

JNMM

Journal of Nuclear Materials Management

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Topical Papers

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Welcome to the 47th INMM Annual Meeting

By Cathy D. Key
INMM President



47th INMM Annual Meeting —
July 16-20, 2006

As you are reading this message the Institute should be well into our 47th Annual Meeting. The summer issue is always published immediately before our annual meeting, and we distribute copies to our attendees. This year's annual meeting may, in fact, break all records for attendance and presentations. We definitely have broken all records this year with our student participation and presentations. I would like to thank the students for their ever-growing interest in the INMM and I would like to thank everyone in the nuclear materials management profession that is supporting and/or mentoring our students.

This annual meeting marks the last for me serving as INMM president. My role as president ends September 30. On October 1, I will begin serving my two-year term as past president. I have thoroughly enjoyed working in this position. It is very fulfilling volunteering my services to this professional organization, as the importance of our profession works to assure our safety throughout the world. I would like to thank everyone for their support and look forward to our organization's continued growth.

Proposal — Best Practices for Safeguarding Nuclear Materials

The Institute continues to work on the proposal defined by the Fellows Committee on "Best Practices." The INMM WINS Steering Committee (SC) of Fellows has been identified and confirmed by the Fellows Committee chair. The new SC has U.S. and international representatives, who provide broad international perspective and support. The initial core Coordinating Committee (CC) members consist of three points of contact for the INMM SC, NTI, and the

U.S. Department of Energy's National Nuclear Security Administration. Their work is just beginning.

The INMM Executive Committee has directed the Fellows to expand communication of the WINS proposal and planning process to include the full INMM membership. There were multiple communication opportunities at the INMM 2006 Annual Meeting in Nashville. There is a growing consensus that while the original WINS focus may be concentrated on physical protection and MC&A, that all six nuclear material management technical areas and divisions of INMM have a role to play in the international goal of preventing nuclear terrorism. Division chairs were asked to have WINS on their Annual Meeting Division meeting agendas. WINS was also on the INMM Business Meeting agenda. There are expected to be growing opportunities for WINS volunteers.

Executive Committee Update

Our Executive Committee continues to thrive. Members-at-Large Chris Pickett and Tom Shea will end their two-year terms this year. Their service continues through this annual meeting and they join our two continuing Members-at-Large Susan Pepper and Steve Ortiz along with Vice President Nancy Jo Nicholas, Secretary Vince DeVito, Treasurer Bob Curl, Immediate Past President John Matter and myself on the 2006 INMM Executive Committee. At the beginning of October 1, 2006, our newly elected members at large will begin a two-year term. These results along with the election results for the other executive committee positions will have been announced at the Annual Meeting Business Meeting.

Student Activities Committee

As was reported last year, we created a new

INMM Student Activities Committee (SAC). SAC Chair Mark Leek and his committee continue to push forward with student involvement in our Institute. Last year we obtained our first student chapter, Texas A & M University. Texas A & M continues to thrive and we are truly proud of their high spirits and involvement. This year we are on the brink of approving our second student chapter, Mercyhurst College in Pennsylvania. We fully anticipate this chapter will be approved by the time of our annual meeting. Also, this year we have a record number of student attendees and presenters at our annual meeting. We are truly moving forward at a fast pace with our student involvement. As everyone remembers, our goal for heightened student involvement is to assure they can contribute to our worldwide nuclear materials management task force.

The INMM Web Site

The INMM Web site, www.inmm.org continues to grow. I urge everyone to log onto the Web site on a regular basis to stay up to date on activities. We have obtained funding from loyal supporters to begin archiving past issues of the Journal onto the Web site as a library reference. Watch the Web site for this to occur. A lot of hard work has already been completed to make this happen. We will have the wealth of knowledge and experience that these past Journals bring as this task is accomplished. Remember, use the INMM Web site to your benefit and send the Internet address to all personnel you think should be viewing this Web site. If you have suggestions for our Web site, send us an e-mail to inmm@inmm.org. We welcome your input.

INMM President Cathy D. Key may be reached by e-mail at cathykey@key-co.com.



Notes on the Past and the Future

By Dennis Mangan



I would like to address an exciting effort for our *Journal*. Thanks to the efforts of Ron Cherry and his colleagues of the U.S. Department of Energy's National Nuclear Security Administration, the INMM has been funded to archive on our Web site past articles that have appeared in the *JNMM* and its predecessors. This is not a small effort, but certainly one that will benefit our Institute enormously. We have copies of most of the past journal articles (maybe 90 percent) and as we execute this archiving project, we definitely will ask for help in getting copies of those issues that we are missing.

It's impressive. Mark Leek recently (last year) accepted the responsibility of being chair of INMM's Student Activities Committee and he is certainly moving out. The papers in this issue are a result of Leek's efforts and connections. Last fall Leek asked me if it would be possible to dedicate an issue of the *JNMM* to education efforts in nonproliferation and national security. With my positive response he solicited eight papers that discuss this effort in various universities (internationally) and international organizations. The basic theme is education efforts in nonproliferation and national security with a sprinkle of arms control and international security. I believe as you read these articles, several general consensus thoughts will emerge. Number one is the need for such education. Number two is the common topics included in the various education programs, independent of their origin. And third is the enthusiasm both from the teachers and the students. It is interesting reading...and important for part of our INMM technical mission space.

Leek is also in the process of establishing a yearly award for the INMM chapter that supports the most students to

the Annual Meeting. The details are not yet resolved (the devil is in the details) but the exact means of deciding the winner should be established in time for the 2007 annual meeting. Leek is to be commended for his efforts as chair of our Student Activities Committee, and should you see him, please express your gratitude.

On a personal note, recent article in the *Albuquerque Journal* newspaper (published in Albuquerque, New Mexico, USA) noted that the engineering department of the University of New Mexico was essentially resurrecting its nuclear engineering graduate degree program and attracting many students. I find this exciting for several reasons. Firstly, it reflects a resurgence in the nuclear industry, which is sorely needed, and secondly, it may indicate a possibility that the University of New Mexico could again have a nuclear engineering department, as it did several years ago when I received my doctorate, but subsequently closed because of a lack of students.

Workshop on Best Practices

We have another aggressive member of our Institute — Chris Pickett of Oak Ridge National Laboratory. Pickett is not only one of our Executive Committee members-at-large, but he is also the General Chairperson of an *International Workshop on Best Practices for Material Hold-Up Monitoring* to be held at the Oak Ridge National Laboratory in Oak Ridge, TN, USA, October 29-November 3, 2006. This workshop is consistent with INMM's efforts to identify best practices to further responsible nuclear material management, and is consistent with some of the Institute's response to the challenge given to the INMM by Charles Curtis, president of the Nuclear Threat Initiative, at last year's annual

meeting plenary session. Details of the INMM response are forthcoming and various presentations are scheduled during this year's annual meeting. I've been honored in having been part of developing the response, and find it an exciting part of our future history. It's something to which you should pay attention.

One Last Note

Here's a trivia question for this issue: What is the oldest public university in the United States?

As always, I would appreciate any comments.

JNMM Technical Editor Dennis Mangan may be reached by e-mail at dennismangan@comcast.net.



In Memoriam

It is with remiss that I omitted from my column in the last issue of the *Journal* that Fred Tingey passed away on November 20, 2005. Fred had a long and distinguished career. After completing his Ph.D. in Mathematical Statistics in 1951 from the University of Washington, Fred joined the nuclear industry and became a world class statistician who had an outstanding capability for innovation in the application of statistics to nuclear materials management. Fred was a Fellow of the INMM, received the INMM Distinguished Service Award in 1991, and was a Professor Emeritus of the University of Idaho.



Special Issue on University Nonproliferation Education and Training Introduction

K. Mark Leek

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Nonproliferation, like many aspects of security, has not played out as many expected following the end of the Cold War. The peace dividend has been elusive in many countries. The notion that the world would become a safer and more secure place as nuclear weapons stockpiles were reduced has been trumped by the rise in international terrorism. Hopes that nuclear weapons would lose their salience as markers of elite status among nations along with pressures to acquire them have been dashed.

The drive by some countries and terrorist groups to acquire nuclear weapons has not diminished, and the threat of proliferation has increased. At the level of the nation state, the Nonproliferation Treaty (NPT) itself is under pressure as more nations acquire nuclear weapons, *de facto* weapons states fail to join, and nations that want to acquire them leave or threaten to leave. At the sub-state level, the convergence of terrorism and weapons of mass destruction (WMD) has introduced an element of uncertainty into nonproliferation that is unprecedented.

Another feature of the post-Cold War era that has taken many by surprise is the continued and growing need for trained specialists in nonproliferation and nuclear materials management. Contained within the notion of disarmament and reduced strategic importance of nuclear weapons was the expectation of a diminishing workforce of trained nonproliferation and nuclear materials specialists. Events have overtaken this assumption.

The response among industrialized nations to this deficit of trained specialists has been growing. In the United States, a programmatic distinction is made between academic nonproliferation education and nuclear materials workforce training. Workforce training is the prerogative of the Department of Energy, Nuclear Regulatory Commission, and private industry. Pertaining to the Department of Energy, the goal of workforce training is to develop and retrain staff employed throughout the Department of Energy's some thirty-eight sites. This training occurs at the National Training Center (NTC) in Albuquerque, New Mexico, which offers more than 130 courses in areas of information security, materials control and accountability, personnel security, program and planning management, and protection program operations. Many courses are accredited and may be applied to a college degree. Through collaboration with NTC, universities may incorporate training courses into their curricula.

University-based nonproliferation education in the United

States is only of recent vintage. According to a 2002 national study of undergraduate WMD-related education conducted by the Center for Nonproliferation Studies, Monterey Institute of International Studies (MIIS), there are few U.S. university curricula in the field of nonproliferation, even after the shock of 9/11. The study found that ten undergraduate programs offer more than one course on WMD. Though the study was performed four years ago, it continues to capture the basic state of university nonproliferation education in the United States.

In the United States, virtually all colleges and universities offer a general curriculum in international relations, typically within departments of political science. A subset of universities offers a specialized curriculum in diplomacy and/or security studies. These schools are often affiliated with the Association of Professional Schools of International Affairs (twenty-nine worldwide; twenty in the United States) and also include the mid-career military service schools (Army War College, Air War College, National Defense University, and Naval War College). While these specialized curricula in diplomacy and/or security studies usually include a larger number of WMD courses relative to other programs, they focus more on national security strategy or military strategy and foreign policy.

A select set of universities offer courses or programs that specialize in WMD nonproliferation. These may be divided into three broad categories: the Monterey Institute of International Studies, which is in a class of its own with a robust stand-alone nonproliferation program; private schools, and public schools, the latter typically land grant colleges. Among the more prominent private school programs are the International Studies Program at MIT; the International Security Program at Harvard; the Center for International Security and Cooperation at Stanford, and Georgetown University's Walsh School of Foreign Service. Among the more prominent public school programs with a nonproliferation policy focus are the Center for International Trade and Security at the University of Georgia and the Institute for Global and Regional Security Studies at the University of Washington (UW). Among those with a more technical nonproliferation focus, are the Nuclear Nonproliferation and International Security Program at Texas A&M (TAMU), and the Nuclear Science and Engineering Institute at the University of Missouri, Columbia. Of these programs, three offer a certificate



or degree in nonproliferation studies. The Center for Nonproliferation Studies at MIIS and Nuclear Science and Engineering Institute at the University of Missouri, Columbia, each offer certificates; the Nuclear Nonproliferation and International Security Program at Texas A&M offers a master's of science in nonproliferation studies.

The U.S. programs featured in this special edition of the *Journal* on nonproliferation education and training all fall within the public school category, along with two specialized international programs offered by the Monterey Institute and the Open World Leadership Center. The three U.S. programs are each remarkable in its own way. The Center for International Trade and Security is a policy-oriented program with a focus on leadership and professional training. The Institute for Global and Regional Security Studies (IGRSS) at the UW and the Nuclear Nonproliferation and International Security Program at TAMU are both closely affiliated with a national laboratory, the Pacific Northwest National Laboratory, and Los Alamos National Laboratory, respectively. IGRSS is a policy oriented program with four nonproliferation courses offered through the Jackson School of International Studies. The program at TAMU is technically oriented with four nonproliferation courses offered through the Nuclear Engineering Department.

Two new programs are directed at some of the special challenges and needs associated with nonproliferation education. The Center for Nonproliferation Studies at MIIS is pioneering a new program directed at training those who teach nonproliferation. This is a direct approach to addressing the gap in nonproliferation education on an international basis. The Open World Nonproliferation Visitors Program brings young Russian professionals, many from closed cities, to the United States to learn about the U.S. approach to nonproliferation. They are introduced to the several elements of the U.S. nonproliferation sector, including university education.

Three non-U.S. nonproliferation education and training programs are featured in this special edition. All three programs are at the forefront of nonproliferation education and training efforts in their respective countries and regions. Two are technical in orientation, while a third has a policy focus.

The technically oriented programs are in Japan and the European Union. In Japan, the University of Tokyo and the Japan Atomic Energy Agency are collaborating in a new program to build human capacity in technical and policy areas of nuclear nonproliferation. In the European Union, the European Safeguards Research and Development Association (ESARDA), is developing a new European curriculum to raise awareness and train the younger generation about the problems and methodologies associated with nuclear safeguards and nonproliferation.

The Program on Arms Control and Regional Security (PACRS) at Fudan University in China has a policy focus. PACRS is China's preeminent program in nonproliferation and security studies. It conducts research and offers graduate-level

courses in areas of international security, regional security, nonproliferation and international security, science and technology of national security, U.S. defense policy, EU common security policy, contemporary America, and China and the world.

In considering university-based nonproliferation education programs, there are some interesting questions about the factors and conditions that are conducive to their development. Among them:

- It doesn't appear that nonproliferation education programs are constituency driven. That is, university administrators do not appear to take the lead in developing them in response to pressures from outside constituencies or some larger perception of the public mandate. In this regard, to what extent does the development of a non-proliferation education program depend on the emergence of a faculty champion?
- What role do associations with institutions outside of the university play in the development of nonproliferation education programs? How central, for instance, is an association, collaboration or partnership with a national laboratory?
- How should one think about or approach the roles of policy and technology in building a program? Should technical programs incorporate a policy dimension, or is policy something that is learned on-the-job and in practice? Must policy-oriented programs include a technical component to be considered credible?
- Should universities be doing more to build programs in what is arguably an increasingly vital element of security?
- Is further study needed to assess the state of nonproliferation and nuclear materials management education in the United States and globally? If so, who are the appropriate entities to organize such an assessment?
- Should professional organizations like INMM play a role in the development of university-based nonproliferation curricula?

Finally, what can be said about the study of nonproliferation itself? In practice, the global nonproliferation system is based on cooperation of the International Organizations, the United States, the Russian Federation, the EU states, Japan, China, and other nuclear-capable states. The teaching of nonproliferation requires concepts of how states, alliances, and international agencies address the relationships linking national security, nuclear technology, energy issues and international politics at the state and sub-state levels.

Critical issues for study include the global distribution of nuclear weapons arsenals and delivery systems at the levels of states and alliances; the overlapping systems of global and regional treaties limiting nuclear weapons proliferation; the development of national scientific-technological-economic capabilities to produce fissile materials; corresponding national capabilities for civilian nuclear power facilities; development of measurement and accounting systems for nuclear materials management; research on new methods/equipment for detection of nuclear and



radiological materials; and safeguard systems aimed at preventing nuclear terrorism by non-state actors.

This is an exciting and important issue of the *JNMM*. It highlights many of the global nonproliferation education programs in one edition. Information about these programs can raise their visibility, and thereby contribute to the development of future nonproliferation education programs

K. Mark Leek, of the Pacific Northwest Center for Global Security and Pacific Northwest National Laboratory, is the chair of the INMM Student Activities Committee, and is co-director of the Institute for Global and Regional Security Studies, University of Washington.

Nuclear Nonproliferation and International Security Master of Science Degree at TAMU

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Abstract

Texas A&M University (TAMU) has been developing nonproliferation and nuclear security educational courses for the past several years. These have included both fundamentals in nuclear engineering and nuclear science as well as topical courses on nonproliferation issues and international security policy. TAMU teaches a senior-level undergraduate nuclear engineering course titled "Nuclear Nonproliferation" as well as graduate-level courses such as "Technical Issues in Nuclear Nonproliferation and Arms Control," "Policy Issues in Nuclear Nonproliferation and Arms Control," "Radiation Detection and Nuclear Material Measurements," and "Critical Analysis of Nuclear Security Data." Recently TAMU has endeavored to construct a master of science degree plan that links these courses and provides a structured technical degree focused on nuclear nonproliferation and international security. This program had its genesis from collaborations and discussions with Los Alamos National Laboratory, the U.S. Department of Energy's Office of Defense Nuclear Nonproliferation, and two key Russian universities (the Moscow Engineering Physics Institute and the Obninsk State Technical Institute for Nuclear Power Engineering). It is envisioned that this degree program will provide the next generation of students focused on the nonproliferation arena and generate key personnel for laboratories and governments institutions alike.

Introduction

The spread of weapons of mass destruction (WMD), and specifically nuclear weapons, threatens the peace among nations and deteriorates the safety and security of all mankind. In the past century, we were witness to the greatest spread in weaponry designed specifically for the mass extermination of human life than at any other time in history. Mankind now possesses the capability to facilitate its own extinction through the unchecked use of these weapons. In addition, a situation now exists unlike any other in history in which an unsophisticated nation or rogue group can threaten the very existence of a superpower through the unconventional use of these weapons. It is therefore in the general interests of mankind and the specific interests of the United States government to detect, prevent, and reverse the proliferation of WMD materials, technology, and expertise and control existing arms stockpiles. To achieve this goal, policy and decision-makers

must be supported by state-of-the-art science and technology.

The development and application of these nuclear security sciences is occurring primarily at national laboratories around the world. A small number of universities study political and social science aspects of this field, but there is a marked deficit in university organizations that focus on the technical details of nuclear security sciences while at the same time understanding the policy implication of new technologies.

Traditionally, universities have educated students in a general field that establishes the foundation of knowledge needed in some portion of the nuclear security science profession, but little effort has been spent producing education and training with a direct focus on this important field. Recently there has been a shift in the role of academia toward a more focused education and changes in curricula related to nuclear security sciences is in many ways leading this shift.

Texas A&M University (TAMU) has been spearheading several programs related to security sciences including course development throughout TAMU and the U.S. Department of Energy (DOE) complex, a certificate program in homeland security offered by the TAMU George Bush School of Government and Public Service, and a master of science degree specialization in nuclear nonproliferation and international security. TAMU has also been working closely in collaboration with two premier Russian universities (the Moscow Engineering Physics Institute and the Obninsk Institute for Nuclear Power Engineering) on developing master's degree programs in nuclear nonproliferation in Russia.

TAMU faculty initiated the generation of a master of science degree program specifically designed to educate nuclear engineering graduate students in the field of international nuclear security. This is a technical degree that teaches nuclear engineering disciplines with a focus on nuclear nonproliferation. This degree program was initiated by faculty at TAMU and built upon several existing courses.

History of Nonproliferation and International Security Education at TAMU

TAMU faculty and students have been active in the research fields of nuclear nonproliferation, nuclear material safeguards, and international security for many years. Activities have included scientific and engineering research projects with Los Alamos,



Sandia, Oak Ridge, and Pacific Northwest national laboratories. Faculty have been involved in research related to proliferation-resistant nuclear fuel designs, proliferation-resistance assessments for fuel cycles, nuclear material safeguards development and analysis, development of portal monitors for detecting the illicit trafficking of nuclear materials, modeling of nuclear smuggling routes, post-event nuclear material attribution, compilation of reactor data for international safeguards and safety purposes, developing methodologies for verifying the history of plutonium production reactors both pre- and post-decommissioning, generating techniques for the identification of covert nuclear weapons programs, and studying nuclear terrorism pathways.

TAMU teaches some of the only U.S. engineering courses dedicated to addressing the technical aspects of nuclear nonproliferation. TAMU also offers a number of courses that provide the fundamental technical basis for work in the fields of nuclear nonproliferation, arms control, and safeguards. TAMU faculty have taught summer courses and short courses throughout the DOE complex in these areas.

In the spring 2004, summer 2004, and spring 2005 semesters, TAMU taught a graduate-level technical course titled “Nuclear Nonproliferation and Arms Control,” which gives an overview of policy and technical issues associated with nuclear security science. In the summer 2005 and spring 2006 semesters, TAMU taught a graduate-level technical course titled “Critical Analysis of Nuclear Security Data.” In the spring 2006 semester, TAMU taught an undergraduate topics course titled “Nuclear Nonproliferation.” In spring 2006, TAMU taught a graduate-level policy-based course titled “WMD Response and Recovery.” In the fall 2004 and fall 2005, TAMU taught a graduate-level course on nuclear radiation detection that has since been reorganized into a nuclear materials measurement course. These and other efforts at TAMU have established a strong background in nonproliferation education and led to the interests in building a dedicated degree program focusing on this important discipline.

Curriculum Description

This degree program is intended to develop new understanding in the area of global nuclear security through research and creativity with a solid technical focus. Students completing this degree will be the next generation of leaders in the fight to detect, prevent, and reverse the proliferation of nuclear and radiological weapons. The degree program is designed as a one- to two-year program. This degree program consists of nine formal courses. Of these formal courses, seven are required courses and two courses must be selected from a set of possible electives. Also, the students are required to attend a one-credit-hour seminar in nuclear nonproliferation. As a part of earning the master of science degree, the students will also complete research of fundamental interest to the field and write a corresponding thesis detailing their research. The outline of the master of science in nonproliferation and interna-

Table I. MS-NIS Degree Curriculum

	Course Designation and Title	Credit Hours
Fall Year 1	NUEN 650 Nuclear Nonproliferation and Arms Control	3
	NUEN 601 Nuclear Reactor Theory	3
	NUEN 605 Radiation Detection and Nuclear Materials Measurement	3
	NUEN 681 Seminar in Nuclear Nonproliferation	1
	NUEN 685 Independent Study	2
Spring Year 1	NUEN 604 Nuclear Radiation Shielding	3
	NUEN 606 Nuclear Reactor Analysis and Experimentation	4
	NUEN 651 Nuclear Fuel Cycles and Nuclear Material Safeguards	3
	NUEN 691 Research	2
Fall Year 2	NUEN 656 Critical Analysis of Nuclear Security Data	4
	Technical Elective	3
	Technical Elective	3
	NUEN 691 Research	2

tional security (MS-NIS) is shown in Table I.

The set of elective courses is still under development; however, it is envisioned that the students will choose from the following possible sets of courses:

- WMD Terrorism and Combating Nuclear Smuggling
- Methods for Nuclear Noncompliance Verification
- Peaceful Uses of Nuclear Energy
- The Nonproliferation Regime and Arms Control Treaties

These courses are intended to give the student’s education a particular focus on several issues of interest to the field and provide some diversity for the student’s degree program.

Brief Course Descriptions

This section provides a brief description of the required courses involved in this degree program, a general overview of the details to these courses, and how the overall degree program provides education of the next generation of experts in this field. The design of this program was intended to build upon the general fundamentals of a nuclear engineering master of science degree. Thus many of the courses are fundamental nuclear engineering courses that would exist to some degree at nearly any nuclear engineering program.



Nuclear Nonproliferation and Arms Control

This course gives a basic overview of topics learned in the degree program and introduces the student to the political and technological issues associated with nuclear nonproliferation. Topical areas will be discussed in brief detail and then expanded upon in other courses. Topics will include the history of arms control, descriptions and effects of weapons of mass destruction, the fundamental technology of nuclear weapons required by the proliferator, details of various arms control treaties and efforts, proliferation pathways in the nuclear fuel cycle, international and domestic safeguards, proliferation resistance in the nuclear fuel cycle, nonproliferation strategies, treaty verification regimes, safeguards measurement techniques for material accountancy programs, containment and surveillance, and physical protection mechanisms.

Nuclear Reactor Theory

This course discusses fundamental nuclear reactor theory. The course focus is on calculations of nuclear reactor material production, reactor criticality, and reactor neutron fluxes. The student will learn the physics of nuclear systems including neutron-nucleus interactions; neutron energy spectra; transport and diffusion theory; multigroup approximation; criticality calculations; cross-section processing; buildup and depletion calculations; and modern reactor analysis methods and codes.

Nuclear Radiation Shielding

The basic principles of radiation interactions and transport, especially as related to the design of radiation shields are studied in this course. Radiation sources, nuclear reactions, radiant transport, photon interaction, dosimetry, buildup factors, and fast neutron shielding are covered in detail and students are expected to develop a complete understanding of these topics.

Nuclear Fuel Cycles and Nuclear Material Safeguards

Descriptions of the civilian and military nuclear fuel cycles are given including the physics of the fundamental components of the fuel cycle (including enrichment, fuel fabrication, reactors, and reprocessing). The student learns methods for analyzing these cycles. Topics include the nuclear fuel resources, mining, and metallurgy; enrichment and conversion; reactor fuel design and fabrication; in-core fuel management; reprocessing and recycling; fuel cycle economics and analysis; heavy water and tritium production; and high-level waste management. The course also details the fundamentals of nuclear material safeguards. This includes material protection, control, and accounting practices and the International Atomic Energy Agency (IAEA) system of safeguards. The course also covers statistics applied to safeguards; the additional protocol; strengthened and integrated safeguards; environmental sampling; remote monitoring; application of nondestructive assay and destructive assay to safeguards; and the application of measurement techniques to reactors, fuel fabrication facilities, reprocessing plants, enrichment plants, and critical assemblies.

Detection of Radiation and Nuclear Materials

This course begins with the fundamentals of radiation emission and detection. The focus is on neutron and gamma-ray radiation detection including the use of gas-filled detectors, scintillation detectors, and semi-conductor detectors. Topics include gamma-ray interactions with matter; gamma-ray detectors, gamma-ray spectroscopy, and passive gamma-ray detection; measurement of uranium enrichment; measurement of plutonium isotopic compositions; neutron interactions with matter; neutron detectors; total neutron counting; neutron coincidence counting; active neutron interrogation; irradiated fuel measurements; perimeter radiation monitors; calorimetry; and holdup measurements.

Critical Analysis of Nuclear Security Data

This is a project-based course that studies the analysis of nuclear security events, threats, and data. Students are each assigned a project that requires an analysis of data for a hypothetical case of interest to national security. The course focuses on detailed technical analysis using diverse datasets and country/organization profiles. These datasets may include overhead imagery; mass and gamma-ray spectroscopy from air, biota, soil, and water samples; press reports; watchdog group reports; historical details; seismic data; ultrasound data; nondestructive radiation measurements of materials; destructive analysis of materials; export control information; and safeguards accounting data. The students are divided into small teams and develop their analysis of their case over the semester by learning how these analyses are performed in professional environments. The students present their results on several occasions throughout the semester and the audience will serve as the "Red Team" for the analysis. Quantitative and qualitative analysis are developed. The following techniques are discussed and used where applicable: critical success factors, competitor profiling, SWOT analysis, and gap analysis. Also included are presentations on recognizing the interaction between the collection and analysis phases, methods to analyze creatively, how to employ inductive and deductive reasoning in analysis, how to recognize gaps and blind-spots and ways to determine to cease analysis. This course serves as the capstone course for the degree program.

Conclusions

The master of science degree program specializing in nuclear nonproliferation and international security has been described and the general history leading to the building of this degree was given. The general philosophy of this program is based on the concept that nuclear nonproliferation is an engineering problem that includes a multi-disciplinary component. This engineering problem however is simply one of the fundamental pillars of nuclear engineering (in the opinion of the author the other pillars are fission engineering, fusion engineering, and health physics). Development of this program in the future will continue including



modifications based on feedback from the primary customers for this program: the national laboratories, government agencies, and the IAEA.

Acknowledgements

Numerous individuals have aided in the development of this program and it would be impossible to mention them all here due to space limitations; however, we must thank the faculty of the Nuclear Engineering Department at TAMU especially Jean

Ragusa, Warren (Pete) Miller, Lee Peddicord, David Boyle, and Pavel V. Tsvetkov. Also, we must thank our collaborators from the George Bush School of Government and Public Service including Charles Hermann, Joseph Cerami, Larry Napper, and Sam Kirkpatrick. Lastly, we must thank the many members of N-division at Los Alamos National Laboratory who aided greatly in the development of the courses for this program. We would specifically like to acknowledge the efforts of Sara Scott, Jim Doyle, and Paula Knepper.

Nonproliferation Education at the University of Washington

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The nonproliferation curriculum at the University of Washington (UW) is the product of collaboration between Pacific Northwest Center for Global Security (PNWCGS) at the Pacific Northwest National Laboratory (PNNL) and the Jackson School of International Studies (JSIS) and the Department of Political Science at the University of Washington. This collaboration began in 2001 with the establishment of the Institute for Global and Regional Security Studies (IGRSS). IGRSS is housed in the Jackson School, which will celebrate its centennial in 2008 as a center for the study of world regions. PNNL also engages in a number of collaborative relationships with UW units in the natural and applied sciences.

The principal goal of IGRSS has been to develop courses that draw graduate and undergraduate students into careers in the field of nonproliferation. Since offering its first courses in 2002, IGRSS has assisted a substantial number of UW graduate students in submitting successful applications for nonproliferation positions in U.S. government agencies, including the Nonproliferation Graduate Program at the National Nuclear Security Administration. Since 2001, several UW undergraduates have begun careers in the field of nonproliferation, either by working at national laboratories or enrolling in non-UW graduate programs.

The UW brought to its nonproliferation partnership with PNNL long-established programs in a wide range of professional programs and academic disciplines, including the fourteen interdisciplinary regional and topical programs of the Jackson School of International Studies (JSIS). The JSIS is an interdisciplinary and interdepartmental enterprise that brings together faculty and students from across the UW. Since the late 1940s the UW has trained experts for the nation's foreign policy community in programs focused in the languages, cultures, and histories of regions deemed critical to U.S. national security. However, since the termination of its program in nuclear engineering several decades ago, the UW has not supported hard science faculty positions that require knowledge of the theoretical and practical dimensions of the nonproliferation of nuclear technologies.

Among U.S. national laboratories, PNNL has special strengths in technologies critical to the implementation of arms control treaties and to the detection of activities associated with the production, deployment, and dismantlement of weapons of mass destruction (WMD). PNNL plays a central role in the management of U.S.-Russian programs for protection of fissile materials. In 2000, the PNWCGS initiated outreach to universi-

ties and NGOs. The Pacific Northwest Center for Global Security and the Jackson School have sought to bring PNNL expertise to the UW campus and the PNWCGS currently funds several IGRSS course instructors. The PNWCGS has arranged for Russian scientists to teach an experimental course in the IGRSS curriculum. In partnership with the Pacific Northwest Center for Global Security, IGRSS is presently seeking to engage scholars and scientists from other countries in joint teaching programs with the UW.

IGRSS permits students to combine their disciplinary and professional specialties with the interdisciplinary and international IGRSS curriculum and its specialized courses on nonproliferation and WMD threats. IGRSS now offers three core courses and several occasional courses on special topics related to WMD issues. The core courses will serve as the requirements for a planned graduate certificate and undergraduate minor. The three core courses are discussed below:

"Arms Control and International Law" is taught by Ambassador Thomas Graham, Jr., and Professor Christopher Jones, co-director of IGRSS. First offered in 2002, the course examines arms control treaties and related international agreements as instruments of national security strategy for the United States and other countries. It also examines international responses to the threat of nuclear terrorism. Enrollment ranges from fifty to sixty students per year.

Graham, a former general counsel and former acting-director of the Arms Control and Disarmament Agency, has been involved at the principals' level with every major arms control negotiation from 1970 until his retirement from government in 1997, as special representative of the president of the United States for Arms Control and Nonproliferation. He led the successful U.S. effort for the indefinite renewal in 1995 of the Nuclear Nonproliferation Treaty. He is the author of four studies published by the University of Washington Press, including a 1,500-page annotated compendium of all arms control treaties since 1925, *Cornerstones of Security*. Jones has written on Soviet and NATO Security Policy and has recently published "The Axis of Non-Proliferation," a study of Moscow-Washington cooperation in the March/April issue of *Problems of Post Communism*.

"Weapons of Mass Destruction" is taught by James L. Fuller and K. Mark Leek. First offered in 2004, the course provides students with an understanding of the development and deployment of weapons of mass destruction, along with a practical overview of WMD proliferation detection technology. The course



also addresses the problem of WMD terrorism. Enrollment ranges from twenty-five to thirty-five students per year.

Fuller, a former director of PNNL's Nonproliferation and Arms Control Program, is the author of a number of scientific publications and a developer of advanced laser technologies. In addition, he served as a technical advisor at the U.S. Department of Energy. He established the Pacific Northwest Center for Global Security and was its first director. Leek is a PNNL senior staff scientist who serves as co-director of IGRSS.

"Arms Control Simulation" is taught by Graham and Jones. First offered in 2005, this capstone course offers students a war game simulation of the technical, political, and human factors at play in international negotiations. Graham has had extensive experience in conducting such simulations before developing this course at the UW. Outside experts and visiting professors have played cameo roles, including visiting professors from Russia. Enrollment has ranged from fifteen to twenty-five students. This role-playing course requires students to integrate substantive knowledge acquired in the other core courses. After completing the course, most students report that they have acquired an awareness that "where you stand depends on where you sit."

In addition to the three regularly offered core courses, IGRSS has sponsored or co-sponsored the following courses with other units of the UW:

"Perspectives on the Nuclear Fuel Cycle and Nonproliferation" was taught by Professors Gennady Pshakin and Victor Sosnin of Obninsk State Technical University for Atomic Energy, with administrative participation by Leek and Jones. This course was first offered in 2005 with sponsorship from the UW Ellison Center for Russian, Eastern European, and Central Asian Studies, and is still under development. In this course, visiting Russian physicists examine (in English) the historical interaction between the development of the nuclear fuel cycle and the emergence of international cooperation to prevent nuclear weapons proliferation, with Russia as the principal case study. Pshakin worked for a decade at the International Atomic Energy Agency and twice served as a UN weapons inspector in Iraq. The course uses a translation of Russia's first official textbook on nonproliferation and the nuclear fuel cycle, co-authored by Pshakin and Sosnin. PNNL sponsored the writing and translation of the Pshakin-Sosnin text *Nuclear Nonproliferation*.

Frederick Lorenz, a retired Marine Corps lawyer who previously taught at the National Defense University, offers a rotation of three courses: International Law and Military Intervention, International Humanitarian Law, and Water and Security in the Tigris-Euphrates Basin. Wonmo Dong, former chair of Asian Studies at Southern Methodist University, offers a rotation of two courses: "The Politics of a Divided Korea" and "U.S.-South Korean Security Relations."

IGRSS also offers students a menu of speaker programs and independent research opportunities. These include:

"The Pacific Northwest Colloquium on International

Security," a year-long series (which is also part of the doctoral program in international security at the UW Department of Political Science) is run by Professors Elizabeth Kier and Jon Mercer, both of the UW Department of Political Science.

Reading and research courses are presented under the co-supervision of PNNL staff scientists and UW faculty. This program has involved mainly graduate students but some undergraduates have also participated. For the planned graduate certificate, this will be a requirement (which will overlap with thesis requirements of the primary M.A. or Ph.D. program of a graduate student).

IGRSS has developed a teaching and administrative model of relying on interested UW faculty, PNNL staff, affiliate faculty, and distinguished practitioners. The advantage of this model is bringing to the classroom the perspectives of both the academic world and the world of practitioners. Support from the Center for Global Security has allowed the IGRSS faculty, administrators, and distinguished practitioners to explore together the uncharted territory of nonproliferation education. Graham's prolific record of publication with the University of Washington Press—*Disarmament Sketches: Three Decades of International Law and Arms Control* (2002), *Cornerstones of Security* (2003), *Common Sense on Weapons of Mass Destruction* (2004), and his forthcoming 2006 study of the revolution in intelligence gathering and verification technologies—has developed in part out of his participation in this teaching program.

The relative absence of nonproliferation curricula and curricular materials in U.S. universities suggests a need to achieve a better match between national rhetoric about the importance of nonproliferation and local financial commitments to nonproliferation education in American colleges and universities. The slow response of U.S. universities in developing nonproliferation programs may testify not only to the scarcity of funding but also to the administrative difficulties of bringing together experts in nonproliferation science and technology, academics trained in international law and international studies, and working relationships with foreign experts in countries crucial to global nonproliferation.

The experience of the classroom as a teaching laboratory has led to an informal consensus among IGRSS faculty that nonproliferation can be taught in a manner roughly analogous to that in which American universities have traditionally taught national security and military strategies. Perhaps the discipline of the history of science can also serve as a model for an emerging discipline of nonproliferation. In the eyes of IGRSS instructors, nonproliferation does in fact have a teachable history. This history consists of 1) technological developments in collecting WMD information, verifying treaties, and developing inspection protocols; 2) arms control as a security strategy for nations and alliances, in conjunction with military strategies and military force postures; 3) the development of international law and regional and global agencies for creating and maintaining arms



control regimes; and 4) the evolution of the relationship of civilian nuclear power issues to nonproliferation.

Despite the vast amounts of information available in various published sources, national and international histories of nonproliferation remain relatively few in number. In particular, the transformation of Moscow's policies on arms control and military strategy during the Gorbachev period has yet to be fully examined in terms of the lessons of this experience for the post-Cold War

period. There is no single-volume history of WMD proliferation or nonproliferation during the Cold War period, though there are some outstanding studies of Cold War nuclear strategies. In other words, the field of nonproliferation has unexplored possibilities for research, publishing, and the development of texts and curricula. Such possibilities beg for cooperation across national borders among scholars and technical experts.



Nuclear Nonproliferation Education at the University of Tokyo

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Introduction

Japan has promoted the research, development, and utilization of nuclear energy exclusively for peaceful purposes, while having set the goal of eliminating all nuclear weapons and adhering to the three Non-Nuclear Principles (not possessing, not manufacturing, and not permitting the introduction of nuclear weapons into Japan) as the only country ever bombed with nuclear weapons.

It is the basic policy of Japan to maintain this position in the future. In so doing, one of the most important things is to secure the human resources that can contribute to the sustainable development of nuclear energy.

In the field of nuclear nonproliferation, it is essential to develop human resources that can make an international contribution toward the compatibility of the peaceful use of nuclear energy and nuclear nonproliferation.

With this viewpoint in mind, two organizations were established last year. One is the Department of Nuclear Engineering and Management of the University of Tokyo. The other is Nuclear Nonproliferation Science and Technology Center (NPSTC) of Japan Atomic Energy Agency (JAEA). This article describes the current status of the related activities of the University of Tokyo and the cooperation between the University of Tokyo and NPSTC/JAEA.

Role and Activities at the University of Tokyo

Objectives

The University of Tokyo established the Department of Nuclear Engineering and Management in the Graduate School of Engineering on April 1, 2005. At the same time, nuclear nonproliferation education programs were started in the new department.

There are two primary reasons for the establishment of the new department. One is to secure the next generation of leaders in the research, development, and utilization of nuclear energy in such fields as advanced nuclear energy, advanced accelerators, and medical physics and nuclear socio-engineering, which includes nuclear nonproliferation. The other is to educate experts who intend to contribute to international organizations such as International Atomic Energy Agency (IAEA). Nuclear nonproliferation is a key area that is closely related to each objective.

First, Japan is a non-nuclear weapons state that has a full-

scale nuclear fuel cycle. Nuclear energy programs in Japan have been and will continue to be promoted exclusively for peaceful purpose in such a way as is compatible with international nonproliferation norms and taking into account that Japan is the only country to ever have been struck with an atomic bomb. Second, it is necessary for an education program to be promoted so that more Japanese staff can work in the international organizations such as IAEA in the field of nuclear nonproliferation.

At present, there are few experts in the field of nuclear nonproliferation in Japan. Therefore it is important for Japan to train experts in nuclear nonproliferation who will become familiar with both international policies and nuclear technology. Those are the main reasons why nuclear nonproliferation education is highlighted in the new department.

Faculty and Students

There are five (associate) professors, eleven concurrent (associate) professors, and eight visiting (associate) professors in the department. In the field of nuclear nonproliferation, the faculty consists of one professor and four visiting (associate) professors. In the master's degree course, twenty credits and a master thesis are required for graduation, while the doctorate course requires ten credits and a doctoral thesis for graduation.

As of April 1, 2006, the department had sixty-six students (forty-two in the master's degree course, and twenty-four in the doctorate course). Five of them (one in the master's degree course, and four in the doctorate course) are interested in studying nuclear nonproliferation.

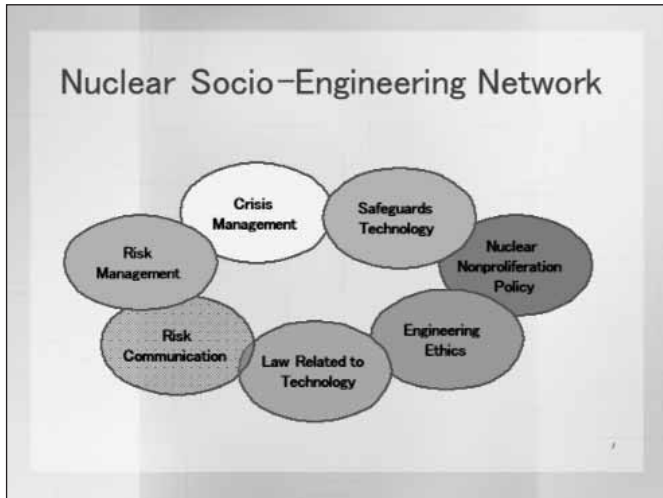
Relations Between Nuclear Nonproliferation and Nuclear Socio-Engineering

Figure 1 shows the network of the nuclear socio-engineering schematically. A leader of nuclear engineers needs a broad range of expertise; he or she needs knowledge of not only technology but also of the ethics or morals of technology, risk communication, and technology law. The knowledge of the relationship between society and technology is also important for the study of nuclear nonproliferation policies and international safeguards. From this viewpoint, nuclear nonproliferation can be regarded as a key element of the nuclear socio-engineering.

Nuclear nonproliferation study is not only carried out inde-

pendently; it also takes into account the interaction among each area of study, such as technology law.

Figure 1. Nuclear socio-engineering network



Courses

Three courses are offered for students who are interested in nuclear nonproliferation.

The first is nuclear technology, which includes such topics as advanced nuclear energy engineering, nuclear fuel cycle engineering, waste management engineering, and radiation and risk. The second course is international relationships and includes topics such as international law and politics, international administration, and negotiation and agreement. This course is provided by the other departments, such as the faculty of law or the graduate school of public policy. The third course is nuclear nonproliferation itself, and it covers topics such as international nuclear nonproliferation, international safeguards, and international cooperation.

Nuclear Nonproliferation Lectures

The international nuclear nonproliferation course offers thirteen lectures in a semester and each lecture is 100 minutes (two credits). They include:

- Chronology and current status of international nuclear nonproliferation
- International laws and regimes related to nuclear nonproliferation
- Export control policy
- U.S. nuclear nonproliferation policy
- Regional issues on nuclear nonproliferation
- Disarmament
- Various concepts of international security, etc.

The international Safeguards course also offer thirteen lectures (two credits), which include:

- Chronology of the international safeguards system
- IAEA safeguards system
- State system on accounting for and control of nuclear material
- Safeguards technologies
- Concrete measures of export control
- Proliferation resistance technologies
- Monitoring system for the Comprehensive Test Ban Treaty
- Physical protection

The International Cooperation course also offers thirteen lectures (two credits), which include:

- Energy policy and nuclear energy programs in main countries and Asian countries
- Frameworks related to the international nuclear cooperation
- International nuclear cooperation in Japan
- International Atomic Energy Agency
- Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD)
- Cooperation on disarmament of former Soviet Union states

Role of the Nuclear Nonproliferation Science and Technology Center of Japan Atomic Energy Agency

The Japan Atomic Energy Agency (JAEA) was established by merging the Japan Atomic Research Institute (JAERI) and the Japan Nuclear Cycle Development Institute (JNC) on October 1, 2005. JAEA is the only governmental nuclear research and development institute in Japan. It engages in research activities ranging from basic research to practical applications in the nuclear field. It operates research laboratories, reactors, a reprocessing plant, and a fuel fabrication plant. At the same time, the Nuclear Nonproliferation Science and Technology Center (NPSTC) was established as part of JAEA to conduct the studies on the strategy for nuclear nonproliferation research.

NPSTC serves five roles:

- Policy study think tank
- Nuclear materials management
- Technological research and development
- Weapon disarmament support
- Human resources development

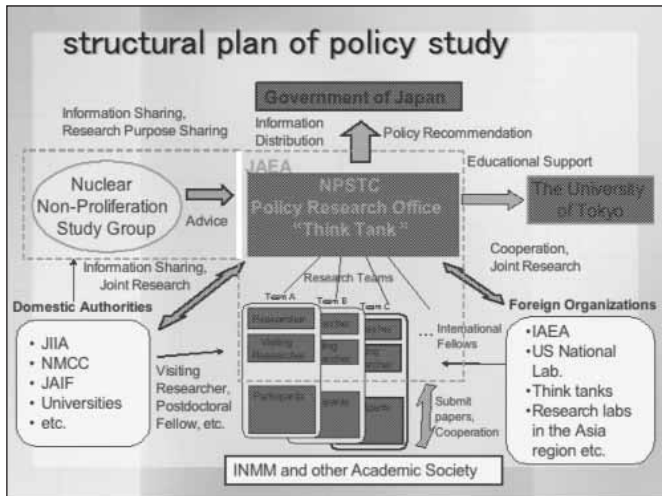
In particular, it is a great challenge for the center to carry out policy studies because such studies had never been a role of JAERI nor JNC. In the policy study area, two theses have been carried out. One is an "Evaluation of Japanese Cooperation to safeguards implementation as one of best practices in terms of openness and transparency." The other is "Transparency of peaceful use of nuclear energy in East Asia."

In order to carry out the center's roles effectively and efficiently using the available resources, the center aims to be a



research hub for nuclear nonproliferation studies. The center also aims to maintain and create “an all-Japan and worldwide partnership network” based on the partnerships that JAERI and JNC had constructed. NPSTC intends to continue to expand nuclear nonproliferation cooperation.

Figure 2. Structural plan of policy study



Cooperation Between the University of Tokyo and JAEA

The Framework for Nuclear Energy Policy was decided by the Japanese Cabinet on October 14, 2005. It highlights the importance of human resources development in the field of nuclear nonproliferation as follows. “It is expected that related organizations, both domestic and foreign, and including universities, will cooperate with each other to develop human resources capable of assuming the responsibilities” of the maintenance and strength-

ening of the Nuclear Nonproliferation Regime. For this purpose, the University of Tokyo and JAEA concluded the cooperation agreement for human resources development.

In accordance with the provision of the agreement, four visiting (associate) professors have been sent from NPSTC/JAEA to the University of Tokyo for nonproliferation education. Internship programs for students have also been carried out in cooperation with JAEA so that the interns are able to learn the actual facility operation and the safeguards measures that are applied in the main facilities of JAEA. Cooperation programs will be strengthened so that students can take part in the nuclear nonproliferation policy study that JAEA carries out, if they wish.

The University of Tokyo intends to expand its education program in order to send Japanese students to foreign institutes or to serve as IAEA interns and to invite lecturers from foreign universities or institutions.

Conclusion

On April 1, 2005, the University of Tokyo established the Department of Nuclear Engineering and Management, where nuclear nonproliferation education programs were incorporated as an important field. Students have been taught not only the nonproliferation objectives and policies but also how to achieve them through the combination of institutional measures and technological measures. Education programs have been carried out in cooperation with the JAEA’s NPSTC. Internship programs have been carried out to supplement and reinforce formal classroom training. It is the challenge of the new department to develop experts and specialists who have knowledge in both policies and technology concerning nonproliferation and are responsible for relevant activities.

Nuclear Safeguards Education for European Nuclear Engineering Students

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Abstract

The knowledge retention problem in the nuclear field was acknowledged by the Organization for Economic Cooperation and Development (OECD) in 2000. ESARDA, the European Safeguards Research and Development Association (<http://www.jrc.ecc.eu.int/esarda/>), reacted to that with a strategy to tackle the problem and created a Working Group on Training and Knowledge Management (ESARDA TKM-WG). The final objective of the ESARDA TKM-WG is the setup of course modules to an internationally recognized reference standard.

This project is in line with the movement of establishing a European curriculum for nuclear engineering. Teaching in the nuclear safeguards field is indeed strongly influenced by national history so the objective of the course is to provide homogeneous material in nuclear safeguards and nonproliferation matters at the European level. The harmonization of a European curriculum is driven by factors of economy and safety. In the nuclear safeguards field in Europe, the harmonization force is the Euratom Treaty that any nuclear facility should observe.

This paper reports on the feedback of the course that was held by some of the leading experts in the field of nuclear safeguards in Europe. Its content deals with the general background of safeguards legislation and treaties, the nuclear fuel cycle, various safeguards techniques, verification technologies and the evolution of safeguards. The audience — forty university students and five young professionals (STUK and JRC) — from twelve different European countries was highly interested and provided positive feedback.

The course has been introduced in the course database of the European Nuclear Education Network on the Web site <http://www.neptuno-cs.de>. Further, recognition as an academic course of three credits under the European Credit Transfer System has been requested to the Belgian Nuclear Higher Education Network. In the future, this course will be repeated on a regular basis and evaluated, aiming to achieve recognition by the European Nuclear Education Network (ENEN). With an ENEN label it will be included in the list of optional courses for a European master's degree in nuclear engineering.

Acknowledgments

The following individuals are members of the ESARDA Working Group on Training and Knowledge Management: G. Janssens-Maenhout, A. Hamilton, T. Jonter, G. Stein, E. Martikka, A. Håkansson, K. van der Meer, B. Autrusson, R. Howsley.

The following individuals were lecturers during the ESARDA Course, March 6-9, 2006: J. Baute, B.A. Burrows, M. Franklin, P. Funk, M. Hunt, J. Joly, C. Jorant, M. Kalinowski, P. Peerani, A.E. Poucet, K. Mayer, P. Schwalbach, L. van Dassen.

Introduction

The situation of the nuclear industry in the last decades of the twentieth century had consequences in the education of nuclear engineers. European universities did no longer register a minimum number of students for a master's degree in nuclear engineering. Also the U.S. National Research Council (1990) reported a strong reduction in nuclear engineering students, an extremely high age of faculty members, and a shutdown of nuclear research facilities at American universities. The Organization for Economic Cooperation and Development (OECD) (2000) expressed its major concern about the diminishing and disappearing nuclear knowledge. The International Atomic Energy Agency (IAEA), the Nuclear Energy Agency of the OECD, the World Nuclear Association of Nuclear Operators, and the World Nuclear Association therefore founded the World Nuclear University with twenty-nine nuclear research centres as institutional participants, organizing a nuclear summer course annually. This international university organization focuses on major academic nuclear disciplines with a non-European dimension. However, it neither copes with the European brain-drain problem nor includes teaching of nuclear safeguards principles. Therefore, first, the European Commission called for a European solution for the nuclear retention problem, which was developed with the European Nuclear Engineering Network. Second, the European Safeguards Research and Development Association (ESARDA) extended its mandate on enhancing the efficiency of nuclear safeguards systems and developing new techniques with an educational role.



The European Nuclear Education Network Association

The European Commission launched an initiative for addressing this knowledge retention problem. This was done under the 5th Framework Program for Research and Technological Development — FP5 (1999-2002). This resulted in setting up the European Nuclear Engineering Network — ENEN. In parallel to this international project some national satellite networks were established, such as the Belgian Nuclear Higher Education Network — BNEN, the Italian Interuniversity Consortium for Research and Technology on Nuclear Energy — CIRTEEN, the UK's Nuclear Technology Education Consortium — NTEC, and the German Education Centrum for Nuclear Technology — TÜV Nord Akademie. According to Van Goethem (2005) the strategy for safeguarding nuclear education and training is based on three pillars: (a) common qualification, (b) mutual recognition, and (c) mobility of scientists and students.

The FP5-project ENEN is followed up on the one hand by the NEPTUNO¹ project under the 6th FP (2003-2006) and on the other hand with a sustainable European Nuclear Education Network Association. The major objective of this association is the reinforcement of the three above mentioned pillars. Activities focused on the work of five specific committees: (i) teaching and academic affairs, (ii) advanced courses and research, (iii) training and industrial projects, (iv) quality assurance and (v) knowledge management. The history and the current organization of this international association are described by Giot (2006).

Since 2003 the European Nuclear Education Network Association provides an educational program for the specialization in the nuclear field. Students are expected to have already an engineering or equivalent university diploma. Moreover, their nationality should be from a country that signed the Nonproliferation Treaty. The complete program is — although also industry-oriented — taught at European universities, profiting from the recognition of the long-established universities, from the fact that only universities can award an academic diploma, and from the pool of professors that are selected and financed by the universities. In 2005, the first four students obtained the master's degree in nuclear engineering. The master's degree takes a minimum of one academic year (sixty ECTS² credits — five courses of six ECTS, five courses of three ECTS, and a thesis of fifteen ECTS) for accomplishing these studies. The student can select these courses out of a large variety offered by twenty-four universities. The database of courses is open for consultation on the Web site <http://www.neptuno-cs.de>. An analysis of the up to 250 courses available leads to the conclusion that a course on nuclear safeguards and/or nuclear nonproliferation is not offered by any university.

ESARDA Strategy for Nuclear Safeguards Education

This shortcoming on education in nuclear safeguards was discussed by ESARDA and a strategy to tackle this problem has been defined by its steering committee in several steps. As published by Brill (2004), ESARDA intends to propose a continuum from the glossary that explains shortly the various concepts and objects used in the nuclear safeguards fields, to a specialised course entirely devoted to teaching nuclear safeguards concepts, methods and techniques. The latter are also addressed with a medium-size document of the so-called technical sheets. Both glossary and technical sheet examples can be found on the ESARDA Web site and the course activity is still ongoing. The course modules initiative was launched in September 2002. Upon positive evaluation of the demand and interest for these course modules, a first task group was officially set up in May 2003 with Messrs. G. Stein, K. Van der Meer, and S. Guardini (replaced by Ms. G. Maenhout in 2004). This group, called the Training and Knowledge Management Working Group – TKM-WG, started preparing the course modules in 2005.

The 2005 Prototype of a Three-Day Nuclear Safeguards Course

Upon request of the students from the Belgian Nuclear Education Network a first nuclear safeguards and nonproliferation course was established by the JRC in collaboration with the SCK-CEN Belgian research centre. The course was held at JRC, Ispra site, March 1-3, 2005. The course was attended by ten university students and eight young professionals, as shown in Figure 1. The feedback of the students and the experience at the JRC and the SCK-CEN was positive. Details on the course can be found in Janssens-Maenhout & Poucet, 2005, and van de Meer et al., 2005. The ENEN students made a report on the total content of the safeguards course and the students from the University of Ghent worked out a study on the illicit trafficking trend and their evolution from before 1990, between 1990 and 2001, and in the post-era.

The First ESARDA Course 2006 on Nuclear Safeguards and Nonproliferation

Content

The first ESARDA course was discussed in content and organization by the ESARDA Training and Knowledge Management Working Group and guaranteed a complete nuclear safeguards overview, presented by the major stakeholders (nuclear industry and regulatory authorities) taking into account the presence of the various nationalities in the EC and including the research and development (with the involvement of the research centres). The final schedule for the four-day course with theoretical lectures, a classroom exercise and some practical visits is given in Figure 1. A



Figure 1. Schedule of the first ESARDA course on Nuclear Safeguards and Nonproliferation in Ispra, March 6-9, 2006

Monday	Tuesday	Wednesday	Thursday visit-scheme is group-dependent
9:00 Introduction (Mr. J. Joly - IRSN)	9:00 Basic principles of safeguards (SSAC, NMAC, NRTA, ...) (Mr. B. Burrows - BNG)	9:00 information collection and analysis (Mr. J. Baute - IAEA)	9:00 visit to PERLA laboratory
10:15 Nuclear Fuel Cycle (Ms. C. Jorant - AREVA)	10:15 accountancy from statistical point of view (Mr. M. Franklin - JRC)	10:15 coffee break	10:00 exit of controlled area
11:30 Coffee break	11:30 coffee break	10:30 Iraq case study (Mr. J. Baute - IAEA)	10:15 visit to TAME laboratory
11:45 Non proliferation aspects of the nuclear fuel cycle (Mr. J. Joly,)	11:45 Monitoring (of C/S, of process, ...) (Mr. P. Funk - IRSN)	11:45 New challenges in security: illicit trafficking (Mr. L. van Dassen - SKI)	11:00 visit to Surveillance labs
13:00 lunch	13:00 lunch	13:00 lunch	12:15 visit to SILAB
14:00 History of Nuclear Safeguards and Non-Proliferation (Mr. T. Jönter, Stockholm Uni)	14:00 Inspections on site (DIV, PIV, ..., "surprises") (Mr. P. Schwalbach - EURATOM ?)	14:30 NDA equipment: neutron /gamma for inspectors (Mr. P. Peerani - JRC)	13:00 lunch
15:15 Coffee break	15:15 Environmental monitoring (Mr. M. Kalinowski - CTBTO Prepcom)	16:00 Coffee break	14:30 Some Proliferation Questions (Ms. G. Maenhout - JRC)
16:30 Overview treaties: NPT, AP, CTBT ... (Mr. A. Poucet - JRC)	16:30 coffee break	16:15 Open discussion topics from journal/newspaper articles/ internet info: questioned	15:15 coffee break
16:45 exercise: how to setup a verification of a certain state (Ms. M. Hunt - IAEA)	16:45 DA & nuclear forensics (Mr. K. Mayer - JRC)	18:00 Closure with wrap-up of safeguards principles	15:30 Closure with feedback exchange
18:00 Proliferation and control: impact for industry (Ms. C. Jorant - AREVA)	18:00 Import/ Export control (Mr. M. Kalinowski - CTBTO Prepcom/ Uni Hamburg)		

Table I. Distribution of students attending the safeguards course in Ispra, March 1-3, 2005

Glasgow University	3
Ghent University	3
European Nuclear Education Network	1
Belgian Nuclear Higher Education Network	3
Joint Research Centre Ispra Nuclear Safeguards Unit	2
Joint Research Centre Ispra Medical Service	1
Joint Research Centre Ispra Radioprotection Unit.	2
Joint Research Centre Ispra Nuclear Decommissioning & Waste Management Unit	2
Joint Research Centre Ispra Consultant	1

more detailed outline of the course is available at http://esarda2.jrc.it/internal_activities/WC-MC/Web-Courses/index.html, the TKM-WG Web site.

The first day aimed to give an overview on the different nuclear safeguards aspects, from a legal point of view and from an industry point of view. Jérôme Joly from IRSN, and current

ESARDA president, introduced the course. Caroline Jorant, AREVA director for nonproliferation and international institutions, addressed the fuel cycle and its nonproliferation aspects. In particular she illustrated how nonproliferation concerns are dealt with within the nuclear industry as a major stakeholder participating in the worldwide effort towards a nonproliferation culture. Thoma Jönter, Stockholm University, described the historical evolution of the safeguards system answering whether a nuclear nonproliferation system exists today in Europe. Andre Poucet, from JRC-IPSC and Katholieke Universiteit Leuven, gave a seminar on arms control treaties (including the Treaty on Nonproliferation of Nuclear Weapons, the Conventions on Biological and Chemical Weapons, the Comprehensive Nuclear Test Ban Treaty, the Conventional Forces in Europe Treaty, the Open Skies Treaty, the Antarctic Treaty, the Treaty of Tlatelolco, the Intermediate Nuclear Forces Treaty, and the Strategic Arms Reduction Treaty) and corresponding verification systems. The first day closed with a classroom exercise by M. Hunt from the IAEA: "How to setup a verification of a certain region?"

The second day focused on the basic principles and logic of nuclear material accountancy and control (NMAC), inspections, monitoring and import/export control. B. A. Burrows from BNFL addressed the material management principles and in particular what is different about nuclear material management, and defined clear components of the NMAC system. This was completed with a statistical point of view, given by Michael Franklin



from JRC-IPSC, on the auditing of nuclear material accountancy. M. Funk from IRSN, addressed the containment and surveillance aspects, while P. Schwalbach reported on DG-TREN-EURATOM on-site inspection strategy. The destructive analysis as carried out in the analytical laboratories to determine accurately in the samples the concentration of isotopes or to identify the presence of some isotopes on some swipes was addressed by K. Mayer from JRC-ITU, with some examples of nuclear forensics. M. Kalinowski from University of Hamburg completed this with details on environmental sampling and with the explanation how to perform import/export control.

The third day of lectures focused on inspectors' tools for collecting and analyzing data (by measuring or by exploring open or other sources). Jacques Baute from the IAEA, clearly indicated the difficulty to collect and analyse the data. He reported on the challenges and lessons learned from nuclear inspections in Iraq during the period 1999 – 2003, based on the experience of his IAEA team in collaboration with the United Nations Monitoring, Verification, and Inspection Commission. To collect independent data, it is necessary to carry out on some samples nondestructive assay (NDA), e.g., by applying neutron counting or gamma spectrometry. The functioning of NDA tools was described by P. Peerani from JRC-IPSC. Finally L. van Dassen from SKI, provided real examples from his collaborations in Russia on nuclear safeguards and illustrated the practical difficulties in the fight against illicit trafficking. The lecture sessions was then closed with the discussion of the exercise results with the different group of students.

The fourth day of the course was organised to give some practical feeling of nuclear safeguards equipment, tools and measurements and included visits to four JRC laboratories: (1) the Performance Laboratory (PERLA) with an extensive collection of well-characterised nuclear reference materials and non-destructive analysing techniques, (2) the Tank Measurements Laboratory (TAME) for total inventory calibrations, densitometry and solution monitoring, (3) Seal and Identification Techniques Laboratory (SILAB), for safeguarding with authenticated seals all nuclear material (such as fuel assemblies) in storage places or containers or transport casks and (4) Surveillance Laboratory with 2D/3D laser surveillance systems and 3D image reconstruction tool for remote verification.

Participation and Feedback

The course was attended by forty-five participants, of which forty students from various universities, spread over ten different European countries and from five young professionals (from STUK and JRC). Table II presents the distribution of the forty-five attendees with their affiliations. The course was highly appreciated by all participants with positive feedback on the content of the lectures, the exercise and the practical demonstrations during the visits. After each lecture, lecturers had the opportunity to answer the many questions asked by the students. As feedback,

Table 2. Distribution of students attending the first ESARDA nuclear safeguards course in Ispra, March 6–9, 2006

Chalmers University of Technology	2
Uppsala University	1
University of Hamburg	4
University of Stuttgart	1
University of Aveiro	2
Lappeenranta University	5
Ghent University	5
Politecnico Milano	4
Politecnico Torino	7
Bulgarian National Centre of Radiobiology and Radiation Protection	1
Institute for Isotopes of the Hungarian Academy of Sciences	2
Atomic Institute Vienna University	1
European Nuclear Education Network	1
Belgian Nuclear Higher Education Network	2
Research Centre Jülich	1
Finnish Nuclear Safety Authority (STUK)	2
Joint Research Centre Ispra Nuclear Safeguards Unit (JRC)	3

the students suggested spreading the course schedule over five days, including more exercises and hands-on exercises in the labs, to be alternated with theoretical courses. Many students were surprised by the many different actors in the nuclear safeguards world and the “slang” — professional jargon — being used and expressed a need to address this in more detail. In general students preferred the lectures on more technical topics. However, coupling the technical issues with the international legal aspects (leading to politics) illustrated by facts significantly opened their perception.

Conclusions

The first ESARDA course was a success, shown by the numerous participants and the positive feedback. The course will be repeated yearly (tentatively in the first week of March) and recognition of this course with 3ECTS in an academic curriculum with



the BNEN (ENEN) label is requested to the appropriate committees. Future repetitions, slightly modified to cope with the suggestions, will be open to both university students and professionals from industry with parallel sessions. The support of the lecturers and their organizations will be further needed. It is also the aim to issue a reference publication on the didactical material, contributed by each lecturer as author.

The ESARDA Training and Knowledge Management Working Group is engaged to steadily enhance the course in content and organization, taking into account students', lecturers' and specialists' suggestions. But there is still a long way to go for a sustainable ESARDA nuclear safeguards course.

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Notes

1. NEPTUNO represents the Nuclear European Platform for Training and University Organizations as described on the following Web site, <http://www.sckcen.be/neptuno/>.
2. ECTS stands for "European Credit Transfer System," defined in the Sorbonne-Bologna process for harmonization of the university courses (needed for exchanging students, e.g., under ERASMUS). (Students can follow courses at other universities and it is well-known what their value are). The so-called three ECTS = 1 teaching module at university with twenty hours of lecture and ten hours of exercises, laboratory sessions and seminars.



PACRS at Fudan University

Dingli Shen

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A remarkable event on the contemporary world stage is the rise of China. How China carries out its foreign policy, and how it views international relations and its role in the world system, has been given an increasing amount of international focus for the past two or three decades.

This has direct relevance to China-U.S. relations. For a long time, the United States has been concerned about China's policy and actions in some international security issues, especially regarding nonproliferation of sensitive technologies and materials. China has complained about the U.S. meddling with Taiwan, which it considers a renegade province. Through their intensive engagement in this regard since the mid-1990s, overall U.S.-China relations in nonproliferation have been greatly improved.

Since the early 1990s, mainland Chinese universities have embarked on an unusual endeavor: researching and teaching arms control, regional security, and the nonproliferation of weapons of mass destruction. In 1991, Fudan University launched its Program on Arms Control and Regional Security (PACRS), at its prestigious Center for American Studies. This was unprecedented in China.

At first this was a concept of the center, founded in 1985, in collaboration with the Washington, D.C.-based Fudan Foundation, a private non-profit organization aimed at helping Fudan University, especially the Center for American Studies under Madame Xie Xide's leadership. This idea became possible with my return in 1991 from America, when I finished a two-year arms control post-doctoral fellowship at Princeton University, from 1989-1991, initially awarded by the Committee on International Relations with People's Republic of China (CIRSPRC) and later co-funded by CIRSPRC and Princeton University's Program on Nuclear Policy Alternatives, led by Professor Frank von Hippel and Dr. Harold Feiveson.¹

Launching such an arms control program at a university in China arose from the convictions that i) arms control and defense as well as foreign policy issues are within the public interest arena, therefore the public shall be informed and join the debate for sound policy making in such areas; ii) both China and the United States are nuclear weapons states, sharing fundamentally common interests and obligations in nuclear disarmament and nonproliferation, for our own interests and benefits of the world, therefore this is where the two countries shall cooperate rather than differ, and iii) we, the *educated*, have a responsibility to inform the public and to provide independent opinion, therefore contribute policy alternatives to the government.

Over a decade and a half, Fudan's program has emerged as the foremost Chinese program on nonproliferation and security studies.

Faculty Build-Up

The program started with only two faculty members — Professor Zhu Mingquan, an accomplished international relations scholar and historian, and myself, a physicist who had switched to arms control. Through fifteen years of strenuous development, our program currently has more than doubled its size of faculty and staff:

- Dr. Dingli Shen — professor, program co-founder and director, specializing in nonproliferation, Chinese and U.S. nuclear policy, and China-U.S. nuclear and security relationship
- Mr. Mingquan Zhu — professor and program co-founder, specializing in international relations, defense policy of Western powers, and nonproliferation
- Dr. Chunsi Wu — associate professor, specializing in deterrence theory, missile defense, and space security studies
- Dr. Jiadong Zhang — lecturer, specializing in terrorism studies

Dr. Deng Hongmei worked with us for a number of years on implementing the Chemical Weapons Convention (CWC) in China, before she took a permanent leave, taking a job with China's Ministry of Foreign Affairs, where she serves as director of chem/bio disarmament division at the Department of Arms Control and Disarmament. Now she is based at the People's Republic of China's mission to the UN in Geneva.

Teaching

Our faculty members have taught a number of graduate and undergraduate courses related to security and nonproliferation. Currently, we offer or co-teach the following courses:

- International Security: Theory and Practice (Ph.D.)
- Regional Security (Ph.D.)
- Nonproliferation and International Security (M.A.)
- Science, Technology, and National Security (M.A.)
- U.S. Defense Policy (M.A.)
- EU's Common Security Policy (M.A.)
- Contemporary America (B.A.)
- China and the World (B.A.)

Currently, we are advising some twenty-five students, mostly



Ph.D. candidates with few graduate students and post-doctoral fellows. Over the last decade, some twenty-five graduate and doctoral students have graduated from our program. They are working at universities, government organizations, corporations and in media.

Research Projects

Our past and current major projects include:

- *(ongoing)* Anti-terrorism: The Ministry of Education has awarded us a major grant to do this research (2005-2007).
- *(ongoing)* Joint research on non-traditional security issues and impact on China-U.S. relations: This is another project funded by Ministry of Education. We will work with the Center for Strategic and International Studies (CSIS) for the next three years to jointly study terrorism, avian flu, chem/bio terror, etc.
- *(ongoing)* National task force on Democratic People's Republic of Korea's (DPRK) nuclear issue: We are leading a national task force under the auspices of the China Arms Control and Disarmament Association (CACDA); the Fudan arms control program contributes an annual chapter on this issue to the *CACDA Yearbook of International Arms Control and Disarmament*.
- *(ongoing)* Scholarly "six-party" talk: We launched and hosted the first scholar six-party talk in December 2005, having Chinese, DPRK, Republic of Korea (ROK), Japan, Russia, and U.S. participants discussing the nuclear issue of the Korean Peninsula, and how to break the deadlock in the official talks. This unofficial talk will continue.
- *(to start)* Training DPRK students and mid-career officials at Fudan University on contemporary economy. This project has been discussed since 2005 and will be implemented beginning in 2006.
- *(ongoing)* Export control: We have spent more than a decade on this, with two faculty members and six graduate/Ph.D. students working successively. China's Ministry of Commerce, formerly MOSTEC, has placed Fudan University in its national expert pool, and has approached Fudan to set up the South China Center of Export Control.
- *(project completed)* Asia-Pacific export control and China's role: This is a project commissioned by China's Ministry of Foreign Affairs. We highly recommended a full-scope safeguards requirement for China's civilian nuclear exports. China accepted this when it joined Nuclear Suppliers Group in 2004.
- *(project completed)* Strengthening China's chem/bio export control: Still a running project of China's Ministry of Commerce. We have contributed to the decision on the control list.
- *(project completed)* Implementing CWC in China, especially in handling Japan's abandoned chemical weapons in China.
- *(project completed)* Space warfare: A commissioned research by central government.
- *(ongoing)* U.S. national security strategy: This is an ongoing project of Ministry of Education. We have produced four books for this project already on issues of missile defense, the U.S.-Europe security relationship, the U.S.-South Asia security relationship, terrorism and United States, etc.
- *(ongoing)* U.S. security relations with South Asia: Over the years we have had three Ph.D./graduate students working on India's nuclear doctrine, U.S.-Pakistani security relations, and post-9/11 U.S.-South Asian strategic relations.
- *(project completed)* Mainland China-Taiwan-U.S. relations: This was commissioned by National Taiwan Study Association. Our research report received a national award.
- *(ongoing)* Arms Control, Technology, and Cooperative Security in South Asia: This is an India-Pakistan-China annual summer workshop series held each year since 1994, presently under the auspices of Regional Centre of Strategic Studies in Colombo. We have selected and organized the annual Chinese participation since its inception, cultivating the younger generation of Chinese academics, journalists, etc., to engage in South Asia's nuclear and security questions and searching for possible links to China.
- *(project completed)* Possible interlink between South Asian nuclear nonproliferation and worldwide nuclear disarmament. This was also called Shanghai Initiative or Shanghai Dialogue, engaging China, India, Pakistan, and U.S. high-level officials, ex-officials, and non-government analysts to address relevant issues. Four rounds were organized: Shanghai (1994), Goa (1995), Islamabad (1996) and Virginia (1997). Fudan took the co-leadership role in launching it and organizing Chinese participation each time.
- *(ongoing)* Chinese textbook of arms control and disarmament: This is a project of National Social Science and Humanities Fund, and we are responsible for two chapters on conventional arms control and disarmament, as well as nuclear arms control and disarmament. The textbooks are supposed to be used in university teaching in China.
In addition to aforementioned research projects, we are also currently conducting major research on Iran, maritime security, U.S.-ROK alliance, deterrence, energy security, and dialogue with Japan, etc.

Writing and Publishing

In the past decade, members of the program have published:

- a series of books on U.S. national security strategy (four books have been published so far)
- a series of edited books on U.S. foreign policy and thoughts (three have been published)
- other authored or edited books on nonproliferation, regional security, etc.



- major pieces on nonproliferation, security issues in China, the United States, and elsewhere. In the United States, our papers have been published in the *Washington Quarterly*, *Nonproliferation Review*, and the *Bulletin of the Atomic Scientists*.
- numerous newspaper column articles in China and other countries.

Contributions to Policy Alternatives and International Understanding

We provide our independent views and analysts to the public, mass media, students, and government officials at home and abroad. At the request of the Chinese government, we provide consulting research from time to time. We receive frequent media interviews on various international relations and security issues.

The members of our program are actively engaged in international cooperation, teaching, and joint research to help promote mutual understanding and cooperation between China and the rest of the world. In 2002, Kofi Annan, secretary general of the United Nations, honored me with an invitation to advise him on the strategic planning for his second term as secretary general of the United Nations. We have also helped other Chinese universities to begin similar work on arms control and security studies.

Over the years, the PACRS has been funded by Fudan University and other Chinese sources. We have also received grants from foreign sources. We are grateful to the support of Ford Foundation, MacArthur Foundation, Ploughshares Fund, Asia Foundation, and the W. Alton Jones Foundation, among others.

Dingli Shen is the executive dean of the Institute of International Studies and director of the Center for American Studies at Fudan University. He co-launched the Program on Arms Control and Regional Security at Fudan in 1991 and has directed it since its inception.

Notes

1. The CIRSPRC has been replaced by the Program on International Studies in Asia (PISA), now based at George Washington University. The Program on Nuclear Policy Alternatives at Princeton has been renamed the Program on Science and International Security.

The University of Georgia: Preparing the Next Generation

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Introduction

The University of Georgia (UGA) is a major research university that consistently ranks among the top twenty U.S. public universities in the annual *U.S. News and World Report* rankings. It has close to 35,000 students, along with entrance requirements that make it one of the most competitive public universities in America. Observes *The New York Times*, "Seemingly overnight, one of the South's largest public universities has become enormously competitive, able to pick and choose among the region's best high school seniors and demanding test scores that would have been unimaginably high just a decade ago." *The Fiske Guide to Colleges* notes, "The University of Georgia is arguably the fastest rising public university in the country. UGA has turned into a highly selective flagship university. The average SAT and grade point average for entering freshmen have soared, and the university has moved aggressively to provide programs to challenge its new and brainier students."

Nonproliferation and security studies represent one arena in which we challenge this gifted cohort of students. UGA is one of the few schools in the country to offer courses and specialized training in these matters. In particular, the Center for International Trade and Security (CITS), aims to prepare students for careers in nonproliferation and international security. We offer more than just coursework or internships. The university and the center educate graduate and undergraduate students through courses and seminars, then put them to work conducting research and outreach projects. And finally, we help them launch careers working with these issues — sustaining the education and training effort beyond graduation day.

Undergraduate Programs

UGA and CITS provide a number of opportunities for qualified undergraduate students. First, and most obviously, students have access to nonproliferation-related courses offered through the Department of International Affairs, an arm of the university's newly founded School of Public and International Affairs. Courses include Arms Control and Disarmament, Weapons Development and Proliferation, Strategic Intelligence, U.S. National Security Policy, Global Security Policy, and Terrorism. Relevant courses are offered in other departments, schools, and colleges within the university. We go out of our way to encourage cross-fertilization among disciplines. I am particularly pleased

when students from the social sciences take relevant classes in the hard sciences and when science students apply to programs at CITS. I am continually impressed with the level of enthusiasm University of Georgia students display toward nonproliferation studies, as well as with the uses they make of their nonproliferation training once they leave Athens.

Second, CITS offers intensive practical and theoretical training through our Security Leadership Program. At the beginning of this decade, prompted by the 9/11 terrorist attacks and the prospect of nuclear, biological, or chemical terrorism, we instituted this yearlong program to immerse select students in study, research, and experience relating to nonproliferation. The program attracts top students who are interested in careers in nonproliferation and national and international security, and gives them the opportunity to amass the knowledge and skills they need to excel in graduate studies or in careers in government, the nonprofit sector, and the business world.

During the first semester of the program, security leadership students undergo a rigorous program of study on nonproliferation, taught by center researchers and visiting experts. This experience involves extensive reading, lectures, seminars, discussion, and instructional exercises. Scenario planning is one technique we use extensively. Security Leadership students undergo interactive planning exercises, appraising such issues as the future of the nuclear nonproliferation regime in a world dominated by uncertainty. Based on what they believe the world will look like in five, ten, or fifteen years, our students design new strategies—or revamp existing ones—in an effort to bolster the regime. They consider, for example, whether the Nuclear Nonproliferation Treaty can continue to anchor the international community's effort to quell proliferation, given the challenges we now face. Scenario planning, in short, forces students to forecast future challenges and craft outside-the-box strategies to cope with them.

Role-playing exercises are another central element of the first-semester security leadership curriculum. Our students take part in simulations of real-world events that pertain to international security and nonproliferation. We strive to maximize the hands-on nature of the exercises. In recent semesters our students have simulated meetings of the U.S. National Security Council and the UN Security Council, evaluating the pending nuclear crisis in Iran. Such activities expose students to the complexities of real-world decision-making, compelling them to weigh vexing issues from multiple perspectives under high-stress conditions. In



short, the first semester, when we carry out the scenario-planning and simulation exercises, supplies our students a unique opportunity to hone their skills at critical thinking and problem solving and to apply these skills to the field of nonproliferation studies.

During their second semester, our security leadership students take a direct hand in the center's nonproliferation research and outreach projects. They gather raw data and conduct research in conjunction with our permanent staff, prepare presentations and reports, and organize conferences and training programs. In recent years, students have traveled abroad with us to administer international programs and conferences. In fall 2005, for example, security leadership students helped organize and execute an international conference on "nuclear security culture." They accompanied us to Moscow, took notes during the meetings, and helped compile the post-conference proceedings. Some of them are now working with the CITS staff on a book manuscript deriving from the Moscow conference, supplemented by their own independent research efforts.

In recent fall semesters, we have taken security leadership program students to Washington, D.C., to attend the annual International Nonproliferation Conference convened by the Carnegie Endowment for International Peace. Students in the spring semester class generally travel with us to Washington on an "alternative spring break," during which they meet with officials and experts from Congress, government agencies, think tanks, nonprofit organizations, and other bodies whose missions relate to nonproliferation. The schedule for this spring's trip included congressional committees, the Central Intelligence Agency, the U.S. Departments of Commerce, Energy, and State, the National Defense University's Institute for National Strategic Studies, the Nuclear Threat Initiative, and the Center for Strategic and International Studies.

Once they complete their second semester and begin contemplating their futures outside Athens, we work to find our students externships, graduate assistantships or fellowships, or jobs related to their interests. Some stay on in Athens to enter the master's of arts or Ph.D. programs at UGA, while others pursue graduate education elsewhere. In recent years, veterans of the Security Leadership Program have won Marshall, Truman, Fulbright, and National Security Education Program fellowships and scholarships for advanced study. These accolades attest to the value of the theoretical and practical training they receive at the university.

Other security leadership graduates have pursued jobs or externships. One applied for an externship at the Defense Intelligence Agency; instead the agency offered him a full-time job after seeing that he had graduated from UGA through the security leadership program. Another accepted a one-year externship at the International Atomic Energy Agency (IAEA) in Vienna, Austria, only to assume a full-time post in the IAEA's Department of Nuclear Safety and Security. Still others have garnered Presidential Management Fellowships, going on to posts in critical U.S. government agencies, while our international stu-

dents typically return home to fulfill critical missions there. I am regularly impressed with what our graduates go on to do.

And third, CITS administers a Student Ambassadors Program, a form of local outreach within Georgia. We expect our security leadership students to participate in the Student Ambassadors Program, sharing the knowledge and experiences they gain at the center with high-school students throughout the North Georgia area. But security leadership students make up only part of our corps of student ambassadors. We recruit widely, searching out students from all schools and disciplines within the university. Under the supervision of the CITS staff, student ambassadors design PowerPoint presentations, simulations, and other instructional exercises, helping enrich the Georgia social studies curriculum and acquaint high school students with critical issues that otherwise might escape their notice. Recent presentations have included "Nukes 101," "The Iranian Nuclear Program," "Biological Weapons," "The History of Nuclear Weapons," "North Korea's Nuclear Program," and "IAEA Weapons Inspections."

The Student Ambassadors Program, like the other programs in place at UGA, benefits everyone it touches. Student ambassadors gain valuable teaching and public service experience, high school students elicit new information and training from college students only a few years older than themselves, and high school teachers see their classrooms infused with youthful enthusiasm about some of the most important issues of our time.

Graduate Programs

The University of Georgia and the Center for International Trade and Security have also amassed considerable experience working with graduate students in nonproliferation. All graduate students at the university are trained in research methodologies and techniques. They must design and conduct original research to earn UGA degrees. The center recruits university graduate students who have interests in nonproliferation, the necessary research and language skills, and the determination to develop these skills further. Graduate students at CITS work on our full panoply of issues and projects, including our projects on nuclear security culture and nonproliferation export controls. They write, present, and publish papers on these topics, furthering their career prospects. Upon graduation, they pursue activities ranging from government service, to university teaching, to research. Georgia, like the Monterey Institute, now boasts a "mafia" in the field of nonproliferation studies.

Our involvement with graduate students dates to the early 1990s. Gene Taylor led a delegation from the Los Alamos National Laboratory (LANL) to the center to discuss plans for a first-of-its-kind conference bringing nonproliferation export control officials from the post-Soviet states to the United States, and I invited some of our CITS graduate students to take part in the discussions. Some of them spoke Russian; all were well-versed in



the nonproliferation challenges facing the former Soviet Union. Taylor and his colleagues took note of their abilities and later invited them to join the national laboratories as graduate assistants. In 1994, CITS students began spending summers and other academic terms at LANL.

LANL's use of UGA graduate assistants blossomed into the U.S. Department of Energy's Nonproliferation Graduate Program, a nationwide initiative now administered by the Pacific Northwest National Laboratory. The initial group of seven CITS graduate students combined academic training at the University of Georgia with technical training at LANL, going on to make significant contributions to the field of nonproliferation. For instance, this talented group of students became interested in assessing nonproliferation export controls in the post-Soviet states. I helped them obtain grants from the National Council for Soviet and East European Research, the Carnegie Corporation of New York, the Ploughshares Fund, and other sources, funding in-country research and their effort to develop a methodology for assessing export control development in Russia, Ukraine, and the other newly independent states.

They made the most of this opportunity, devising a scientific methodology for export control research and traveling to all of the former Soviet states to collect data. The resulting research yielded significant contributions, giving rise to more rigorous study and evaluation of nonproliferation export controls. Their methodology is now the international standard for assessing export control development. We continue to build on their efforts. To date, CITS has used their methodology to assess export control development in more than forty countries worldwide, and the list continues to grow.

Another contribution relates to published research. This group of seven students came to me in 1996, wanting to write up their research on the post-Soviet states and publish it in book form. Although surprised by their audacity at such a tender age, I told them to write it up and I would help them get it published. Six months later, the students delivered a complete manuscript, and a very impressive one at that. I shared the manuscript with four publishers, and a month later we received four contracts in the mail. I asked U.S. Senator Sam Nunn to review the manuscript, and he ended up writing the foreword. Senator Richard Lugar, Jessica Stern, Graham Allison, Ashton Carter, Glenn Schweitzer, and Harold Smith also reviewed the manuscript and wrote endorsements, and *Arms on the Market: Reducing the Risks of Proliferation in the Former Soviet Union* was published by Routledge in 1998.

In subsequent years, these CITS students went on to write other books, articles, and reports, and many of them went on to assume positions of responsibility in U.S. government agencies and universities. They continue to make important contributions. These and other experiences from the Center's founding era made clear the importance of grooming our successors. Our winning strategy is to design a challenging program of study, recruit the

best students, put them together with the best experts, and get out of the way. Wonderful things happen.

Constraints and Opportunities

It is clear to us at the University of Georgia and in our center that students can make critical contributions. Better things lie in store. UGA's new, more applied School of Public and International Affairs, of which CITS is now a part, offers a growing array of relevant courses, training, and programs of study. *Interdisciplinary* is now UGA's watchword. Accordingly, programs integrating the social and natural sciences are spawning collaborative research and education that will further improve nonproliferation education, helping our nation and the international community prevent or respond to terrorist acts involving weapons of mass destruction. In particular, we are forging ties with nuclear and biological scientists across campus to develop innovative programs to counteract these threats. We are involving students in all phases of this work.

There are constraints. Two stand out. One is cultural. In effect, bench scientists from the natural sciences and social scientists speak difficult languages and have different worldviews. This cultural disparity complicates even determined efforts to undertake joint work leading to integrated, interdisciplinary research and education. We are making some progress, but this will be a long-term endeavor. Two, funding represents the biggest constraint on our efforts to consolidate and expand nonproliferation studies and education at the University of Georgia. Here again, ingrained culture plays a role. Universities—and ours is no exception—tend to apply their resources to traditional programs of teaching and research in fields such as the arts, the humanities, and the sciences. Long-established departments and tenured professors have enjoyed the bulk of the funding for centuries. (The University of Georgia was founded in 1785, making it the country's oldest public university.) While CITS has scored some successes, we have found it difficult to convince University administrators to redirect resources to nonproliferation amid the stringent budgetary times of recent years.

Despite these constraints, our assets are formidable: outstanding and motivated students, an experienced staff with an enormous network of contacts in the United States and overseas, and a university that looks increasingly favorably on the kind of education and training we provide. Our efforts to raise the next generation of nonproliferation specialists promise not only to survive but to thrive.

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A Train-the-Trainer Approach to Nonproliferation Studies

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Education and training are vital but underutilized tools to combat weapons of mass destruction (WMD) proliferation and terrorism. Their potential contribution to nonproliferation and disarmament was recognized very clearly in the 2002 report of a United Nations Experts Group on the subject, which was adopted without a vote by the UN General Assembly. The resolution, which conveyed thirty-four recommendations for implementation by member states, the United Nations and other international organizations, civil society, nongovernmental organizations, and the media, emphasized “that the need has never been greater for disarmament and nonproliferation education, especially on weapons of mass destruction.”² This need took on additional urgency following the terrorist attacks on September 11, 2001.

Regretfully, there remains a tremendous gap between the urgency of issues related to WMD proliferation and opportunities for training on these topics globally. Few high schools have curricula that expose students to issues of weapons proliferation and strategies for their control, and the availability of university training is not much better.³ Indeed, the paucity of course offerings in the nonproliferation field is most pronounced at many of the very best U.S. colleges and universities, a consequence of many factors including the relatively recent rise in the prominence of the issue and the absence of faculty with the necessary expertise.⁴ For this reason, train-the-trainer programs focused on college and university faculty and high school teachers have become critical to the success of nonproliferation education in general.

The Center for Nonproliferation Studies (CNS) at the Monterey Institute of International Studies (MIIS), established in 1989, places WMD nonproliferation education and training at the core of its activities. The training of the next generation of nonproliferation specialists is embedded in the center’s mission and implemented through a variety of programs.

CNS has been in the forefront of developing specialized courses and programs in WMD nonproliferation for more than fifteen years. Some featured programs include the Nonproliferation Certificate Program — a formal master’s degree program for students at the Monterey Institute of International Studies; the Visiting Fellows Program — a two- to three-month focused study in Monterey for professionals from the newly independent states of the former Soviet Union, China, and, more recently, other countries in critical regions; faculty train-the-trainer programs in the United States, Russia, and China; and the Critical Issues Forum — an outreach program on nonprolifera-

tion for U.S. and Russian high schools. Other educational and training efforts by CNS, while also contributing to nonproliferation education and training, are less relevant to the train-the-trainer approach and are not discussed in this article.

This article provides an overview of educational programs run by CNS and summarizes CNS experience in implementing these programs. It also offers some lessons learned by CNS over the last fifteen years that could be useful for other institutions as they expand or think about launching their own nonproliferation education and training activities. (Detailed information and resources on nonproliferation education and training can be found on the CNS Web site at <http://cns.miis.edu>.)

Certificate in Nonproliferation Studies

The Certificate in Nonproliferation Studies is a graduate program designed to prepare students for professional careers in arms control, nonproliferation, or counterterrorism. The certificate provides focused training in the concepts, technologies, and policies related to the spread of weapons of mass destruction and delivery systems, as well as the means for their control. In addition, regional security issues involving the former Soviet Union, East Asia, the Middle East, and South Asia are included in the curriculum. The certificate is available as a specialization within the Monterey Institute’s M.A. degree in international policy studies or as stand-alone program. Through specialized courses, research assistant programs, internships, simulations, and other learning activities, the certificate curriculum prepares students for positions in government, academia, corporate research, journalism, public interest groups, and international organizations.

To earn the certificate, students must complete at least twenty semester units designed to provide both technical background and policy expertise. The core courses include a four-unit course in nuclear weapons and nonproliferation and a four-unit course in chemical and biological weapons and nonproliferation. The remaining twelve units consist of elective workshops and seminars such as International Organizations and Nonproliferation, Nonproliferation Tools: Export Control, Chinese Nonproliferation and Security Policy, Security and Nonproliferation in the Middle East, Security and Arms Control in Northeast Asia, Terrorism and Weapons of Mass Destruction, Emerging WMD Supply Networks, Contemporary Issues in Nonproliferation (a Monterey model course with content sections taught in Chinese, Japanese, or Russian and plenary sessions



interpreted into English, Japanese, Chinese, and Russian by student interpreters) or the nonproliferation-oriented Arms Control Negotiation Simulation (frequently focused on the NPT review process). The majority of courses are taught by CNS staff, many of whom have joint faculty appointments with the Graduate School of International Policy Studies at the Monterey Institute. While primarily focused on policy issues, the curriculum also taps into the expertise of specialists at CNS with nuclear physics, biology, and chemistry backgrounds, U.S. national laboratories, and other organizations to enhance the technical aspects of the graduate training program.

Certificate students may further enrich their professional development through on-the-job training at CNS and internships in international organizations dedicated to nonproliferation and disarmament, including the International Atomic Energy Agency (IAEA), the Organization for the Prohibition of Chemical Weapons (OPCW), and the United Nations Department for Disarmament Affairs. On average, about fifty graduate students per semester have an opportunity to work as research assistants at CNS. Students are involved in on-going projects at CNS and interact with staff members and faculty on a daily basis, gain practical knowledge beyond the material covered in classes, and regularly contribute to center publications and databases.

More than 225 students from more than twenty-five countries have completed the certificate program since its inception in 1993. It is the most popular specialization in the Graduate School of International Policy Studies at the Monterey Institute today. Most alumni work in professional positions at international organizations, governments, and NGOs. U.S. students most often are employed by U.S. government agencies such as the Departments of Commerce, Defense, Energy, or State and the intelligence community. A number of certificate graduates have gone on to develop courses and training programs in nonproliferation at universities, laboratories, government agencies, and other institutions.

Visiting Fellows Program

Established in 1991, the Center for Nonproliferation Studies Visiting Fellows Program is designed to assist mid-career professionals in various foreign ministries, national export control bodies, journalists, and research and academic institutions to develop the skills necessary to have a positive impact on arms control and nonproliferation policy in their home countries. The program originated in response to the lack of national expertise in many post-Soviet states in the WMD nonproliferation and arms control area. Since its inception, the program has trained more than 140 participants from Russia and other former Soviet states, including professors, teachers, and instructors. In 2003-2005 alone, twelve professors and instructors from Russia and the NIS received training in Monterey. Since 1996, CNS also has hosted Chinese officials in its Visiting Fellows Program. Overall, CNS has

brought close to fifty visiting fellows from China to Monterey over the past ten years, representing the Chinese Ministries of Foreign Affairs, Commerce, and National Defense; the People's Liberation Army (PLA); and numerous Chinese research institutes and universities.

The program, offered three times a year, combines training, research, discussion, capacity building, and networking opportunities that fellows carry back to their home institutions. The centerpiece of the program is a specially designed ten- to twelve-week tutorial presented by CNS senior staff members. The lectures and seminars cover both the policy and technical aspects of arms control and nonproliferation and include exercises on research techniques, writing, and policy analysis. Lecture topics include an introduction to nuclear technology; verification technologies; treaties, regimes, and organizations; material protection and accountancy; export controls; regional security and arms control issues; terrorism; biological and chemical weapons; and missile proliferation issues. Many visiting fellows also attend graduate-level courses offered within the Nonproliferation Certificate Program at the Monterey Institute, as well as the numerous lectures, brown-bag seminars, and weekend workshops on nonproliferation that are regularly held at CNS. Visiting fellows work with designated mentors at CNS to prepare and complete a substantive research project on a nonproliferation topic. Visiting professors and instructors also use their time at CNS to develop curriculum and instructional materials for their own courses and modules on nonproliferation.

When funding permits, visiting fellows are offered opportunities to visit other leading institutions in the field of nonproliferation, allowing them to broaden their contacts and further strengthen their understanding and analysis of nonproliferation issues. CNS works to assure that the fellows' visits are not "one-off" projects with little long-term impact and maintains regular contact with former visiting fellows and provides them with additional research materials and CNS publications to sustain their nonproliferation activities at home over the long term. Past visiting fellows have returned to their respective countries and integrated their expertise and training into their professional activities as scholars, university professors, researchers, academic program directors, and policy analysts within both academic settings and their countries' foreign affairs and defense ministries. Many former fellows have been promoted to senior positions in their government departments. Training of fellows has also had a significant *multiplier* effect by increasing the access of key institutions in these countries to nonproliferation information, expanding the cadre of persons qualified to implement nonproliferation policies, and initiating a number of nonproliferation courses at national universities to assist in the training of a new generation of specialists.



Faculty Train-the-Trainer Programs

A prerequisite to the task of building a domestic nonproliferation culture is spreading understanding of the underlying principles behind nonproliferation policies. Specifically, government and industry personnel need to understand why certain exports can contribute to the acquisition of WMD materials and technologies, or why turning on monitoring equipment, following accounting and security regulations, and complying with international norms and regimes are important to their country's national, as well as international security. One of the critical elements of developing this nonproliferation culture is the introduction of nonproliferation values through educating future decision makers, policy analysts, and WMD specialists. Nonproliferation courses and programs at the college- and university-level could and should give students at least a basic understanding of nonproliferation concepts, treaties, and regimes; emerging and regional nonproliferation concerns and threats; and weapons technologies and efforts to control their transfer and export.

A train-the-trainer approach in developing and expanding expertise in teaching nonproliferation is a necessary and obvious approach that has a multiplier effect. The train-the-trainer efforts by CNS in the past five to six years have been focused on China, Russia, and the United States.

China

Train-the-Trainer Initiative: In 2000 and 2001, CNS organized two summer workshops aimed at promoting the teaching and research of arms control and nonproliferation in China. Twenty-five professors from top Chinese civilian and military academic institutions participated in the two workshops, which were conducted in both Chinese and English to facilitate debates and discussions between Chinese professors and CNS staff. The highlight of the workshops was the development and refinement of course materials for teaching arms control and nonproliferation. Designed as a "course in a box," these materials include lectures based on the Monterey Institute graduate course "Security and Arms Control in Northeast Asia," supplementary readings for each lecture, and a comprehensive reading list on arms control and nonproliferation, all of which have been translated into Chinese. At least seven professors have begun teaching some variation of this course at their universities, while at least ten others have incorporated the materials into previously existing curricula. Several others indicated that they were planning on teaching the course in the near future once minor modifications have been made.

Tsinghua University Summer Symposium on Arms Control: CNS has been co-sponsoring a week-long introductory summer seminar on arms control and nonproliferation issues with Dr. Li Bin, a former visiting fellow and the director of the arms control program of Tsinghua University's Institute for International Studies, and the Union of Concerned Scientists since 2002. The

seminar attracts about 100 applicants across the country and selects about thirty-five to fifty Chinese participants, including military officers, junior researchers, and graduate students. The seminar provides students with an introduction to arms control and nonproliferation issues, site visits to Chinese research institutions that carry out arms control related work, and interaction with senior Chinese arms control officials and analysts, as well as officials from a number of foreign embassies from the United States, Russia, India, Pakistan, and Japan. CNS staff, Chinese government officials, nongovernmental experts, and diplomats from other countries give lectures at the seminar in both English and Chinese.

Russia and the Newly Independent States (NIS)

CNS has been hosting individual faculty members from Russia and the NIS in its Visiting Fellows program since 1991. CNS visiting fellows can rightfully take credit for the introduction of the first courses on nonproliferation at universities in Russia, Belarus, Ukraine, Uzbekistan, and Kazakhstan. The Visiting Fellows Program, to date, has proven to be the most effective approach when it comes to custom-training individual faculty. The opportunity to become deeply immersed in nonproliferation topics for two to three months, communicate with CNS and other U.S. experts on a daily basis, and carry out a research project and/or work on curriculum development is not available through any other program. At the same time, the program has its limitations: high per person costs, long duration, English language proficiency requirement, and limited space (two to three faculty members a year).

These limitations and the fact that almost all Russian academic and research experts in nonproliferation are concentrated in Moscow, St. Petersburg, and a couple of other central cities, caused CNS to turn to the train-the-trainer approach with an emphasis on training faculty from geographical regions outside central Russia. Since 2002, CNS has organized six such workshops and seminars in Russia.

The first train-the-trainer workshop was organized for faculty from Russia's regions teaching economics, politics, and international policy issues to future policy analysts, diplomats, and journalists. The workshop was organized in cooperation with the Moscow State Institute of International Relations (MGIMO) — a leading Russian university training international and foreign policy specialists. This event involved the provision of a week-long course of lectures on nuclear nonproliferation to twenty-six professors from regional universities throughout Russia (including Tomsk, Nizhniy Novgorod, Ekaterinburg, Vladivostok, Khabarovsk, and other cities).

In January 2003, CNS in cooperation with the Moscow Engineering Physics Institute and the Russian Methodological and Training Center organized a seminar for faculty and instructors from technical universities and institutes, also from many Russian regions, as well as from professional development centers



for the Russian nuclear industry. The workshop focused on the specifics of teaching nonproliferation to natural science students, i.e., future nuclear engineers and other specialists for the Russian nuclear complex. Thirty-five professors and instructors participated in the program.

A small follow-up workshop was organized in Moscow in September 2003 for participants in the first two workshops who had already started implementing nonproliferation courses and modules. Participants in this workshop were also invited to attend an international nonproliferation conference (organized by the Carnegie Endowment for International Peace and the Center for Policy Studies in Russia). Firsthand interaction with top international nonproliferation experts and networking opportunities were invaluable to these faculty members.

In 2004-2005, CNS partnered with the Center for Policy Studies in Russia (PIR-Center), a Moscow-based nongovernmental organization active in the nonproliferation and security area, to organize region-specific training workshops. Participating faculty came from both social and natural science programs. The September 2004 train-the-trainer program was held in the Urals, Russia. A similar program in 2005 was organized for the Siberian region. Both regions house critical nuclear infrastructure and also are homes to large regional universities and technical institutes oriented towards the nuclear, chemical, and biological industries. More than twenty professors and instructors participated in each of the two regional programs.

Another train-the-trainer program organized in 2004 targeted faculty from a specific university — Tomsk Polytechnic University (TPU) — and its partners — Tomsk State University, Seversk State Technical Institute, and the Siberian Chemical Combine. The organization of this program was prompted by the introduction of the new engineering degree program “Security and Nuclear Material Nonproliferation” at TPU, and included approximately twenty professors and instructors teaching courses for this new degree program.

Preliminary reports from participants in the train-the-trainer workshops in Russia indicate that about half of them have already incorporated WMD nonproliferation issues into their teaching in one way or another. As a rule, it is much easier to implement and incorporate nonproliferation studies at social studies departments than at natural science schools. In some cases, outside assistance is necessary to assist in the development and implementation of the nonproliferation studies at technical schools. CNS has been contracted by the U.S. Department of Energy to assist in the development of university degree programs on nuclear safeguards in some of the key technical universities and institutes in Russia since 1997. During this time, CNS has been involved in curriculum development and implementation of nonproliferation courses at MPhI, TPU, and a number of technical institutes and universities in Russia's closed nuclear cities (Sarov, Snezhinsk, Seversk, Ozersk, and Novouralsk). This work is being supported by the Nuclear Cities Initiative and the Materials Control and

Accountancy programs at DOE.


In summer 2006, CNS and the PIR Center will hold a joint summer school on WMD nonproliferation for young specialists in Moscow. This week-long program is geared toward young professionals in the Russian and NIS governments, junior faculty, as well as researchers from think tanks and NGOs. CNS and PIR Center experts deliver most of the lectures. Invited speakers will include senior officials from the Russian MFA, Rosatom, and the State Accounting Chamber. Textbooks, copies of slides, handouts, and other resources will be provided to the participants.

United States

CNS has been assisting in an effort called the Summer Nonproliferation Institute since its initiation in 2003 at the University of North Carolina, Asheville, North Carolina, U.S.A. The program was inspired by an earlier course offered at the Nonproliferation Policy Education Center for college professors in the mid-1990s. After the events of 9/11, it became apparent that nonproliferation policy issues were more important than ever—and yet taught in very few courses at American universities. The Summer Nonproliferation Institute targeted college professors and aimed to increase their awareness and assist interested faculty members in the development of new classes in the field, across a variety of disciplines (political science, history, physics, public health, and others).

The first Summer Nonproliferation Institute was a collaborative effort involving input from CNS, the mathematics department of the University of North Carolina, and the Institute for Defense and Disarmament Studies in Cambridge, Massachusetts, and was funded by the Ploughshares Fund. This first program brought twenty-five faculty members, mostly from the southeastern United States, to UNC-Asheville. The course set a precedent for subsequent meetings in terms of its broad coverage of nuclear, chemical, biological, and missile issues, as well as regional proliferation concerns (Middle East, Russia/NIS, Northeast Asia, and South Asia). Speakers came from academia, NGOs, and the U.S. government. Taking place over five days, the program benefited from a flexible format, which involved nightly films or discussions, plus time for additional, ad hoc lectures on topics of particular interest to speakers and students. In June 2004, a larger workshop, again at UNC-Asheville, attracted thirty-five faculty members (including a few from foreign countries). In 2005, Washington and Lee University in Virginia took the lead in organizing and hosting the institute. Approximately forty faculty members from around the country (particularly the southeast and east) and abroad attended the 2005 institute.

For 2006, Middlebury College in Vermont has been designated the host of the summer course, with Professor Robert Cluss (Bio-Chemistry, Middlebury College) and Clay Moltz (CNS, Monterey Institute) serving as co-organizers. The Ploughshares Fund has again provided support, although it has indicated an interest in attracting new funders (especially larger U.S. founda-



tions) for the program in subsequent years. The 2006 meeting will be conducted over four days, with a special (though not exclusive) focus on chemical and biological weapons issues, as well as renewed emphasis on WMD terrorism. (For more information about the 2006 Summer Nonproliferation Institute, refer to its Web site: <https://segue.middlebury.edu/index.php?action=site&site=nonproliferaton>.)

Already, plans are underway for the University of Georgia's Center for International Trade and Security to host a 2007 meeting. Overall, the results of this program have been the following: a significant increase in the number of courses taught in the United States in nonproliferation studies across many academic disciplines in the sciences, social sciences, and humanities; greater awareness of pedagogical techniques and nonproliferation resources (books, Web sites, etc.) among faculty members; and the strengthening of contacts among U.S. and international college professors teaching in this field.

High School Nonproliferation Program

The Critical Issues Forum (CIF) is a CNS educational outreach program. The mission of CIF is to promote awareness of nonproliferation and international security issues and develop analytical skills in high schools in the United States, Russia, and other countries. The program applies a train-the-trainer approach to continuing education for secondary school teachers.

Drawing on an approach initially developed by the science education program at Los Alamos National Laboratory, CIF helps students to develop informed opinions and think critically about weapons of mass destruction, terrorism, and other crucial international issues of the 21st century. This approach emphasizes the links between technical and policy issues in four content domains: scientific/technical, economic, social/cultural, and political/geopolitical. Utilizing the knowledge and experience of experts at the Center for Nonproliferation Studies, scientists from U.S. national laboratories and academia, as well as experienced high school educators, CIF develops curricula, methods, and resources for students to conduct directed research on topics related to weapons of mass destruction (nuclear, chemical, or biological weapons) and ballistic missiles. Each year's program starts with the development of a curriculum and a training workshop for teachers in Monterey and involves about twenty to twenty-five teachers from the United States and Russia. In the spring, students and their teachers attend a conference where the students present the results of a research project they worked on during the year. Past years' CIF topics have included nuclear weapons, chemical and biological weapons, missiles and missile defense, WMD in the Middle East and South Asia, nuclear issues in Northeast Asia, and radioactive materials and radiation weapons. In 2005-06, high schools in eleven U.S. states and ten of Russia's "closed nuclear cities" are investigating Nuclear Weapons and Nonproliferation. Students' projects range from academic

research papers to self-produced documentaries to board games. Over 200 students from the United States, Russia, and Great Britain have participated in CIF conferences since 1999.

In Russia, the majority of schools are from the closed nuclear cities. The CIF program is an important tool for reaching out to the young generation in the closed nuclear cities and creating an awareness of nonproliferation objectives among future residents and potential scientists and employees of nuclear facilities. High schools from all ten closed nuclear cities — Lesnoy, Novouralsk, Ozersk, Sarov, Seversk, Snezhinsk, Trekhgorniy, Zarechniy, Zelenogorsk, and Zheleznogorsk — are currently involved in CIF activities. CNS works with two leading organizations for nonproliferation education at the high school level, the Nuclear Cities Educational Information Center in Novouralsk and the School for Cosmonautics in Zheleznogorsk, to engage schools, train teachers, and develop curricula and learning objectives.

Additional information about these and other programs, as well as nonproliferation education resources can be found on the CNS Web site, <http://cns.miiis.edu>.

Recommendations

More than fifteen years of hands-on experience in teaching WMD nonproliferation, including train-the-trainer programs, has yielded several valuable lessons that could be useful to other institutions that recently have embarked on nonproliferation education and training.

Build on a broad educational base. It is difficult to create and maintain a train-the-trainer program from scratch as a stand-alone endeavor. Such a program works best if it exists in an environment of varied educational projects in WMD nonproliferation. At CNS, train-the-trainer programs build on the experience and resources of other educational activities, such as a master's-level nonproliferation certificate program, language training, and a visiting fellows program. This synergy and cross-fertilization offers maximum effectiveness and enhances the learning experience of participants. For example, visiting fellows have an opportunity to audit courses offered by CNS experts to MIIS students. The active involvement in research projects and participation in international conferences and meetings provides CNS staff with a broad background of experiences, which they can share with other colleagues and students.

Have a critical mass of cadres. A train-the-trainer program (or a full-fledged concentration or degree program) built around a few experts is possible if these experts are qualified to cover most relevant issue areas. A larger pool of experts, who can cover a broad range of nonproliferation-related topics, however, is desirable. Some outside instructors can be brought on board to teach specific topics, but it is essential to have a core group of teachers capable of covering the majority of topics. Ideally this core group should include researchers, teachers, and practitioners from a variety of countries and disciplines.



Assemble teaching teams with policy and technical expertise.

Policy and technology are integral parts of WMD nonproliferation regimes and consequently both should be present in any educational program. Without knowing the basics about nuclear weapons, nuclear material, and the fuel cycle, it is impossible to comprehend many nuclear policy issues. Similarly, without knowing the politics of proliferation, it is impossible to understand the obstacles to nonproliferation or how they might be overcome. The CNS team has found this dual approach to teaching nonproliferation to be particularly important in the former Soviet Union and China, where policy issues for a long time remained the sole responsibility of technical experts unfamiliar with nonproliferation regimes and their country's legal obligations. Equally, political science students and faculty need to be given at least basic technical knowledge to understand fully the implementation challenges facing WMD nonproliferation regimes.

Have a foreign partner. When train-the-trainer activities are pursued abroad or are directed at foreign audiences, a local partner organization is extremely important to the success of a program. If available, it is desirable to find a teaching partner from an educational or nongovernmental organization that has expertise in the course-relevant area who can assist in teaching the course, identify additional local experts, and help in the selection of trainees. The benefit of a cross-country teaching team goes beyond burden-sharing because such partners can also bring on board understanding of the language, formative experience, background, key notions, and terminology of the learners. This facilitates contact between instructors and students and generally enhances the effectiveness of the course. A partner that is involved in multiple educational programs over a period of several years develops a constituency with a vested interest in the continuation of the same activity. As a result, organizing subsequent programs becomes easier and, perhaps even more importantly, the partner eventually develops its own capacity for nonproliferation training activities—the key to sustainability.

Know your audience. It is self-evident that a one-size-fits-all approach to teaching is suboptimal. As a rule, train-the-trainer program organizers know their trainees and can customize the course to maximize the learning experience. One approach to customization was mentioned above: the appropriate balance of political and technical aspects of WMD nonproliferation. Various teaching methods can be applied, while different sets of resources and readings may be required for different trainees. Obviously, students should be given a broad picture and introduced to all aspects of WMD nonproliferation, but special emphasis could also be given to the areas of greatest interest for the learners and/or areas in which students will work after completing the training course.

Speak the language of the trainees. This rule is particularly important for educational programs offered to non-English speaking audiences and goes beyond a mere language expertise requirement, which is undoubtedly important in its own right.

Of equal or greater importance are the following additional aspects of cross-cultural and cross-country teaching:

- **Understanding the terminology and basic concepts with which the trainees operate.** The same words often do not carry the same meaning, which is why simple translation does not help and sometimes even confuses matters. It is advisable to have dictionaries and glossaries or at least to have trainers that are also country experts.
- **Textbooks and other teaching materials in the language of the audience are often in short supply.** For example, the first Russian-language college-level textbook on nuclear nonproliferation was published only a few years ago. Many specialized areas are not sufficiently covered by existing literature at all. At the minimum, this means that presentation slides and, ideally, supporting literature should be translated for the audience.
- **Political and cultural sensitivity.** Differences in background and political views can complicate the learning process. Explanation and examples should be selected not only based on their merit, but also proceeding from their compatibility with the audience. It is always valuable to emphasize the international nature of WMD nonproliferation and demonstrate how relevant regimes address the national security interests of the trainees' own country. It cannot be emphasized enough that expertise or good familiarity with the country or region of the audience are extremely important in the organizing and teaching process, for finding the most persuasive arguments, and avoiding the pitfalls in which foreigners often find themselves.

Multinational teaching teams often offer the best approach to solving cross-country communication problems. Indigenous experts can offer advice, smooth awkwardness or mistakes, and facilitate communication both within and outside the classroom.

Engage multiple countries and international organizations. Many nonproliferation educational projects, including train-the-trainer programs, are bilateral in nature. Although this is often unavoidable, programs can benefit from the involvement of additional international partners. CNS, for example, has had a very positive experience cooperating with the Swedish Nuclear Power Inspectorate (SKI) in a growing number of educational and training programs in the former Soviet Union. In addition to the obvious benefit of expanding the resources of these programs, such cooperation significantly broadens the perspective of participants by exposing them to multiple points of view.

Stay in touch, expand networks. No matter how valuable a train-the-trainer program might be, it is worth very little if the educational institution loses contact with its former students or partners. A network of partners and alumni can help sustain interest and knowledge, facilitate horizontal interaction among former students, provide a channel to supply them with new or updated materials, and generally make the nonproliferation culture and education more sustainable. Newsletters, personal



contacts, or (if funding allows) seminars or conferences for alumni can help preserve and expand relationships that begin in the classroom and insure program sustainability.

While some networking activities can be expensive, particularly meetings and conferences, others can be done on a very small budget. One low-cost option is the publication of a newsletter for the network. Since 1999, CNS has published a Russian-language quarterly newsletter, *Vestnik*, for alumni of its various educational and training programs in Russia and the NIS. The newsletter provides a forum for discussion on current research, planned conference and other relevant activities in the region, and opportunities for joint research. The newsletter also has a section specifically devoted to teaching nonproliferation. Faculty members from various institutes and universities share their experiences, curriculum, and instructional approaches in this newsletter.

Support local initiatives. In many cases, the emergence of partners results from the initiative of motivated individuals. In more than one case, CNS visiting fellows have launched new nongovernmental organizations, offered nonproliferation courses at their universities, or, having engaged local administrations, offered their institutions as host partners for in-country educational activities. Such initiatives have to be nurtured by providing organizational and scholarly advice, teaching materials, and sometimes seed funding—by sharing information on funding opportunities and providing assistance with writing grant proposals. In June 2005, CNS organized a workshop on sustainability and fundraising for Russian universities and institutes teaching nonproliferation and invited private foundations and foreign governments to this seminar.

Funding. Unfortunately, nonproliferation education is not currently a fashionable area for most private foundations. In the past, the majority of CNS training activities were funded by major U.S. foundations, but, paradoxically, this funding began to dry up following the September 11, 2001, terrorist attacks, at the very time this issue acquired greater urgency. One of the most important supplements to foundation support for nonproliferation education has been the U.S. Department of Energy's (DOE) National Nuclear Security Administration. An attractive feature of DOE support that deserves special mention is the absence of micromanagement and political guidance.

Although the DOE's role in promoting nonproliferation education is laudable, it also is necessary for more private foun-

datations to return to the nonproliferation education and training field. International organizations also can and should do much more to further nonproliferation education and training. As UN Secretary General Kofi Annan has noted, "education is, quite simply, peace-building by another name."⁵

Notes

1. The authors would like to thank J. Clay Moltz, Fred Wehling, and Jing-dong Yuan at the Center for Nonproliferation Studies for their contributions to and comments on this article.
2. UN Resolution 57/60, "United Nations study on disarmament and nonproliferation education," November 22, 2002; <http://www.un.org/depts/dhl/resguide/r57.htm>. See also Masako Toki and Fred Wehling, "U.N. Study on Disarmament and Nonproliferation Education Presented to the General Assembly," October 8, 2002, <http://cns.miiis.edu/pubs/week/021007.htm>.
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Advancing the Nonproliferation Culture to Russian Professionals through the Open World Leadership Center

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Introduction

In 1999, Dr. James Billington, Librarian of Congress, introduced the Open World Leadership Center (OWLC). The goal of OWLC is to introduce young Russian leaders to areas of interest in the United States that may be useful for them to consider in developing programs of their own. Open World programs have covered the topics of education, environment, health, rule of law, economic development, libraries, and women as leaders. The OWLC accomplishes its mission through exchange opportunities with U.S. professional counterparts.

The OWLC recently initiated a program beneficial to world security and peace. Since the days of former President Eisenhower's call for the use of nuclear energy for peaceful purposes, the two superpower nations have accepted the challenge to a point but have retained their path of continuing development of nuclear weapons arsenals. The United States and Russia have long histories of nuclear weapons development but have now seen through the advent of global terrorism, the madness of others who possess the will to use such weapons for their particular cause without consideration of the impact to human society. Unfortunately, the numbers of other groups who may wish to follow the path of al Qaeda may stagger the imagination but illustrate in stark reality the vulnerability of all people.

As the United States and Russia are the predominant world nuclear powers, they are also the predominant nuclear states with the responsibility to address these issues. They also have the responsibility to engage each other, and other countries, in defining the means by which the public's safety is secured, and for helping to ensure world security via plans carefully formulated and implemented with other world leaders.

The OWLC builds on this spirit of cooperation that defines U.S. and Russian global nonproliferation efforts. The program, which began in late 2005, introduces Russia's next generation of leaders to the world of nonproliferation, with a particular focus on how nuclear nonproliferation is practiced in the United States. Along with enhancing understanding of this important area, a

goal of the program is to promote a culture of support for nonproliferation within Russia.

The organization and structure of the new Open World program on nonproliferation issues is focused on three specific areas: targeting the next generation of civic, political, and economic leaders who will address the issue of nonproliferation in further securing weapons of mass destruction (WMD); providing basic knowledge of the U.S. model and approach to nonproliferation; and establishing an alumni network program for broadening the base and sustaining the effort on a continuing basis. The first two objectives have been met, and they are addressed in this paper. The third objective, establishing the (Russian) alumni program, is under development. The results of an active and ongoing program are expected to yield long-term benefits both for the two nations and for the global community.

Design of Nonproliferation Issues Program

In 2005, OWLC asked K. Mark Leek of Pacific Northwest National Laboratory and John Randolph of Oak Ridge National Laboratory to develop and implement the new nonproliferation issues program under the direction of the Pacific Northwest National Laboratory (PNNL). The model program had to conform to standard Open World requirements while establishing a set of criteria that clearly focused on nonproliferation. To capture the unique features of nonproliferation, the program was designed to introduce participants to the core elements that comprise the U.S. nonproliferation sector. These are

- Executive and legislative branches of the U.S. government
- The U.S. Department of Energy (DOE) laboratory system
- Universities
- Non-governmental organizations (NGOs)
- Private contractors and law firms
- Media

The program is intended to convey how these elements com-



bine to form a more or less integrated system. Part of the goal is to introduce participants to the process by which U.S. nonproliferation policy is made. The program represents not only an opportunity to learn about nonproliferation but also to learn about the inner workings of the American government as a policy-making and implementing institution.

OWLC exchanges are typically ten days in length, with the first two days in Washington, D.C., where incoming delegates receive an orientation to OWLC and Washington culture. After the brief orientation, the delegates transfer to a host city within the United States, where they are introduced to various professionals and organizations matching their professional backgrounds (i.e., health, environment, etc.). Delegates are hosted in the homes of community residents, giving them the opportunity to gain understanding and appreciation of American citizens and their culture.

The standard OWLC structure was modified to take into account the unique nature of the nonproliferation sector. This relates to the science and technology that drive policy formulation and implementation. To anchor the essential technical and scientific character of the nonproliferation sector, it is important to start the U.S. tour at the national laboratories where the bulk of this expertise resides. In addition, before departing for the United States, delegates receive a one-day orientation at the Center for Policy Studies (PIR) in Moscow on the fundamentals of nonproliferation from the Russian perspective. The assumption is that it is essential for delegates to have a Russian frame of reference for what they experience and learn while in the United States. Upon arriving in the United States, delegates travel directly to the national laboratories and their cities for an extended visit. Then they travel to Washington, D.C., to learn about the institutions responsible for policy formulation and overseeing policy implementation.

The Inaugural Visit

The inaugural visit of the nonproliferation issues program occurred in October 2005. Delegates were selected through an identification and vetting process conducted by U.S. Embassy staff in Moscow and by staff of the Open World program office located within the U.S. Embassy in Moscow. Applications were distributed to prospective candidates via government ministries and nonproliferation-related NGOs. Sixteen delegates and four facilitators were chosen. Delegates included several individuals from closed cities, including Sarov and Mayak; nuclear-related research facilities such as the Kurchatov Institute; nonproliferation-related NGOs, such as Vladimir Mikheyev, Civilian Center for Nuclear Nonproliferation, Krasnoyarsk Regional Branch; and nuclear-related federal ministries such as ROSATOM. The selection process was successful in recruiting entry and mid-career professionals. The character of the group was young, spirited, and inquisitive. Many were highly knowledgeable of nuclear- and

nonproliferation-related subject areas because of their professions in the nuclear field.

As stated previously, the first phase of the learning process occurred in Moscow prior to departure for the United States. Four lectures on various aspects of nonproliferation were offered by PIR staff and prominent Russian nonproliferation academics and specialists. One of the lectures on nonproliferation-related legislation, offered by Dr. Ildar Akhtamzyan, Moscow State University of International Relations, Russian Ministry of Foreign Affairs, provided an understanding of the Russian legal context for nonproliferation.

The overall U.S. program provided the delegates with a perspective of the people and organizations involved in constructing and implementing U.S. nonproliferation policy. The development of U.S. nonproliferation policy is an integrated process that has two primary phases: national policy development and implementation. The process begins with development of a national policy created at the federal level through the executive and legislative branches of government. Once the policy has been crafted, the department levels of government are tasked with the implementation of that policy, and those departments exercise an implementation strategy through various government agencies and their respective national centers or laboratories. In the area of nonproliferation, the agency primarily responsible for formulating an implementation strategy is the Office of Defense Nuclear Nonproliferation (DNN) within the National Nuclear Security Administration (NNSA). DNN directs the implementation of policy primarily through the national laboratories, which provide the expertise necessary for informed and effective policy and expert implementation.

At Oak Ridge and Pacific Northwest national laboratories, delegates were introduced to the historical missions of the two laboratories within the U.S. weapons complex, along with the Cold War legacy issues the laboratories face involving environmental site remediation and the promotion of stable local economies, in part, through the diversification of the nuclear workforce. These issues also confront closed cities within Russia and were topics of great interest to delegates.

Concerning the capabilities of the laboratories, staff contributes policy and technical expertise in the pursuit of national and global nonproliferation goals. In the area of policy, the delegates were introduced to scientists who formulate programs and advise on areas of export control, international safeguards, and nuclear materials, protection, control and accounting—covering all the many aspects of first and second lines of defense. In technical areas, delegates were introduced to scientists in the areas of nuclear explosion monitoring, reactor safety, proliferation-resistant design, etc. Delegates were also introduced to some of the non-nuclear technologies developed at the laboratories to illustrate the diversification of research capabilities as models for laboratories in Russia. Delegates and laboratory staff both commented on how rich and rewarding the exchanges were.



Universities contribute to nonproliferation by providing entry-level professionals for positions in government, national laboratories, and NGOs. Universities also contribute to U.S. nonproliferation goals through the establishment of centers with nonproliferation curriculum and expertise. The PNNL delegates were introduced to the Institute for Global and Regional Security Studies, a program at the University of Washington with a comprehensive policy-oriented nonproliferation curriculum, including a course on the technical dimensions of WMD tailored for policy-oriented students. At the University of Tennessee, the ORNL delegates were introduced to the fundamentals of policy making at the Howard H. Baker Center for Public Policy. They also visited the International Trade and Security Center (ITSC) at the University of Georgia. ITSC addresses key issues on export control matters related to nonproliferation. At the Georgia Institute of Technology's Center for International Technology, Security, and Policy, the delegates were introduced to the mission of educating members of the public and private sector on nonproliferation issues. The delegates thoroughly enjoyed their experiences at the various universities and learning about the contributions that universities provide to the U.S. nonproliferation program.

While in the Pacific Northwest, delegates spent half of a day at the Pacific Northwest Center for Global Security, a center for policy analysis of the Pacific Northwest National Laboratory. They also visited the Foundation for Russian-American Economic Cooperation (FRAEC), an NGO whose mission supports the implementation of nonproliferation policy for the U.S. FRAEC, and as a contractor, contributes to the nonproliferation effort through foundational development projects in Russia, including support to DOE for development of International Development Centers at closed nuclear cities with programming for preparing and educating nuclear workers for non-nuclear employment.

The Washington, D.C., portion of the visit was organized in large part by Ron Bartek, executive vice president of Mehl, Griffin, and Bartek, a leading Washington, D.C., consulting firm specializing in arms control and national security-related matters. Bartek previously served on the staff of the House Armed Services Committee, and while in the State Department served as negotiator on the U.S. delegation to arms control talks in Geneva. For the Open World visitors program, Bartek helped organize meetings and shared in hosting responsibilities.

The Washington, D.C., component began with a very special presentation and dinner with former Ambassador Thomas Graham Jr. as the keynote speaker. Graham provided the audience with a rich history and background of cooperative efforts between the United States and Soviet Union/Russia in the development of the international nonproliferation regime.

Also in Washington, the delegates were introduced to the executive and legislative branches of government. From the legislative branch, delegates heard from Kenneth A. Myers III,

senior professional staff member on the Senate Foreign Relations Committee, who spoke on the evolution of the Nunn-Lugar program, and from Madelyn Creeden, staff member, Senate Armed Services Committee, who discussed the legislative-executive branch relationship in formulating and funding nonproliferation policy. From the executive branch, Susan Koch, senior advisor to the Undersecretary of State for Arms Control and International Security, spoke on nonproliferation policy formulation in the White House, U.S. Department of Defense, and U.S. Department of State. Phil Dollif, Office of Proliferation Threat Reduction in the Department of State, discussed nonproliferation issues as they pertain to Russia. Kenneth Baker, principal assistant deputy administrator for the Office of Defense Nuclear Nonproliferation, provided an overview of the Defense Nuclear Nonproliferation Office at the National Nuclear Security Administration.

Delegates also heard from officials of several Washington, D.C.-based NGOs. Prominent NGOs, many based in Washington support nonproliferation policy formulation through expert testimony before Congress and through critical analysis of nonproliferation issues intended for use by policy makers. Delegates heard from William Hoehn III, Washington office director of the Nuclear Reduction Project at the Russian-American Nuclear Security Advisory Council, on the topic of cooperative threat reduction. They also heard from Dr. Jonathon Tucker and Sonya Ben Ouaghran, both of the Monterey Institute, on topics of biological weapons. From the media, delegates heard from Dafna Linzer of the *Washington Post* on the media's role in nonproliferation.

Program Benefits

The Nonproliferation Program was intended to provide several benefits to participants:

- A view of the U.S. nonproliferation sector as an integrated system composed of several elements
- Insights into how U.S. government policy is made
- Opportunities to meet and develop relations with U.S. peers and counterparts
- Opportunities to meet and develop relations with professionals from other sectors and elements of Russian government and society
- Ongoing involvement through development of an alumni program

Each of the identified benefits was achieved, with exception of the final item, which is under development. After the visit, one delegate developed a Web site for hosting an open forum on nonproliferation for delegates. Some delegates are maintaining e-mail communication with program leads and their home hosts. Such relationship building is important to express ideas and opinions on this vitally important subject. Overall, the delegates gave high marks to the program and the professional presentations. The



facilitators' reports also gave high marks to the program. These are all good indicators of interest on the part of the delegates.

Several delegates have already indicated benefits resulting from their participation in the program. Two delegates from a prominent Russian research institute noted that their stature within the organization has increased since their travel to the United States, providing more leadership opportunities. Another delegate from a closed city used the knowledge of commercialization she obtained while visiting a national laboratory to successfully develop a new proposal and business plan that became funded by the DOE.

Lessons Learned

By all accounts from delegates and U.S. participants, the program was a success. All U.S. participants have indicated that they would like to repeat the experience, and delegates are anxious to pass on what they have learned to future delegates to help prepare them for their U.S. visits. All host families reported that they had a wonderful time and would like to repeat the experience. The families were vital to helping delegates feel welcome in their new environment, which translated directly into a positive feeling about the program.

In post-visit briefings, delegates conveyed that they would

like more of a big-picture overview of the links among elements of the nonproliferation sector, including moving a graphic representation of the sector to the front of the program. As always, it is useful to strive for more interactive dialogue between presenters and delegates, and new ways are being explored to achieve this goal. Future plans include expanding the Washington, D.C., portion by one day in order to provide more opportunities for in-depth discussions with policy makers, including meetings with more NGOs. An effort also will be made to make the two laboratory agendas more similar in content.

Conclusions

The program was successful in achieving the objectives and goals of the Open World Leadership Center. It is apparent that many of the delegates are future leaders of tomorrow. The benefits of the program will play out over the course of the delegates' lives and careers, and directly contribute to the development of new cooperative programs between the United States and Russia. Programs directed at the development of human capacity, especially those that foster knowledge of counterpart programs in other countries, are relatively rare and deserve support. Open World is contributing directly to world peace by accepting the challenge of dealing with the paramount security issue of our time.



☼ Dennis Spurgeon Sworn in as Assistant Secretary for Nuclear Energy

Dennis Spurgeon was sworn in as assistant secretary for nuclear energy at the U.S. Department of Energy (DOE) in April. Spurgeon was nominated by President Bush on February 13, 2006, and confirmed by the U.S. Senate on March 27, 2006.

Spurgeon is the first person to serve in this position in more than a decade. In this position, Spurgeon is responsible for the DOE's nuclear energy enterprise, including nuclear technology research and development, management of the department's nuclear technology infrastructure, and support to nuclear education in the United States.

Spurgeon also leads the recently announced Global Nuclear Energy Partnership (GNEP), which is aimed at accelerating the demonstration of a more proliferation-resistant closed fuel cycle and bringing the benefits of nuclear energy to the world in a safer and more secure manner, reducing the possibility that nuclear energy could be used for non-peaceful purposes.

Most recently, Spurgeon served as executive vice president and chief operating officer for USEC, Inc., an international supplier of enriched uranium for nuclear plants. Before that, he served as chair, chief executive officer, and principal owner of Swift Group, LLC, an international leader in shipbuilding for commercial and military markets.

☼ DOE Awards \$3 Million Contract to Oak Ridge Associated Universities for Expert Review of Yucca Mountain Work

The U.S. Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) in March announced the selection of Oak Ridge Associated Universities/Oak Ridge Institute for Science and Education (ORAU/ORISE) to provide independent expert reviews of scientific and technical work on the Yucca Mountain Project.

ORAU is a not-for-profit consortium that includes ninety-six doctoral degree-granting institutions and eleven associate member universities. Together, these institutions produce one-third of the nation's science and engineering Ph.D.s. ORAU operates ORISE, a DOE institute dedicated to furthering scientific initiatives and education in the United States.

OCRWM is providing \$3 million in funding to ORAU/ORISE for the remainder of fiscal year 2006. In addition, at least \$3 million will be available next year for ORAU/ORISE. OCRWM will identify specific products or activities for review and provide a scope of work, based on which ORAU/ORISE will identify experts in appropriate disciplines and coordinate the activities of review teams.

☼ DOE Initiates Environmental Impact Statement for Global Nuclear Energy Partnership Technology Demonstrations

The U.S. Department of Energy (DOE) in March announced plans to prepare an environmental impact statement (EIS) for the technology demonstration program of the Global Nuclear Energy Partnership (GNEP) initiative.

DOE issued in the Federal Register an Advance Notice of Intent to prepare an EIS for the GNEP technology demonstration program and plans to issue the final Notice of Intent in summer 2006. The advance notice requests comments from the public and private sectors on the scope of the EIS, reasonable alternatives, and other relevant information.

The EIS will inform DOE officials and the public of the potential environmental impacts associated with the program to develop and demonstrate advanced technologies to safely recycle spent nuclear fuel using more proliferation-resistant processes. The EIS will evaluate all reasonable alternative technologies as well as locations where the key elements of the technology program will be performed.

When the final notice is issued, DOE will announce a schedule of public scoping

meetings in various locations to assist the department in further defining the scope of the EIS and identifying significant issues.

The department will issue a request for proposals later this spring and award contacts this summer to prepare site evaluation studies for locating engineering scale demonstrations of the department's advanced recycling technologies. The results of these studies will provide information for the development of the environmental impact statement.

Additional information on the advance notice of intent, the request for expressions of interest, and the GNEP program as a whole may be found on the Department's Web site and <http://www.gnep.energy.gov/>.

☼ DOE Cites Bechtel National Inc. for Price-Anderson Violations

The U.S. Department of Energy (DOE) has notified Bechtel National Inc. (BNI) that it will fine the company \$198,000 for violations of the DOE's nuclear safety requirements. BNI is the primary design and construction contractor for the Waste Treatment and Immobilization Plant (WTP).

The Preliminary Notice of Violation (PNOV) issued in March cited a series of violations that occurred during the design and construction of the WTP between May 2002 and September 2005. Violations include failure to abide by design codes documented in facility safety requirements, failure to abide by inspection requirements for waste processing vessels, failure to utilize correct suppliers to fabricate certain components, and calculation errors resulting in inconsistencies in structural steel design requirements.

The proposed civil penalty of \$198,000 is based on the significance of the violations yet reflects substantial mitigation granted by the department for aggressive corrective actions taken by BNI to prevent recurrence of the identified deficiencies. If left uncorrected, the design and construction issues could have



adversely effected the operation of the WTP compromising the DOE's ability to process radioactive waste currently being stored at the Hanford Tank farms and posing potential safety and health risks to workers and the public.

Additional details on this and other enforcement actions are available at <http://www.eh.doe.gov/enforce/>.

Florida Power & Light Submits License Application

Florida Power & Light revealed in April that it intends to submit a license application with the Nuclear Regulatory Commission that could lead to a decision to build its third nuclear power plant in the state. The announcement that FPL could "potentially pursue a new nuclear plant in Florida" came as the state's largest electric utility filed a document updating its ten-year plan on future electricity generation with Florida Public Service Commission.

FPL spokesperson Rachel Scott explained the company's submission saying, "Filing the letter of intent (for a combined construction and operating license) with the NRC is a way of signaling our interest in keeping the option open. It's the very first step."

Scott said the utility plans to streamline the approval process by building a plant design that already has been approved by the NRC. A site for a potential new power plant is expected to be chosen in the next three years. However, obtaining the license and building the facility still could take more than a decade

to complete. The company has slated 2009 as a target date to file the application.

FPL currently provides electricity to more than 4 million homes and businesses, and expects to begin adding about 100,000 customers per year.

Federal Court Awards TVA Over \$30 Million for Government's Failure to Remove Used Nuclear Fuel

The U.S. Court of Federal Claims has awarded almost \$35 million in damages to the Tennessee Valley Authority as a result of the U.S. Department of Energy's failure to dispose of the utility's used nuclear fuel.

Under the 1982 Nuclear Policy Waste Act, the basis for TVA's claims, the federal government is obligated to remove used fuel from the country's 103 nuclear power plants. However, it missed the 1998 deadline for removal established by the legislation.

Judge Charles Lettow's ruling in the TVA case is the first time a court has awarded damages in a utility suit against the federal government for its failure to remove used fuel. The damages are intended to alleviate the expenses TVA incurred for storing used fuel at the Brown's Ferry and Sequoyah plants through September 30, 2004. There are more than sixty other such lawsuits still pending in federal court.

Scana Corp. and Santee Cooper, utilities serving the bulk of South Carolina, settled a similar suit against the federal government in December 2005 for \$9 million.

Progress Energy Identifies Site for Potential New Nuclear Power Plant in North Carolina

Progress Energy announced in late January 2006 that its Progress Energy Carolinas subsidiary has selected its Shearon Harris power plant site near Raleigh, North Carolina, U.S.A., to evaluate for possible new nuclear power plant construction. The site twenty miles southwest of Raleigh currently has a single-unit, 860-megawatt reactor that began operations in 1987.

Progress Energy also announced it has selected Westinghouse Electric Co. to supply the reactors for its potential expansion in the Carolinas. The announcements reflect the importance that nuclear energy may play in the company's efforts to meet the demands of a rapidly growing customer base.

The company informed the Nuclear Regulatory Commission in August 2005 of its plans to submit a combined construction and operating license (COL) for a nuclear power plant. It updated those plans last November to include a second COL, one for Florida and one for the Carolinas. Each COL will cover up to two reactors at each site, the company said. This preliminary licensing work does not obligate the company to build a plant, but the steps under way could lead to a plant coming online — if ordered — around 2016.



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PHYSOR-2006

American Nuclear Society's Topical Meeting on Reactor Physics
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Web site: [//www.cns-snc.ca/physor2006/](http://www.cns-snc.ca/physor2006/)

October 16–20, 2006

International Safeguards Symposium on Addressing Verification Challenges

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October 22–25, 2006

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Contact: Arika Johnson

E-mail: registrar@nei.org

Phone: 202/739-8039

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Oak Ridge, Tennessee, U.S.A.

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Hyatt Regency Albuquerque and Albuquerque Convention Center
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December 11–15, 2006

International Conference on Lessons Learned from Decommissioning of Nuclear Facilities and the Safe Termination of Nuclear Activities

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[http://www-pub.iaea.org/MTCD/](http://www-pub.iaea.org/MTCD/Meetings/Meetings2006.asp)

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48th INMM Annual Meeting

Starr Pass JW Marriott Resort & Spa
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