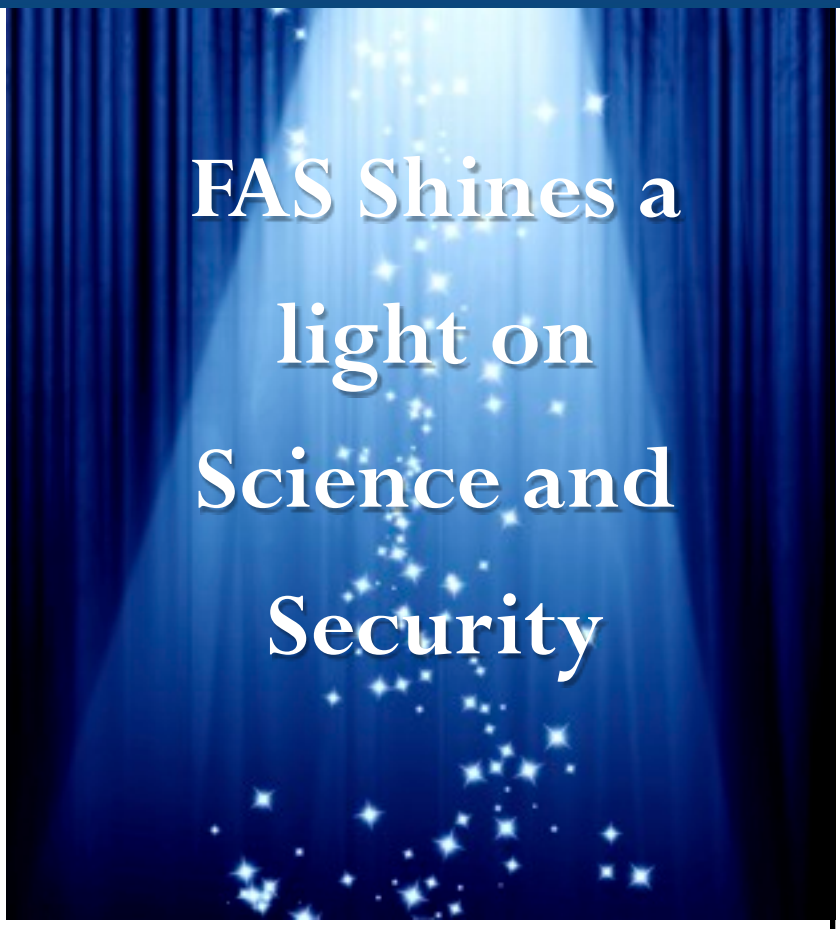
FAS will honor **Dr. Steven Chu**, the United States Secretary of Energy, with the 2011 Hans Bethe Award.

The inaugural 2011 Richard L. Garwin Award will be presented to **Dr. Richard Meserve**, President of the Carnegie Institution of Science.

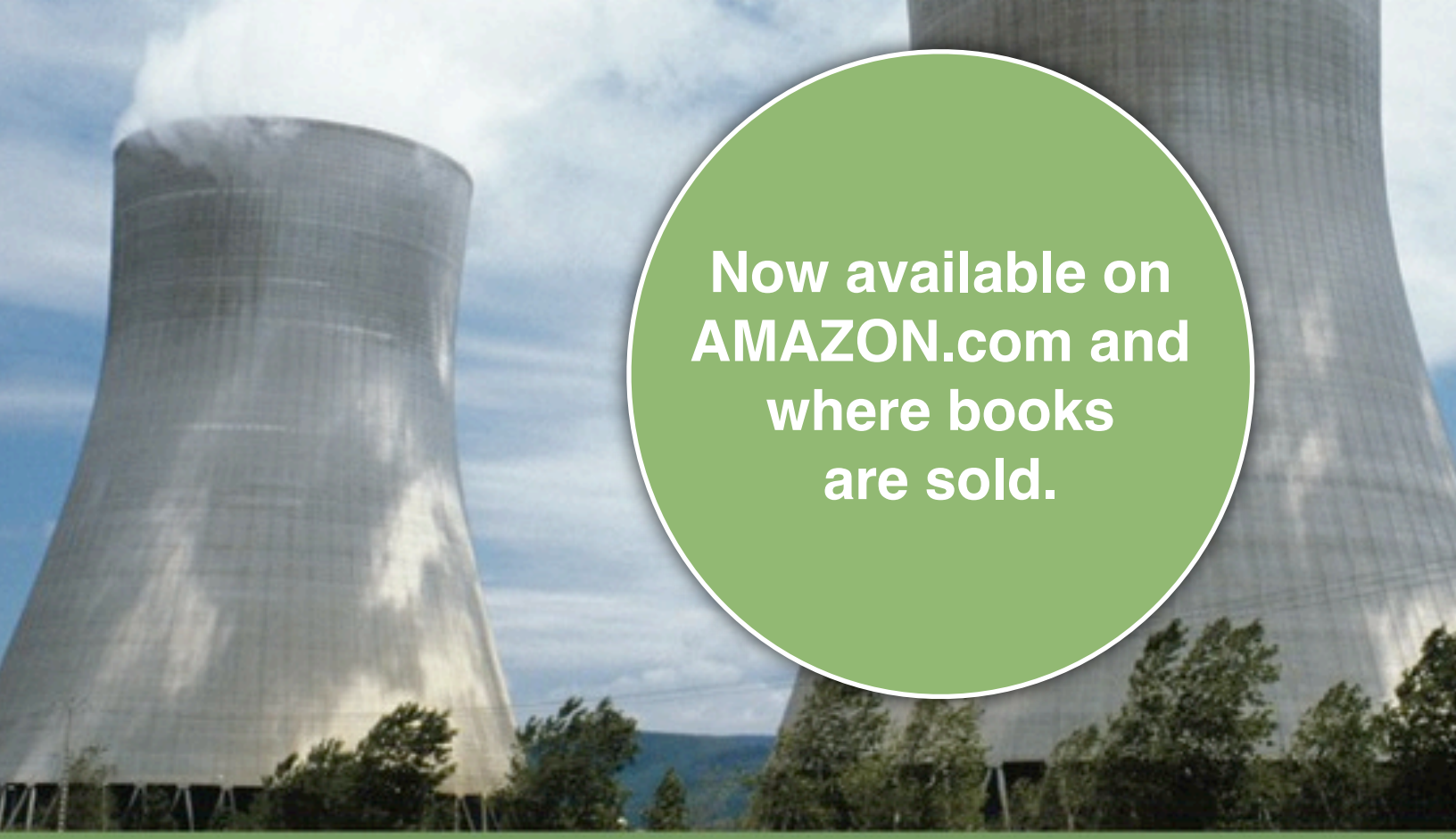
The evening's Master of Ceremonies is **Dr. John Holdren**, the Director of the White House Office of Science and Technology Policy and Science Advisor to the President of the United States.

The FAS Hans Bethe Award reaffirms Dr. Chu's work to improve energy security worldwide.

Dr. Meserve will receive the Richard L Garwin Award for distinguished service and significant contributions to nuclear safety as Chairman of the Nuclear Regulatory Commission, and for more than 30 years of leadership in science policy.



To learn about Sponsorship Opportunities contact Monica Amarelo at mamarelo@fas.org or 202-454-4680.



Now available on AMAZON.com and where books are sold.

NUCLEAR ENERGY

WHAT EVERYONE NEEDS TO KNOW

CHARLES D. FERGUSON