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Closing the Gaps: Securing Highly Enriched Uranium

The following article is a reprint of the executive summary from the new report written by Robert L. Civiak and sponsored by the FAS Strategic Security Project. Complete copies of the report can be obtained by contacting Jaime Yassif at (202)454-4688 or visiting the FAS website at http://www.fas.org/ssp/docs/020500-heu/index.html.

This report presents three proposals to expand existing programs for reducing foreign stockpiles of high-enriched uranium (HEU), the material of choice for terrorists seeking nuclear weapons. Under the first proposal, the United States government would pay Russia to double the current rate at which it transforms HEU that has been removed from nuclear weapons, into low-enriched uranium (LEU), which is too dilute for weapons use. The additional LEU would be stored in Russia and eventually sold for use as nuclear power plant fuel under an existing agreement, which this proposal would build upon. Under the second proposal, the United States would expand its efforts and incentives for nuclear institutes in Russia to reduce — or preferably eliminate their use and stocks of HEU. The HEU would

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Radically Improving How We Learn: Seizing the Opportunity

By Kay Howell

Americans understand well the importance of education and training to our country's future, both in terms of personal and economic success, as well as national security.

We care deeply about education and training, so much so that we invest nearly a trillion dollars a year in it, nearly one sixth of the nation's GDP. Parents, students, and businesses – whose economic success depends largely on a well-trained, highly-skilled workforce – consistently list the quality and effectiveness of the educational enterprise among their top concerns. There is a strong consensus that a dramatic improvement in learning outcomes is needed. While the U.S. educational enterprise is among the best in the world, the variances in results and access are far too great. The median results are too low and the bottom end of the performance curve is also much too low. [1]

Much Debate, Little Vision

There is considerable debate about how to fix this problem, but remarkably little vision. We constrain ourselves by failing to "think outside of the box," specifically in this case, by failing to engage our imaginations to think beyond today's model of a classroom with thirty students and a teacher lecturing at the front of the classroom. Thanks to recent advances in learning science and information technology, we have the opportunity to completely re-think how we teach and learn. We have the chance to provide education with the richest tool set in history; tools that in the hands of well-educated teachers and trainers have the potential to make learning more meaningful, more engaging, more effective, and more accessible. However, this potential cannot be harnessed without significant, sustained basic and applied research in

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About FAS

The Federation of American Scientists (FAS), founded October 31, 1945 as the Federation of Atomic Scientists by Manhattan Project scientists, works to ensure that advances in science are used to build a secure, rewarding, environmentally sustainable future for all people by conducting research and advocacy on science public policy issues. Current weapons nonproliferation issues range from nuclear disarmament to biological and chemical weapons control to monitoring conventional arms sales; related issues include drug policy and space policy. FAS also promotes learning technologies and limits on government secrecy. FAS is a tax-exempt, tax-deductible 501(c)3 organization.

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learning science and technology. Current R&D funding levels are grossly inadequate and existing R&D efforts are fragmented and often discontinuous. We lack an established community of researchers, industrial participants, educators, and educational institutions from which we can mobilize teams that span technology and learning to develop, evaluate, and distribute innovative learning tools.

FAS is working aggressively to increase awareness of the potential for new learning environments and to promote and stimulate R&D investments. Our Learning Technologies program is focused on strengthening the community of scholars interested in education technologies R&D. The program's activities include collecting, analyzing, and disseminating information on worldwide R&D in learning technology. FAS serves as the Executive Secretary for the Learning Federation, which is being formed as a private/public research consortium for learning science and technology to fill the enormous void in national research. The Learning Federation will focus on R&D to facilitate the creation of new learning environments for post-secondary education in science, technology, engineering, and mathematics, although the research results and tools developed will have wider implications and be useful for all age groups and all subject areas. FAS will provide administrative leadership, increase the Learning Federation membership, and develop a technical research roadmap and management plan for the Learning Federation research fund. We are also meeting with and briefing public policy makers on the importance of learning science and information technology R&D in order to solicit their support for this important area of research.

Re-Thinking How We Teach and Learn

Almost every enterprise in America has been transformed by the use of technology over the past twenty years. Why is it that we still teach and learn in much the same way as we did at the turn of the century? Leon Lederman, Nobel Laureate in Physics, observed that "A visitor from 1900 would feel totally out of place in our greatly changed world, except in one environment. In our classrooms we are still teaching in ways designed in the nineteenth century." If you ask the question, "Why do we teach the way we do?" the answer would probably be that we didn't know there were other options. This no longer needs to be true. With what we now know about cognition, and with advances in information technology, we need not be constrained to a model of a 30-student classroom with a teacher lecturing. Learning science research tells us that tutoring produces significant improvements in knowledge and skills. Throughout history, work requiring highly specialized skills has been taught in one-on-one learning situations. Two hundred years ago apprenticeships were used. Today, surgeons, pilots, even student drivers are taught using one-on-one tutoring methods. We justify the time and cost of one-on-one tutoring for these "learners" because the tasks they are to perform require great skill, and because lives could be lost if the individual doesn't successfully master the needed skills. However, the high cost of one-on-one tutoring makes it unaffordable for most learning situations. Our goal should be to use new methods and technologies to achieve similar results to those of one-on-one tutoring at a reasonable cost. Information technology, used both within classroom settings with well-educated and motivated teachers and individuals, has the potential to do this.

A Vision for The Future

Current use of computers in learning provides us with a limited glimpse of the potential of technology-enabled education, but current uses fail to exploit the potential of emerging technologies. The best is yet to come.

One of the most significant opportunities provided by emerging information technologies is that these technologies may make it practical to adopt approaches to learning that theorists have advocated for many years — shifting from learning to know, to learning to do. With "just-in-case" education, students learn a comprehensive curriculum without an emphasis on how or when this information is to be used. With "just-in-time" learning, students focus on a topic when the knowledge is directly related to a problem they've encountered. Inquiry-based (also known as project-based) learning centers instruction on "authentic tasks" that allow students to model adult professional skills and behaviors.

Powerful computer simulations can allow participants to navigate through the interior of a cell, gain experience operating or repairing complex or expensive equipment, practice surgical procedures, or practice marketing techniques. Highly visual, interactive systems allow learners to

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Utilizing Information Technology to Prepare the Nation's Responders to Chemical, Biological, Radiological, and Nuclear Events

By Van Blackwood

Recent events have demonstrated that the US must be prepared to respond to a wide range of threats – including attacks utilizing chemical, biological, radiological, or nuclear (CBRN) weapons. While the US goal is to prevent such attacks through diplomacy, deterrence, intelligence efforts, and other means, preparing military and civilian medical and emergency personnel to respond effectively to incidents involving these weapons is an essential part of a balanced response to these new threats. Unfortunately, many of our emergency and medical personnel do not have the training that would allow them to respond to a CBRN attack in a way that would limit casualties.

Providing this training presents a number of challenges, including:

1) A large number of people must be trained;

2) Complex new material must be mastered;

3) New information is being generated constantly; and

4) Few, if any, of the people will have had any direct personal experience with injuries or illnesses caused by these new kinds of weapons.

This article briefly outlines a national approach for using advanced information technology to address these challenges.

Large numbers of people must be trained and their skills updated continuously. We must also be able to provide rapid training updates to large numbers of people in the event of an actual emergency. The number of individuals needing some level of CBRN response training in the US is staggering. Individuals that can be characterized as emergency response personnel include more than 1 million firefighters in the US including approximately 750,000 volunteers, more than 800,000 full-time employees in local police departments and sheriffs' offices, more than 150,000 nationally registered emergency medical technicians (EMTs), and approximately 60,000 army medics. Medical personnel include the roughly 700,000 physicians and 2.7 million nurses in the US. Each of these groups will need varying levels of training and expertise in different aspects of responding to CBRN events.

The threat of CBRN weapons is current, so a national program should provide training material that can be delivered to large numbers of providers in the next year (therefore material must be compatible with hardware already in place). A first step should be to identify and convert the best existing traditional training material into readily available online resources, but this iniative should be framed in the context of a plan that will take advantage of simulation-based training and other innovations as they become available. A successful program will necessitate bringing together groups with different areas of expertise to perform the following require activities:

- Content and curriculum development
- Training material certification
- Robust delivery network development and maintenance
- Advanced training technology research and development.

Content and Curriculum

It is essential that the emergency and medical responder communities identify appropriate curriculum and identify where current training material is incomplete. These groups should also develop the pedagogy for using current and future instructional tools. Another requirement will be to propose and help develop multi-dimensional measures of competence (such as: written tests, performance in a simulation, and performance in live exercises) that focus on the assessment of cognitive and psychomotor skills for the target audience.

Certification

Course materials, course curricula, and assessment tools must be peer-reviewed and certified to ensure their appropriateness and technical accuracy. Fortunately there are existing bodies for certifying training material for the target audiences such as the National Registry for EMTs. These groups are accustomed to certifying more traditional training material, such as textbooks and training manuals, but have the expertise to evaluate online training material and advance training tools such as virtual reality simulators.

Robust Delivery Network

A robust, scaleable, and secure communication network is needed to store and deliver the varied training material required for the different target audiences. The network must be compatible with any new emergency service communication systems and serves health care and emergency responder facilities with a wide range of infrastructure (extending from 56K dialup to broadband). The network must provide a technical infrastructure for peer-review/certification, bug reporting and response process, and a means for protecting intellectual property rights.

Advanced Training Technology

The pressing need for improved CBRN response training dictates utilizing existing technology to deliver online text (low bandwidth), images (medium bandwidth), and video (broadband) with perhaps the ability for email-based Q&A with experts. However advances in communication technology, if coupled with increased national support for learning technology research and development, could permit:

- Collaborative, discovery-based learning
- Intelligent tutoring/user modeling assistance to instructors
- Simulation-based instruction (such as immersive training environments, digital human)
- Linking of learners nationwide to teachers, counselors, and subject matter experts.

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Such advances would greatly improve the readiness of the nation's medical and emergency response personnel.

The Way Forward

Resources are likely to be available to improve training for responders to CDNR events. The President's Fiscal Year 2003 budget asked for more than $6.8 billion to improve the nation's security against bioterrorism attacks alone (including $665 million to the Federal Emergency Management Agency to train state and local first responders). However, without a national plan, much of this money and other resources could be divided into many disjointed efforts without solving the actual problem. An interagency steering group is needed to avoid redundancy and leverage the strengths of the various federal agencies. The steering group would:

- Define the overall mission and requirements
- Review existing materials and ongoing programs
- Assign roles and responsibilities to agencies
- Provide for coordinated issuance and review of requests for proposals
- Develop and enforce interoperability, quality control, and other standards
- Provide regular reporting to Congress and the public.

The Department of Defense (DoD) has a comparative advantage in leading such an interagency group. The DoD has experience building and maintaining secure communications networks. The DoD also has expertise in developing and utilizing online and simulation-based training tools. Additionally, the military has its own network of medics, doctors, nurses, police, and firefighters who need to be trained to respond to CBRN attacks (an army study conducted in 2000 showed that only 16% of 347 medics examined passed a cognitive test on how to treat nuclear, biological, and chemical casualties[1]). These responders would provide a test audience for training material as it is developed. ***PIR***

Notes:

1 *Chemical and Biological Defense: DoD Needs to Clarify Expectations for Medical Readiness*, General Accounting Office (GAO-02-38, October 2001)

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grasp complex concepts quickly and retain this understanding in ways that transfer rapidly to practical problems. New communication tools can enable learners to collaborate in complex projects and ask for help from instructors and experts from around the world. The systems can be built to adapt to differences in student interests and backgrounds, learning styles and aptitudes. Technology-enabled educational systems can provide a much richer set of tests and measures of a student's grasp of information and ability to use this knowledge to solve practical problems. Systems can continuously measure a student's grasp of concepts being learned, the learning style which the student finds most comfortable, and student motivation and interest. Using this information, the system can then adapt instruction and build a sophisticated record of expertise.

Achieving the Vision

Given the importance of education and training, and our seemingly universal agreement that significant improvements are needed, it is difficult to understand why we invest so little in research and development aimed at improving how we teach and learn. R&D in K-12 education is funded at only 0.03 percent of total K-12 expenditures ($100 million out of $300 billion expended).[2] We invest approximately $10-20 billion annually on computers, internet connections, and other information technology hardware for education, but less than $100 million to study how to unleash the potential of this hardware or to examine whether it has any beneficial affect. The success of information and training technology can only be established with development, use, and evaluation.

One of the greatest R&D challenges is the development of the software tools and systems which would enable the routine use of highly-interactive learning environments and facilitate development of education and training content. Currently, it is not unusual to spend 100-200 hours developing one hour's worth of interactive materials, and simulations are even more difficult and costly. We need a wide range of tools that perform well and predictably; that can be easily adapted to learning contexts and learners' needs; and that are interoperable, extensible, scalable, and maintainable over time. Developing these software tools and systems will be like other software development efforts: it is difficult, labor intensive, expensive, and subject to errors.

To support the development of these software tools and systems, new research management mechanisms that support systematic engineering approaches are needed. The education technology community is still working in a cottage industry mode. Typically a single person or a very small group attempts to build most tools from scratch – including simulation tools, systems for tracking students, systems for answering questions, etc. These efforts are disconnected, sporadic, custom-built, and largely unevaluated. This is how software design began in all areas, but most other sectors of the U.S. economy have moved to more advanced models of software development.

Seizing the Opportunity

Enabling the types of new learning environments we envision will require significant effort. It will require building a community of researchers that spans technology, cognition and learning, and education. A wide range of well-performing, maintainable, and extensible software tools and systems need to be developed, evaluated, and disseminated. To make progress, we need to agree on the critical research challenges, articulate a research plan that outlines an R&D chronology and establishes metrics for success, to grow and mobilize teams to perform the R&D, and establish effective methods for evaluation of successes and failures. Increased funding for learning science and technology R&D is needed, as well as new management mechanisms to support large-scale, sustained efforts to complement the small grant proposals currently supported. The breadth and scale of the needed research effort and the necessity for learning technology, innovation, and diffusion requires unprecedented cooperation and partnerships among government, industry, foundations, universities, and schools.

There is a great deal of work to do. But the opportunity to make learning more productive and more engaging for all people is simply too important for us to ignore. It is difficult to imagine any innovation that would have a greater impact on prosperity, or offer a more practical chance to ensure that the benefits of a technologically sophisticated society are broadly shared. ***PIR***

Notes:

1 Report to President Bush, "Using Information Technology to Transform the Way We Learn", President's Information Technology Advisory Committee, February 2001.

2 Report to President Bush, "Using Information Technology to Transform the Way We Learn", President's Information Technology Advisory Committee, February 2001.

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be consolidated with larger stockpiles at other facilities and possibly be blended to LEU. Under the third proposal, the United States would provide more help to institutions in Russia and elsewhere, that depend upon research reactors for their work, to replace their HEU fuel with high-density LEU fuel.

Implementation of these three proposals would significantly reduce the risk that terrorists or other groups might divert HEU for use in nuclear weapons. All three are low cost options that could be started and would produce results quickly.

Russia and other nations of the Former Soviet Union (FSU) present a serious risk that a nuclear weapon or nuclear material could be diverted for malevolent purposes. The economic and political collapse of the Soviet Union created a formidable challenge to keeping its nuclear weapons and materials under adequate control. Individuals and groups have attempted to steal uranium or plutonium from sites in the FSU dozens of times during the past ten years, and in several incidents, a kilogram or more of weapons-usable material has been stolen or lost. In January 2001, a bipartisan task force chaired by former Senate majority leader, Howard Baker, and former White House counsel, Lloyd Cutler concluded:

> The most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons-usable material in Russia could be stolen, sold to terrorists or hostile nation states, and used against American troops abroad or citizens at home.

There have been no confirmed reports of successful thefts of a complete nuclear weapon or sufficient nuclear material to make one. However, given the inadequate Soviet-era record keeping for nuclear material stocks, there is no way to know for sure that significant diversions have not already occurred. If they have not, without prompt action, it may only be a matter of time before they do.

Nuclear materials present a greater opportunity for terrorists than intact nuclear weapons, because their security is generally poorer. Soviet nuclear weapons have all been consolidated in Russia and are guarded by highly trained professional security forces. Nuclear weapons are relatively large, heavy objects that are not easily stolen. They come in discrete units that are easily counted. Contrary to the numerous thefts of nuclear materials, there are no known cases of theft or attempted theft of actual nuclear weapons.

Implementation of these three proposals would significantly reduce the risk that terrorists or other groups might divert HEU for use in nuclear weapons.

HEU is of particular concern, because it is the material of choice for terrorists. Even though it takes at least three times as much HEU as plutonium to make a nuclear weapon, HEU can be used in rudimentary nuclear weapon designs, for which plutonium cannot be used. HEU is less radioactive and therefore less dangerous to handle than plutonium, making it easier for terrorists to transport, store, and fashion into a weapon. In addition, there is six times as much HEU as plutonium in Russia, and it is located at many more sites.

Three Proposals for Expanding Efforts to Reduce HEU Stockpiles in Russia

In 1993, the United States agreed to purchase Low-Enriched Uranium (LEU) derived from 500 metric tons of HEU from dismantled Russian nuclear weapons. This agreement, commonly referred to as "the HEU deal", has proven to be one of the most successful of all US-Russian nonproliferation programs. Since 1993, about 140 metric tons of Russian weapons-origin HEU has been blended into LEU. This "blending" process involves mixing HEU with other forms of uranium in order to convert it to LEU. The benefit of this conversion is that LEU, unlike HEU, does not constitute a proliferation threat.

However, the implementation of the HEU deal is limited by the rate at which LEU can be sold without disrupting the international market for nuclear fuel. Under the current schedule, the full 500 tons of HEU will not be eliminated until 2013. Furthermore, if all Russian nuclear weapons scheduled for retirement are dismantled, there will be hundreds of tons of additional excess HEU in storage. Finally, a significant portion of Russia's HEU does not come from nuclear weapons and so is not covered under the HEU deal. This material is located at storage, research, nuclear fuel processing, and other facilities that generally have less security than storage sites for nuclear weapons and weapons-origin material.

We propose the following:

Proposal 1: *Rapid Blend-Down of All Excess Russian Weapons-Origin HEU*

We recommend that the Administration seek to expand the existing HEU agreement with Russia based on the following elements.

• **Speed up HEU conversion.** The United States will pay Russia its costs, plus a modest incentive payment, to blend an additional 30 metric tons per year of HEU from nuclear weapons to 19.9-percent enriched LEU using natural uranium as a blendstock.

• **Make sure the LEU does not disrupt the international market.** The 19.9-percent enriched LEU will remain in Russia, without further blend-down, until at least 500 metric tons of HEU have been blended into LEU under the terms of the existing HEU agreement.

• **Arrange Future LEU Transactions.** The United States will agree to purchase, and Russia will agree to sell, the LEU once it has gone through an addi-

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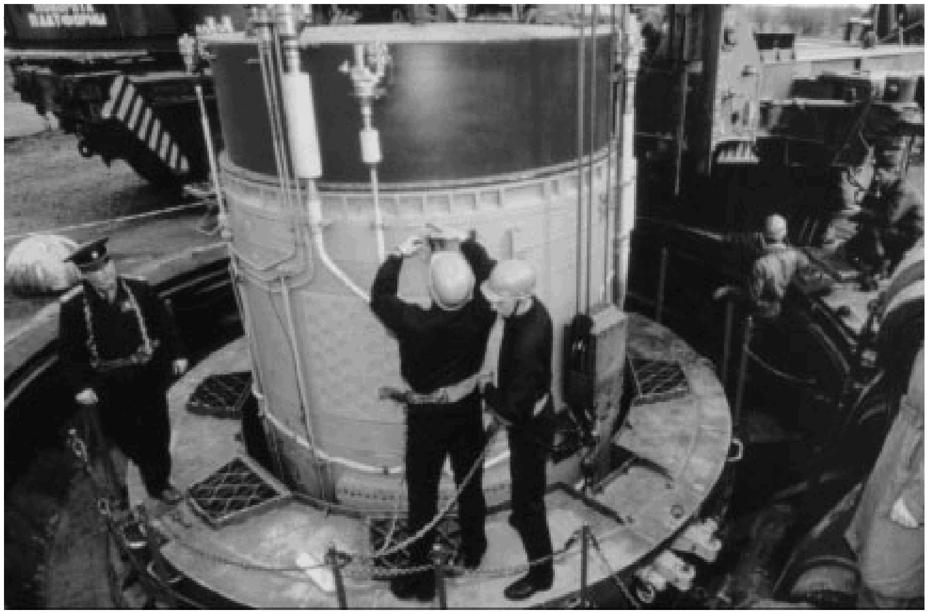

A Russian army officer oversees ICBM dismantlement at a Pervomaysk, Ukraine missile base (1995).

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tional downblending step from 19.9-percent enriched LEU to fuel grade material. The pricing for this arrangement will be worked out separately from the framework agreement, as is done under the current HEU deal.

This proposal would double the current rate of blend-down of excess weapons-origin HEU. Such an increase would be straightforward and could be accomplished for about $40-60 million per year to cover the cost of the blending and of providing the incentives for Russia to carry it out. The financial incentives and other benefits of the proposed expanded blend-down may be sufficient for Russia to increase its total HEU downblending goals by 200-to-300 metric tons. Such an expansion of the existing HEU deal would be a significant achievement, and even greater reductions might be possible. However, larger reductions in Russia's HEU holdings would eventually impinge upon the size of its nuclear weapons stockpile or on HEU reserves that it plans to hold for potential use in nuclear weapons. As HEU reductions approach the limit of excess Russian HEU, the Russian government is unlikely to continue to down-blend its holdings without a reciprocal agreement from the United States. The US must address the issue of reciprocity if it wants to obtain the security and arms control benefits of deeper reductions in Russian HEU stockpiles.

Proposal 2: *Remove HEU Stockpiles from Smaller, Less Secure Facilities*

We recommend a number of measures to enhance the US Department of Energy's (DOE) efforts to encourage Russia to consolidate broadly distributed, poorly secured HEU into a few well-guarded facilities. The security of HEU would be significantly enhanced if it were removed from smaller, less secure, civilian facilities in the FSU, with a focus on the facilities that present the greatest risk of nuclear materials diversion.

Under the existing HEU deal, Russia must derive the LEU it sells to the United States from nuclear weapons. There is no question that downblending and selling this material improves its security and provides a long-term benefit for arms control. Nevertheless, stockpiles of HEU in small research facilities, with fewer resources for security, pose a greater immediate risk of diversion and should be given an even higher priority for elimination. According to the Department of Energy's 2003 budget request to Congress, "civilian sites contain approximately 35 tons of the most vulnerable, proliferation concern material. These facilities are located in densely populated areas throughout the Russian Federation and the Newly Independent States and are considered to be the most likely target for proliferants seeking weapon useable material through either abrupt theft or protracted diversion."

In 1999, the DOE and the Russian Ministry for Atomic Energy (Minatom) established the Materials Consolidation and Conversion (MCC) Project to reduce the complexity and the costs of securing Russian HEU. The approach of the MCC Project is to move HEU from smaller facilities to two large Minatom facilities with downblending capabilities, blend the HEU to 19.9-percent LEU, and store it at those facilities. The Department of Energy pays the blending facilities a fee for each kilogram of 19.9-percent LEU they produce. Unfortunately, DOE has little say in determining where the HEU to be downblended comes from - that decision is ultimately left to the Russian blending facilities. As a result, the most vulnerable facilities do not necessarily get targeted first.

The take home message is that DOE must take a more active role than the current MCC project allows for, specifically in setting priorities to work with the facilities most vulnerable to theft and in site-by-site planning to remove HEU stockpiles from those facilities. DOE should tailor specific packages of assistance to individual institutes in Russia and other nations of the FSU to provide the appropriate incentives for the removal of their HEU stockpiles. DOE should offer larger payments and additional incentives to sites that completely eliminate their HEU stockpiles.

We recommend that the Department of Energy:

- **Prepare a comprehensive list** of facilities in Russia and other states of the FSU that may be candidates for HEU reductions or removal
- **Assign an American project manager** for each facility
- **Target facilities that are the highest priority** to the US for HEU reduction and elimination
- **Designate a senior official** to negotiate tailored packages of incentives on a site-by-site basis
- **Provide an appropriate incentive** for Russia to take back spent HEU fuel from research reactors outside of Russia

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Most of our recommendations are for policy changes that would cost little to implement. However, we also recommend that annual funding for DOE's Materials Consolidation and Conversion project be twice the Administration's 2003 request of $27 million. The additional funds, if maintained for three years, would be sufficient to remove all HEU from high priority facilities within that time.

Proposal 3: *Replace HEU Fuel in Soviet-Built Research and Test Reactors with LEU Fuel*

In the third proposal, we recommend expanding existing efforts to help organizations with Soviet-designed research reactors replace HEU fuel with high-density LEU fuel. Thus, research institutes can continue to operate the nuclear reactors crucial to their work while eliminating a potential source of nuclear weapons materials.

Russia has approximately forty operational, research reactors and critical assemblies with HEU cores. There are also three such reactors in former Soviet republics and several others in operation elsewhere. Unused or slightly used fuel cores at these facilities represent attractive targets to terrorists or nations seeking to obtain HEU for nuclear weapons. Spent HEU fuel is less attractive, however, because it is radioactive and, therefore, dangerous to handle. Nevertheless, weapons-useable uranium can still be extracted from spent research reactor fuel, especially after it has had many years to cool. These uranium stocks can be eliminated as targets for proliferants if the reactors are converted from HEU fuel to non-weapons useable LEU fuel —or shut down if they are no longer needed— and if all HEU-based fresh and spent fuels at those sites are moved to larger, more secure facilities within Russia.

A US-funded program in Russia and a Argonne National Laboratories is currently developing high-density LEU fuels that are similar to HEU in their performance capabilities but can be used without the security threat that HEU poses. Under this proposal, the United States would accelerate the research program and facilitate the transition of research reactors to LEU fuel.

We recommend expanding efforts to replace HEU fuel in Soviet-built research and test reactors with LEU fuel. This will require:

- **Increasing support** for research programs to develop higher density LEU fuels
- **Providing funds for at least the initial LEU fuel cores** as an incentive for reactor operators to convert
- **Making payments to Russia** to take back Soviet-supplied spent fuel and unused fresh fuel from other countries

An increase over current appropriations of less than $20 million per year, for the next few years, could be sufficient to fund the conversion of all but one or two of the highest power Soviet-built, HEU-fueled reactors and the return of all HEU fuels to Russia by 2010.

Implementation of all three of these proposals would significantly reduce the risk that terrorists or other groups would divert HEU for use in nuclear weapons. All three cost relatively little, and none of them pose insurmountable policy challenges that would obstruct their implementation. They are the low hanging fruit. They can be picked now while other efforts continue to address some of the more challenging long-term problems. We estimate that adopting all of our proposals would cost about $100 million per year for the first three years and $50-90 million for another five to ten years, depending on how much weapons-origin HEU is eventually downblended under the first proposal. *PIR*

Dirty Bombs Contd.

By Michael Levi & Henry Kelly

We have received several questions about our analysis of the dirty bomb threat published in the March/April *PIR*, and trust that the following addresses most of them.

•What were the technical parameters for your simulations?
The Cs-137 source in example one was 2 curies (Ci); the Co-60 source in example two was 10,000 Ci; and the Am-241 source in example three was 10 Ci. We assumed light winds of 2 mph, and complete dispersal of the materials. For the Am-241 case, we assume an inhalable fraction of 20%.

•Why didn't you challenge the linear no-threshold assumption?
We were asked to estimate the areas that would need to be decontaminated under existing EPA and NRC standards. These guidelines, developed through standard agency procedures, use the linear no-threshold assumption. Clearly, there has been some controversy over the agencies' decisions, but our analysis was not designed to reopen debate on this issue. We did point out that there may be a need to rethink EPA safety guidelines in the event of a radiological attack. *PIR*

FAS Staff News

After twelve years with FAS, **Dorothy Preslar** is leaving to start her own organization, ILIAAD. While with the Federation, Dorothy served as the director of the Animal Health, Emerging Animal Diseases (AHEAD) Project. Her work raised public awareness of the threat that zoonotic disease agents present, and helped encourage innovations in both the management and prevention of these diseases worldwide.

Her research on biological weapons has also been greatly appreciated. It played a critical role in highlighting the threat presented by potential use of animal pathogens in bio-terrorism, and it has helped focus research support and policy attention. Recently Dorothy's research activities have concentrated on Africa, and we are pleased to learn that she will be continuing this important work which has yielded great public health benefits. We wish her well.

FAS is also bidding farewell to its long-time organization manager, **Karen Kelley**. The FAS staff thanks Karen for all her dedication and hard work in this role and as the editor of the *PIR*. In bidding her farewell, we also extend congratulations on her recent marriage and wish her the best of luck in her new endeavors.

Sarah Mason has become FAS' new organization manager. She has recently completed her bachelor's degree at Hamilton College, NY, where her coursework focused on anthropology and political science. She is enthusiastic about her relocation to the nation's capital and joining the FAS team.

Michelle Lucey-Roper, formerly an intern with the Arms Sales Monitoring Project, has assumed the role of special projects co-ordinator and editor of the *PIR*. Prior to joining the Federation, she earned a doctorate at Oxford University and worked for the Congressional Research Service at the Library of Congress. *PIR*

Senate Acts on Nuclear Materials Security

by Jaime Yassif

On June 26, the Senate passed an amendment to the Defense Authorization Bill, authorizing $100 million to nuclear and radiological materials security, implementing many of the recommendations made recently by FAS researchers in studies of radiological weapons and of highly-enriched uranium. Originally introduced as the *Nuclear Nonproliferation Act of 2002*, the proposed legislation passed as an amendment to the Defense Authorization Bill with Senators Domenici and Biden as the principle cosponsors. They were joined in their bipartisan sponsorship of the bill by Senators Lugar, Landrieu, Hagel, Carnahan, Murkowski, Bingaman and Mikulski. The new provisions still must survive conference with the House.

The largest portion of the authorized funds, $40 million, will go toward the accelerated blend-down of Russian highly enriched uranium (HEU) to below twenty percent U-235. The funds can be used to establish new blending facilities, to build centralized secure storage facilities in Russia, and to offer incentives to smaller, less secure facilities to agree to the removal of all their HEU. Incentives can also be offered to other countries in the region—particularly those that cannot afford to provide adequate security—to relinquish their HEU and decommission facilities. In the case of HEU-fueled research reactors, the US can offer assistance in the conversion to proliferation-resistant low-enriched uranium (LEU) fuel.

The amendment also authorizes $15 million for a program on research and technology to reduce the likelihood of nuclear and radiological terrorism, and to mitigate the effects should an incident occur. The goal of this program is to develop technologies for detection, identification, and control of nuclear and radioactive materials as well as for their disposition. The advances made and the knowledge gained under this program will be incorporated into emergency response programs, and will be used to assist other countries in developing a regulatory framework for their nuclear and radiological materials, improving security, and establishing safe means of disposal.

Under the Domenici-Biden amendment, the Materials Protection Control and Accounting (MPC&A) program will be expanded to include countries outside the Russian Federation and the Former Soviet Union. The amendment also establishes the Radiological Dispersal Device Protection Control and Accounting (RDDPC&A) program, which will be tasked with identifying vulnerable radioactive materials worldwide, enhancing their security, and recovering orphaned sources. Five million dollars are designated for these purposes.

The amendment authorizes a total of $35 million for strengthened international safeguards for safety of nuclear materials and nuclear operations. Of this sum, $10 million is designated for the development of "proliferation resistant nuclear technologies" in cooperation with the Russian Ministry of Atomic Energy. These funds will partly go toward the development of high density LEU fuels and feasibility studies for reactor conversion. Fifteen of the $35 million is slated for assistance to the International Atomic Energy Association in strengthening international nuclear safety and security, and $5 million for the protection of nuclear power plants from sabotage by hostile insiders or aircraft impact.

The remaining $5 million is designated for the strengthening of export control programs, particularly in the Former Soviet Union, South Asia, the Middle East, and the Far East. The DOE is authorized to provide assistance to other nations in enhancing their control over the export of materials, technologies and expertise that could be used in the construction of a radiological dispersal device or a nuclear weapon. ***PIR***

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In our continuing effort to provide FAS members with lively and timely articles in national security policy and other areas of science and technology policy, we are inviting members to submit proposals for articles in areas of interest to FAS members (maximum 1000 words). Selection of the articles is at the discretion of the Editor. Completed articles will be peer reviewed.

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1717 K Street NW, Suite 209, Washington, D.C. 20036
(202) 546-3300; fas@fas.org
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