JNMM

Journal of Nuclear

Materials Management

Published by the Institute of Nuclear Materials Management ▪ Volume XXVIII, Number 1 ▪ Fall 1999

JNMM

JNMM (ISSN 0893-6188) is published four times a year by the Institute of Nuclear Materials Management Inc., a not-for-profit membership organization with the purpose of advancing and promoting efficient management and safeguards of nuclear materials.

SUBSCRIPTION RATES: Annual (United States, Canada, and Mexico) $100.00; annual (other countries) $135.00 (shipped via air mail printed matter); single copy regular issues (United States and other countries) $25.00; single copy of the proceedings of the Annual Meeting (United States and other countries) $250.00. Mail subscription requests to *JNMM*, 60 Revere Drive, Suite 500, Northbrook, IL 60062 U.S.A. Make checks payable to INMM.

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Future Challenges Call for Continued Excellence

As technology speeds forward and policy and diplomacy race to catc up, the mission of the Institute of Nuclear Materials Management has never been more relevant than it is today. As was highlighted in the Closing Plenary session of the 1999 INMM Annual Meeting in July, global nuclear materials management spearheaded by professionals with a commitment to safeguards objectives is no longer pie-in-the-sky rhetoric but a real and realizable goal. Finding ways to bring this to fruition is one of the challenges the INMM will need to be prepared for in the near future.

On behalf of the Institute I would like to thank Laura Holgate, director of the DOE Office of Fissile Materials Disposition (MD), for the excellent presentation she made during the Opening Plenary session. Her description of the latest developments in MD programs helped set the tone for the Annual Meeting as she challenged attendees to think about the roles they will need to prepare for in the future. The text of her keynote address and the transcript of the Safeguards Roundtable, which featured Laura as the guest, appear in this issue.

Every two years the INMM membership elects a new president and vice president who, along with the secretary and treasurer, form the core of the leadership team. They work with the Executive Committee, members-at-large, and past president to conduct the business of INMM. These individuals, along with the members of the technical divisions and standing committees, possess a wealth of experience and talent. It has been an honor to serve as president this past year, and I am committed to continuing this tradition of excellence and responsible leadership as we face the challenges of the future.

We had another record-breaking Annual Meeting. There were 708 paid registrants, and attendance was well over 850 with spouses and guests included. The technical program was outstanding, with a total of 340 papers presented. Conference coverage, including summaries of several special sessions held during the Annual Meeting, begins on page 5. The quality of this meeting is a direct reflection of the dedication that members of the Institute put into planning and preparation. I would like to personally acknowledge the invaluable contributions of Technical Program Committee Chair Charles Pietri and the entire committee, Registration Committee Chair Chris Hodge, Exhibits Committee Chair Ken Ystesund and Poster Session Chair Sharon Jacobsen. Special thanks go to the INMM headquarters staff: John Waxman, Rachel Airth, Renée McLean, Lyn Maddox and Hilary Hitchner.

During the INMM Annual Meeting, the Fellows Committee met to discuss, among other issues, long-range planning for the Institute. Several items were mentioned as those INMM should consider as it looks to the future. These include activities that may affect the growth of the nuclear industry, activities of countries that have recently acknowledged their nuclear capabilities and opportunities for INMM to provide expert advice and assistance. Another issue discussed was a potential role for INMM in facilitating the transfer of "safeguards culture" to countries where it has not previously existed. As a nongovernmental organization, INMM has the ability to work colleague-to-colleague to share information about nuclear materials management and its important role in nonproliferation.

In 1998 INMM received Standing Observer status to attend IAEA General Conferences. In September of this year, Denny Mangan represented INMM at the General Conference in Vienna. Having Denny there to represent INMM provided a unique opportunity to get the word out about the activities of INMM and to stimulate thinking about the future of INMM in relation to changing roles.

In considering INMM's future, it is clear that many of the issues facing materials management professionals in 1960 — measurement techniques, packaging, waste management and data management, for example — are still prevalent today. However, many other new and challenging issues have confronted our discipline since then. As weapons dismantlement activities increase and material disposition alternatives are evaluated and ultimately implemented, there will be many more challenges facing the community. As we face the changing situation in international safeguards and issues related to the integration of INFCIRC/153 and INFCIRC/540, additional challenges are inevitable.

As INMM begins a challenging new year, I join the membership in thanking J.D. Williams for his outstanding support as vice president this year, Obie Amacker for his continued support as past president, and Lee Thomas and Rich Strittmatter for their service as members-at-large. I am looking forward to working with Paul Ebel and John Matter, who join Dave Shisler and Sharon Jacobsen on the Executive Committee.

I welcome suggestions from members regarding how we can serve you better or how INMM can better serve the international community. Please feel free to contact me.

Debbie Dickman
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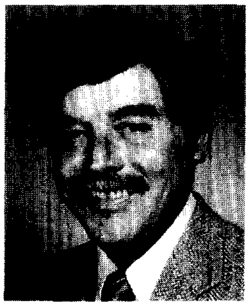
Annual Meeting Yields Variety of Papers Addressing INMM Concerns



The fall issue of the *Journal* generally tends to be interesting because of the variety of topics covered. This issue, I believe, exceeds the normal variety.

In the INMM News section, you will find a nice article by Charles Pietri summarizing the Institute's highly successful Annual Meeting. I would like to extend my thanks to Charles for a job well done. Following the INMM News section, you will find a transcript of the excellent plenary speech given by Laura Holgate, director of the DOE's Office of Fissile Materials Disposition. Her speech highlighted the roles and relationships the Institute's technologies play in her important program. This article is followed by the roundtable interview with Laura, conducted by the associate editors of the *Journal*, along with the INMM officers and selected committee chairs. This was my first opportunity to interact closely with Laura, and I found her to be quite knowledgeable, refreshingly open and certainly gracious. It was a pleasure to interview her.

There are articles included that summarize two special sessions at the Annual Meeting. I personally believe these two papers are excellent examples of how the Institute's Annual Meeting and sessions like these provide the forum to exchange ideas and information, to debate the issues and even to chart the paths forward. The first, "International Certified and SI Traceable: The Ultimate Aim for Reference Materials," covers a topic to which, I must admit, I have not given much thought. Yet it addresses a fundamental need for our measurement activities. The second paper is "U.S.-Russian MPC&A Lessons Learned." This paper, which covers a topic of which I have some limited knowledge, clearly delineates interesting issues that both the U.S. and Russian MPC&A communities are facing in Russia. One can surmise that communication and understanding appear to be at the root of most issues.

The final paper associated with the Annual Meeting in this issue is the summary paper for the Closing Plenary. The closing session focused on the subject of global nuclear materials management. This topic has been on the agenda of the Center for Strategic and International Studies in Washington, D.C., under the leadership of former Senator Sam Nunn. The five distinguished speakers first summarized the findings of the working groups they supported under Senator Nunn's leadership. Then, under the chairmanship of Pierre Goldschmidt, the new deputy director general for safeguards of the International Atomic Energy Agency, they participated in a closing panel discussion. If you have an interest in responsible nuclear materials management worldwide and share the vision encompassing the global management of nuclear materials to ensure their safe, secure and transparent use from cradle to grave, you will find the summary provided by John Matter and his team very interesting.

This issue closes with two papers not related to the Annual Meeting. W.G. Mitchell of New Brunswick Laboratory and G.A. Klemic of Environmental Measurements Laboratory have provided "The Consensus Standards Process for Nuclear Analytical Chemistry and Radiation Physics." Rest assured, these authors do an excellent job of describing the process of writing and balloting consensus standards for nuclear analytical chemistry and radiation physics. Achieving a consensus standard is not a trivial process; in fact, it appears to be quite a dedicated, iterative process requiring a degree of patience I probably do not personally have.

The final paper, titled "Joint DOE-PNC Research on the Use of Transparency in Support of Nuclear Nonproliferation," is authored by Toshiro Mochiji, Robin Keeney and Makiko Tazaki of the Japan Nuclear Cycle Development Institute and Charles Nakhleh, John Puckett and William Stanbro of Los Alamos National Laboratory. If you are interested in transparency issues, you will definitely enjoy this article. Differing views and opinions are presented by the respective sets of authors. Their analysis of the use of transparency in support of nuclear nonproliferation is quite thorough.

More *JNMM* News

At the Annual Meeting of the Institute in Phoenix, I had the opportunity to meet with the associate editors who attended the meeting. The major topic of conversation was the peer review process, and we came to closure on several issues. We initiated a beta test of the process, which at first blush appears to be working effectively. However, I do anticipate some tweaking to occur. As I have promised in the past, I intend to have an article on the process in a future issue of the *Journal*.

As INMM President Debbie Dickman notes in her message in this issue, I had the opportunity to represent the INMM as an observer at the 43rd General Conference of the International Atomic Energy Agency. I hope to provide a report in the winter issue of the *Journal*.

As always, I welcome any comments or suggestions you may have.

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Institute Recognizes Contributions, Bestows Senior Status

The INMM Membership Committee conferred Senior Member status on six INMM members during the annual business meeting of the Institute July 27 in Phoenix, Arizona, U.S.A. To attain Senior Member status, one must have membership in INMM for a minimum of five years, have at least 10 years of professional experience in the field of nuclear materials management and demonstrate a consistent professional contribution to the programs of INMM.

The new Senior Members are:

- Leslie Fishbone, Brookhaven National Laboratory;
- Albert Garrett, DOE Rocky Flats Field Office;
- Alexander Izmailov, ELERON (Minatom of Russia);
- Wanda Mitchell, New Brunswick Laboratory;
- Chad Olinger, Los Alamos National Laboratory;
- Michael White, consultant.

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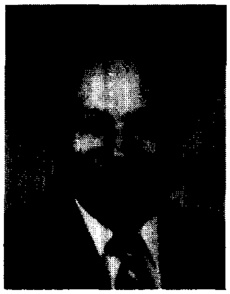
Report of the 40th INMM Annual Meeting: One to Remember



There is absolutely no doubt that the 40th INMM Annual Meeting, which took place at the Pointe Hilton at Squaw Peak in Phoenix, Arizona, U.S.A., July 26–29, was an outstanding, almost totally successful event. This conclusion is based on the overwhelming opinion of the meeting participants who provided comments to me directly, to others, and on the meeting evaluation forms.

Exhibitors had a 45 percent response rate to the evaluation form, with most giving the meeting a good-to-excellent rating, with some items such as the air conditioning being rated only as fair. We had only a 10 percent response rate from attendees, but those who did respond generally gave the pre-meeting process, technical information exchange and logistics a good-to-excellent rating, while some items (air conditioning again, and meeting room locations) were noted as needing improvement. Several positive suggestions for improvements were received.

As before, the most common complaint was that papers are not presented within the time allotment, making it impossible to attend paper presentations in parallel sessions. So, even after I cajoled, implored and finally browbeat speakers, after session chairs were empowered to control the time in their sessions, and after INMM laid out a precise schedule in the final program, there was still a problem with some speakers keeping on time. Suggestions for correcting this problem are welcome. I will be reporting on steps INMM is taking to address some of the other concerns expressed in the evaluation forms in a future issue of the *Journal of Nuclear Materials Management.*

Some of the more interesting comments made about the meeting were:

- "The INMM Annual Meeting can be considered as one of the best training seminars for both novices and experienced professionals." So send or bring your staff (or your boss!) to the next meeting.
- "Some of the issues presented do not have a counterpoint, i.e., there is little presentation of legitimate opposing views, although at times we've experienced some anecdotal comments that are not totally germane to the issues." Suggestions for solutions are welcome.
- "Quality is varied in some of the papers. There does not seem to be enough outstanding papers." This is a task cut out for the Technical Program Committee.

If you are interested in statistics, we had 708 attendees, 340 papers (including 28 posters in a presentation chaired by Sharon Jacobsen) and 43 sessions. In spite of the many paper cancellations before the meeting, this breaks the record. And, yes, it proved once again that we need to move on to bigger hotels with adequate lodging and meeting rooms. (One popular session — Nuclear Cities — still had standing-room only, even after a dozen chairs were added.)

Although I appreciate the many kind words directed to me about the meeting, credit goes to the Technical Program Committee, the Executive Committee, the exhibitors and sponsors, the beleaguered session chairs, our tireless INMM headquarters staff and, most of all, to the authors and speakers who continue to make significant professional contributions to the international nuclear materials management community through the INMM forum. Chris Hodge, Registration Committee chair, and his staff did their usual superb job of registering all the participants and solving a lot of problems before I even knew of them.

Our plenary speaker, Laura Holgate, director of the Department of Energy's Office of Fissile Materials Disposition, was a smash. What you may not realize is that Holgate was a last-minute surrogate for DOE Undersecretary Ernest Moñiz, who was asked unexpectedly to join Secretary of Energy Bill Richardson in meetings with Russian Minister of Atomic Energy Evgeny Adamov and other Russian government officials. Most of the meeting arrangements for Holgate were made while she was in Russia the week before the annual meeting! So July 26, the morning of the opening plenary session, found INMM President Debbie Dickman anxiously pacing, hoping our speaker would arrive on time. Holgate did not disappoint us; she gave a super commentary about the role of her office in disposing of inventories of surplus U.S. weapons plutonium and highly enriched uranium. She also described the technical support and implementation of the efforts to obtain reciprocal disposition of surplus Russian weapons plutonium. It was highly informative, very revealing and most reassuring, in that the program is achieving a level of success. Holgate was able to focus on what needs to be done to sustain the initiative to strengthen international nonproliferation efforts through proper fissile materials disposition. The follow-up interview conducted by *JNMM* Technical Editor Dennis Mangan at the INMM Roundtable later that day was even more enlightening, with some important and fascinating clarifications made. (Look for Holgate's plenary presentation on page 10 of this issue of the *Journal.* The roundtable transcript begins on page 15.)

Incidentally, to our collective knowledge, Laura Holgate is only the second woman to keynote an INMM plenary session, the first being Dixy Lee Ray, former chair of the U.S. Atomic Energy

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Annual Meeting *continued from page 5*

Commission, in 1988! Is INMM dragging its feet in this area? Any suggestions are welcome. On the other hand, we did invite Hazel O'Leary when she was U.S. secretary of energy, but she unfortunately had to cancel two days before the meeting to participate in congressional hearings.

The technical program continued to be enhanced for the second year as INMM went online again with the call for papers, abstract submittal and speaker's manual at the INMM Web site, providing for some improvements. For those of you who have finally mastered the abstract submittal and follow-up process this year, surprise! We will have a more sophisticated Web site submittal and database management system in place by the fall, which should greatly simplify the entire process for authors and allow us to manage the development of the technical program more effectively. Look for additional information by late October at the INMM Web site (http://www.inmm.org). Visit the Web site then to get familiar with the new scheme. It's not difficult, but it is new, and there will be a bit of a learning curve before you can become skilled in its use.

If you are even thinking of a paper for presentation next year in New Orleans, start preparing now. The deadline for abstract submissions is Feb. 1, 2000. Already, B.-K. Kim, INMM Korean Chapter president, is committed to another on-load reactor session next year; New Brunswick Laboratory Director Margaret Tolbert and her colleagues are planning another international analytical chemistry session about metrology in nuclear analysis. We all hope that John Matter will be able to come up with a closing plenary session that beats the super global nuclear materials management plenary he and his associates put on this year. (Look for the summary of this session in this issue of the *Journal* on page 31.) Now is the time to help set up special sessions for the 41st Annual Meeting; next spring may be too late. Let me hear from you soon.

The author, INMM President Debbie Dickman and Sergio Guardini of the European Commission Joint Research Center discuss the meeting's success after the Closing Plenary.

It was not all work at this year's meeting. The President's Reception July 25 was very well attended — a good opportunity greet familiar colleagues and meet new ones. No one left hungry (or thirsty) from this event. President Debbie Dickman and Vice President J.D. Williams made sure it was a success. We also had a nice reception for new members July 26, as well as an excellent awards banquet July 27.

INMM plans to distribute the proceedings of this meeting on CD-ROM by early fall. The response by authors to our request that they submit the final papers by July 15 was reasonably good. INMM cannot begin the production of the proceedings without all the papers in hand to collate, index, paginate, insert graphics and send off to the publishers. (It is not possible to "just fit in" a paper at the last minute.) There were some legitimate reasons for a few authors to request an extension, mostly problems with getting management and/or sponsor approval. However, for those others who did not contact INMM and did not submit their papers on time, there was no excuse. Remember: Authors agree to submit a final paper on time if their paper is accepted for presentation at the annual meeting. Anyone who does not want to prepare a written paper should not commit to presenting a paper either. INMM feels strongly that all presentations should be recorded in the proceedings of the meeting. If it is significant enough to be presented, it is important enough to be published: It's INMM's legacy.

So on to next year. If you think Phoenix was hot (that is, if you sneaked out of the air-conditioned sessions during the day), just wait till we get to New Orleans in 2000. Come prepared to stay cool indoors and participate in all the daytime sessions (a few evening ones, too) at the Riverside Hilton July 16–20, 2000. What a great way to celebrate the millennium! Plan for it now. You won't be disappointed.

Charles E. Pietri
Chair, INMM Technical Program Committee
Western Springs, Illinois, U.S.A.

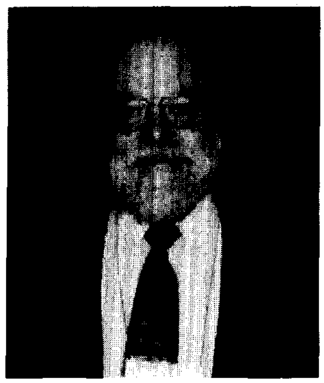
INMM Honors Outstanding Individuals, Corporation at Annual Meeting

At the 1999 INMM Annual Meeting, during the Awards Banquet July 27, several members and attendees received recognition for their outstanding service to the Institute and to the field of nuclear materials management.

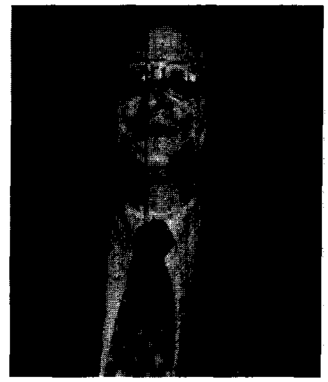
Frank Houck of the U.S. Department of State and Bruno Pellaud, former deputy director general of the International Atomic Energy Agency, were honored with the Distinguished Service Award. The Distinguished Service Award of the Institute of Nuclear Materials Management is one of the highest awards that INMM gives to individuals. Recipients are chosen for their long-term service to the nuclear materials safeguards and management profession as a recognized safeguards authority.

Sylvester Suda, Brookhaven National Laboratory, and Obie Amacker, past president of INMM, Pacific Northwest National Laboratory, were inducted as Fellows during the banquet, and Steve Kadner accepted the INMM Industry Award on behalf of Aquila Technologies Group.

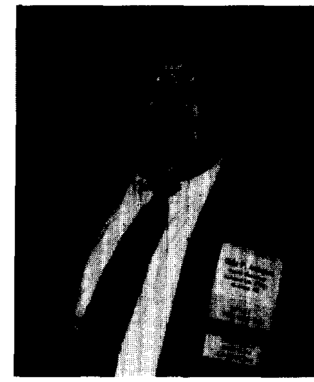
In addition, four resolutions of respect were made during the banquet in honor of members and friends of the Institute who had died during the previous year. These included Leonard M. Brenner, Priscilla Anne Dwyer, Vladimir F. Kossitsyn and Arthur John Martin Waligura.



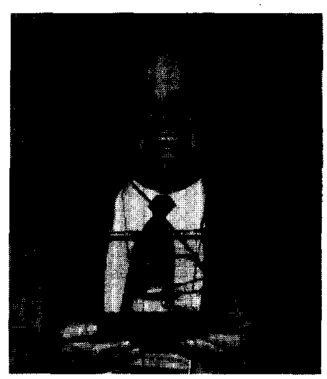
Frank Houck of the Department of State was honored with the Distinguished Service Award.



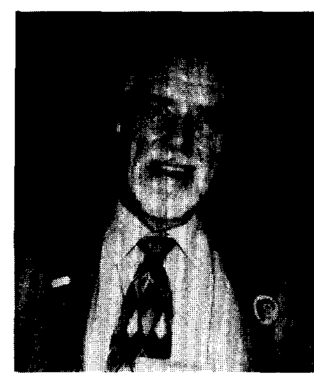
Steve Kadner of Aquila Technologies Group accepted the INMM Industry Award.



INMM Past President Obie Amacker was inducted as an INMM Fellow.



Jim Larrimore accepted the Distinguished Service Award on behalf of Bruno Pellaud.



Sylvester Suda of Brookhaven National Laboratory was inducted as an INMM Fellow.

The Institute of Nuclear Materials Management wishes to thank the organizations that generously supported the events of the 40th INMM Annual Meeting through sponsorships and advertisements. We also greatly appreciate the many exhibitors who took part.

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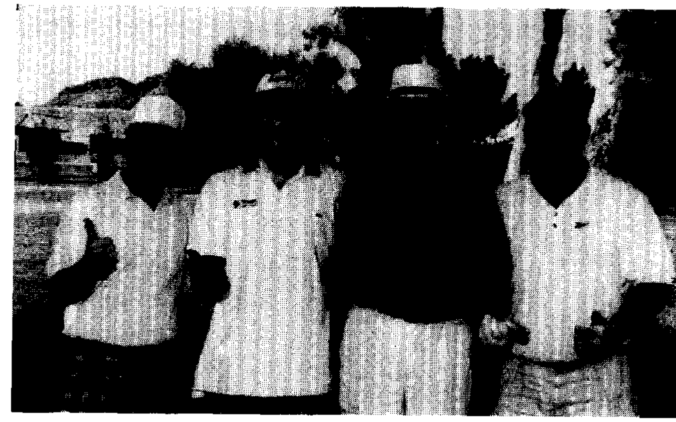
RussTech Language Services Inc.
TSA Systems Ltd.

INMM President Debbie Dickman (second from right) greets attendees during the President's Reception Sunday evening. Shown (l. to r.) are Dale Moul, Battelle Columbus; Glenda Ackerman, Pacific Northwest National Laboratory; Dickman; and Carlo Foggi, European Commission Joint Research Center.

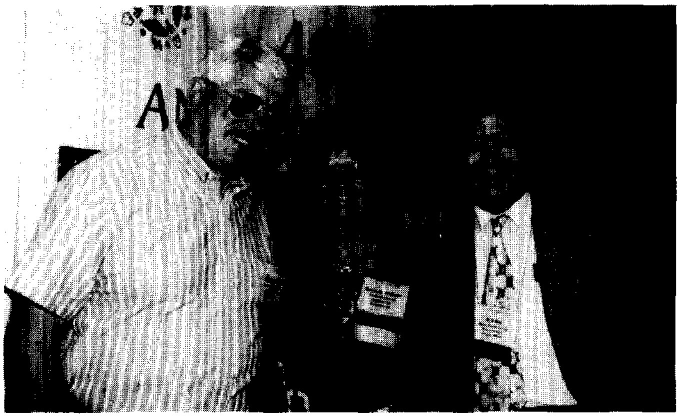
The President's Reception provided a great opportunity for attendees to visit exhibits and speak with representatives from a number of companies. Taking advantage of these opportunities are (l. to r.) Hideyuki Suzuki, Japan Atomic Energy Research Institute; Hironobu Nakamura, Japan Nuclear Cycle Development Institute; Satoshi Iwamoto, Japan Nuclear Security System Co. Ltd.; Junichi Iwatuchi, Nuclear Fuel Industries Ltd.; Shu Hashimoto, Sandia National Laboratories; and Won Woo Na, Korea Atomic Energy Research Institute.

Pat Belew and INMM Past President Obie Amacker get footloose during the INMM Awards Banquet.



Sixty people participated in the annual golf tournament, held July 25 at Marriott Camelback Golf Club in Scottsdale, Ariz. The first-place team, shooting seven under par, consisted of (l. to r.) Tom Headley, NAC International; Whit Creer, Pacific Northwest National Laboratory; Jim Farmer, also of PNNL; and Al Garrett, DOE Rocky Flats Field Office.

The Annual Meeting began with the well-attended President's Reception July 25 in the Exhibit Hall. Shown here, enjoying the music, food and company are (seated, l. to r.) Sharon Jacobsen, Executive Committee member at large; Barbara Cardwell; Roy Cardwell, former INMM president; (standing, l. to r.) Charles Pietri, Technical Program Committee chair; Jim Lovett, a former INMM president, of 21st Century Industries; Yvonne Ferris, also a former INMM president, of GEM Technologies; and Carol Raeder, U.S. Department of Energy.



The Annual Meeting concluded with a closing plenary session that featured a five-speaker panel discussing global nuclear materials management. Obninsk Chapter President Gennady Pshakin of the Institute of Physics and Power Engineering, INMM President Debbie Dickman, and Korea Chapter President B.-K. Kim of the Korea Atomic Energy Research Institute continued the discussion during the break.

Despite the early hour, the 3K Fun Run/Walk attracted 43 participants. Carrie Matthews, Pacific Northwest National Laboratory, took home the women's first place medal. Bob Kinzel of Sandia National Laboratories finished first among the men.

J.D. Williams, INMM vice president, pictured with his wife Wilma, enjoys the sights and sounds of the annual awards banquet July 27.

40th INMM Annual Meeting Committees

Many thanks go to the INMM members who played tremendous roles in making this meeting a success!

General Chair
James D. Williams

Registration Committee
Chris Hodge, Chair

Exhibits Committee
Ken Ystesund, Chair

Technical Program Committee
Charles E. Pietri, Chair

Glenda Ackerman
Obie P. Amacker Jr.
John Arendt
Wendell Belew
Dennis Bishop
Dennis Brandt
James Chapek
Ronald Cherry
Maureen Clapper
Pam Dawson
Deborah Dickman
Billy Cole
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Ruth Kempf
Dennis Mangan
John Matter
Steve Mladineo
Bruce Moran
Cindy Murdock
Steve Ortiz
Douglas Smathers
Cecil Sonnier
Richard Strittmatter
David Swindle
James Tape
Lyle Lee Thomas
James D. Williams

U.S. Fissile Materials Disposition Efforts

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40th INMM Annual Meeting Keynote Address
Phoenix, Arizona, U.S.A.
July 26, 1999

■

Laura S.H. Holgate
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Washington, D.C., U.S.A.

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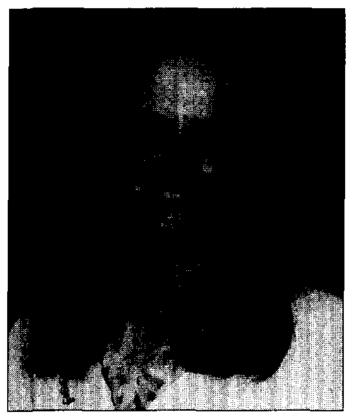

I am pleased to appear before you, representing the Department of Energy and, particularly, the Office of Fissile Materials Disposition. Undersecretary Moñiz was supposed to speak to you today, but he sends his regrets. He was asked to join Secretary Richardson in meetings with Evgeny Adamov, the Russian minister of atomic energy, and other Russian government officials. Dr. Moñiz asked me to represent him today because he believes the materials disposition program mirrors the crosscutting issues and interests of the nuclear materials management community. In looking at the attendance list, I'd surmise that many of you in the audience today are intimately aware of these disposition efforts.

Let me take a few moments to bring all of you up to date on the latest technical and policy issues associated with our efforts to reduce the global threat from surplus fissile materials.

Since the end of the Cold War, hundreds of tons of weapons plutonium and highly enriched uranium have become surplus to defense needs in both the U.S. and Russia. Weapons stockpiles are declining, arms reduction negotiations are proceeding, and weapons dismantlements are continuing. All of these actions will increase the stockpiles of surplus weapons materials. Given the current political instability and worsening economic conditions prevailing in Russia, there is a very real threat that nuclear weapons materials could be stolen or diverted into the hands of terrorists or non-nuclear nations. These materials could be readily fabricated into crude nuclear weapons for use not only against other nations but also in the U.S. against Americans.

The efforts to dismantle weapon delivery systems, secure nuclear materials and prevent the spread of nuclear weapons knowledge are key parts of the Administration's strategy to reduce the threat from weapons of mass destruction.

Within the Department of Energy, the Office of Fissile Materials Disposition is responsible for disposing of inventories of surplus United States weapons plutonium and highly enriched uranium. We also provide technical support for and implementation of Administration efforts to obtain reciprocal disposition of surplus Russian weapons plutonium. Over the past few years, we've defined an integrated program to consolidate and ultimately dispose of these surplus materials.

First, we are reducing the number of sites in the U.S. where surplus plutonium and highly enriched uranium are stored through a combination of storage and disposition efforts. DOE began shipping surplus plutonium pits from the Rocky Flats site in Colorado to the Pantex plant in Texas in April 1997, and we just completed those shipments. The department's plans call for moving all remaining surplus plutonium from Rocky Flats to the Savannah River site in South Carolina by 2002 for storage in the processing area of a former reactor building. Highly enriched uranium (or HEU) will be consolidated and stored at the Oak Ridge Y-12 Plant in Tennessee, pending disposition.

Secondly, since HEU can be made nonusable for weapons by blending it down, we will dispose of as much of the surplus HEU as possible by mixing it with other uranium to make low-enriched uranium that is commercially usable as power reactor fuel. Once blended down to low-enriched uranium, it cannot be used for weapons purposes without undergoing a long and expensive re-enrichment process. This approach advances U.S. nonproliferation goals, reduces storage and security costs and provides revenues to the Treasury from the commercial sale of these surplus assets.

President Clinton declared about 174 metric tons of HEU excess to national security needs. Because of the various forms of HEU and the dates the material will be available from weapons dismantlement and site cleanup operations, this downblending will occur over a 15- to 20-year period. We've already started the process by transferring title for about a third of the HEU to the United States Enrichment Corp., and downblending operations are under way. We expect to transfer additional amounts of HEU that isn't quite up to commercial nuclear utility specifications to the

Tennessee Valley Authority for processing and use in their reactors early in the next century. Other quantities of HEU will be downblended for commercial use over time. HEU that is unsuitable for commercial use will be disposed of as low-level waste.

Unlike HEU, many isotopes of plutonium can be made into weapons. The Administration will use a hybrid strategy to dispose of surplus plutonium as quickly as possible. This strategy relies on two independent but parallel processes. One process will convert the plutonium to a mixed oxide fuel for use in existing domestic commercial reactors. The second process will immobilize surplus weapons plutonium in a ceramic matrix surrounded by vitrified high-level radioactive waste. Both approaches will make the plutonium as inaccessible and unattractive for retrieval and weapons use as plutonium remaining in spent fuel from commercial reactors. DOE is pursuing the hybrid disposition strategy because it provides important insurance against unexpected difficulties with the implementation of either process by itself, and it helps ensure an early start for this important task. This strategy also provides the United States with flexibility and leverage in negotiating with Russia and our allies on the critical task of reducing Russian excess weapons plutonium. As we have found out, there is no universal agreement about the single best disposition approach; there are strong proponents for each plutonium disposition process.

Of the 50 metric tons of plutonium that have been declared surplus to defense needs, approximately one-half is in the form of classified nuclear weapons pits and clean plutonium metal. The Department of Energy plans to disassemble plutonium weapons components, separate the plutonium from other weapon parts, convert the plutonium to an unclassified plutonium oxide form and package the plutonium oxide for storage and subsequent disposition. The pit disassembly and conversion facility will use the Advanced Recovery and Integrated Extraction System (ARIES) process — a low-waste, modular pyrochemical process — to convert the pits and plutonium metal to plutonium oxide. This system was developed at Los Alamos and Lawrence Livermore national laboratories to reduce the environmental impact and worker exposure associated with handling plutonium. Our goal is to have a full-scale facility capable of processing thousands of pits per year. Once plutonium is converted into an oxide form at the end of this process, it is ready for use by either disposition pathway.

The first element of the hybrid disposition strategy involves the fabrication of plutonium oxide into a mixed oxide fuel and irradiation of this fuel in commercial reactors. Because MOX fuel is used in Western Europe on an industrial scale, the principal uncertainties for its use in the United States to dispose of surplus plutonium involve the cost and business arrangements. The department doesn't own the reactors needed to irradiate the MOX fuel or the facilities to make the MOX fuel. To address this need, the department recently entered into a contract with a private-industry consortium to design, construct and operate a MOX fuel fabrication facility and to provide the irradiation services using existing light-water reactors. This approach maximizes private-sector participation by teaming fuel designers and fabricators, architect and engineering firms, construction firms, and reactor operators, who will have full responsibility for construction and operation of the fuel fabrication facility and the modification and operation of the reactors to irradiate the MOX fuel. When the plutonium disposition mission is completed, the MOX fuel fabrication facility will be deactivated. To avoid promoting the civilian use of MOX fuel, a number of restrictions will be placed upon the MOX fuel fabrication facility. The facility will be government-owned and operated solely for the disposition of surplus U.S. plutonium, and the government will retain the right to terminate operation of the fuel fabrication facility either at the completion of the plutonium disposition mission or earlier, if required. With regard to safety, the MOX fuel fabrication facility will be regulated and licensed by the Nuclear Regulatory Commission. In the case of operating reactors, the reactor owners would retain their inherent responsibility for operating their reactors safely in accordance with their NRC licenses.

The second element of the hybrid disposition strategy involves the immobilization of plutonium. To dispose of impure metal, oxides and reactor fuel that is unsuitable for MOX use, the department is focusing on a can-in-canister approach for immobilization. Under this approach, these materials would be converted to a plutonium oxide and then immobilized with ceramic to form disks. The disks would be stacked and sealed in steel cans, which would be arrayed within large steel canisters into which vitrified high-level waste would be poured. The heavy weight — about three tons — and large size — about 10 feet high — of each steel canister, together with the highly radioactive waste barrier, increases the proliferation resistance of the immobilized plutonium. The can-in-canister approach will use vitrified, high-level waste from existing facilities at Savannah River. Subsequently, the canisters would be disposed of in a geologic repository.

Obviously, implementation of both disposition processes will be a challenge. In the next year, the department will proceed with the detailed design of the pit disassembly and conversion facility and the MOX fuel fabrication facility. We'll continue to test the pit disassembly and conversion prototype at Los Alamos, conduct fuel qualification, continue MOX fuel facility-licensing activities and initiate a MOX lead test assembly program. At the same time, the department will begin design of the immobilization facility, establish the technical baseline for the ceramic immobilization process, and develop and demonstrate production-scale processes and equipment to ensure that the facility can be successful in a timely and cost-effective manner.

In summary, the United States is proceeding aggressively with research, design and licensing activities for all three U.S. plutonium disposition facilities. This is necessary to maintain momentum in our efforts with Russia for a plutonium disposition agreement and serves as a sign to private industry, the public and the world community that the U.S. is serious about disposing of stockpiles of surplus weapons plutonium. We will not, however, begin construction of any new facilities unless there is significant progress on plans for plutonium disposition in Russia. This will avoid putting the U.S. at a strategic disadvantage in future negotiations with Russia and avoid the large-scale expenditures of funds until necessary. In this regard, there is much progress to report.

As with any international effort, we've worked hard to build trust and confidence with our counterparts in Russia. In July 1998, Vice President Gore and former Russian Prime Minister Kiriyenko signed a Scientific and Technical Cooperation Agreement. The agreement allows us to conduct pilot-scale tests and demonstrations of technologies needed to dispose of surplus weapons plutonium in Russia. We're jointly conducting small-scale tests of plutonium disposition technologies, such as plutonium metal conversion, VVER-1000 reactor development and modifications, conversion of the BN-600 breeder reactor to a plutonium burner, immobilization, and other operating and regulatory issues, as well as developing advanced gas reactor technology. This work will add to the technical knowledge base, confirm the viability of certain technologies and demonstrate the technologies that might be used for disposition of surplus Russian plutonium, once a bilateral agreement is in place.

At the Moscow Summit in September 1998, President Clinton and President Yeltsin signed a joint statement that committed our two countries to conclude a Bilateral Plutonium Disposition Agreement. The bilateral agreement would specify the schedules and objectives to be followed by each country, the types of facilities to be constructed or modified in Russia, commitments with respect to the financing of these activities in Russia, and, critically, the nonproliferation, transparency, verification and other conditions associated with plutonium disposition.

Serious negotiations on this agreement began last winter. The Department of State leads the U.S. delegation, with key negotiation and technical support being provided by my office. The Russian delegation is led by the Ministry of Atomic Energy (Minatom), supported by the Ministry of Foreign Affairs. The U.S. and Russian delegations have been meeting about every four weeks, with a goal of completing this agreement by September 1999. While there are many difficult issues still to be resolved, current indications reveal a significant commonality of vision on the content, structure and timing of this agreement.

Once the agreement is in place, the U.S. and Russia would each proceed with parallel programs with comparable, although not necessarily identical, rates of plutonium disposition. In Russia, this program would require the design, construction and operation of facilities to convert weapons plutonium metal into oxide and to fabricate MOX fuel, as well as to modify Russian reactors to permit MOX fuel use. To be fair, MOX is not Russia's preferred disposition approach. In the absence of a bilateral agreement, Russia's preference would be to store its plutonium for several decades and ultimately use it in advanced breeder reactors to make yet more high-grade plutonium. Russia realizes, however, that burning the plutonium as MOX in existing reactors is the only near-term approach to meet the political commitment to dispose of this material, and that no international support will be available for new breeder reactors in the near future. Russia has no plans to immobilize weapons-grade plutonium, which they consider an unacceptable waste of its energy content. The department intends to help Russia implement this bilateral agreement, starting with the $200 million provided by Congress last year. We expect to spend these funds for Russia over a number of years, once the bilateral agreement is reached. The $200 million will not cover the entire cost of implementing the agreement, which is likely to be in excess of $1 billion. Russia needs to contribute some resources, and the Administration plans to seek financing from the international community for a portion of this program. A significant portion of my time over the past year has involved negotiations in Moscow and in the United States. Let me provide you a status report on where both nations are in this important effort. There are five main areas that are our focus.

Material Covered

The presidents' summit statement called for the disposition of 50 metric tons of plutonium in stages; the agreement will cover the first 34 metric tons of weapons-grade plutonium from weapons programs. This is the total amount of excess weapons-grade plutonium the U.S. has available for inclusion in this agreement. Should additional material be declared excess by either side, the agreement will call for its inclusion either in this agreement or in some other agreement providing for similar transparency and disposition.

Disposition Techniques

The agreement envisions disposition of plutonium either as MOX fuel in nuclear reactors or through immobilization in ceramic, which then would be surrounded by vitrified high-level waste. Russia continues to express concerns about the U.S. plan to immobilize weapons-grade plutonium, but we are convinced we can find ways to assure Russia that immobilized plutonium cannot realistically be reused.

Disposition Rates

The agreement is based on a two-phase approach, which initially commits both sides to dispose of their plutonium at a rate of at least two metric tons per year, the estimated maximum capacity of existing Russian reactors. By next June, a plan would be developed to identify additional reactor capacity inside Russia and outside Russia in the developed world to permit the doubling of disposition rates.

Financing

Russia has made clear that acceptance of near-term MOX-based disposition is dependent on the provision of assistance from the U.S. and others in creating the requisite infrastructure. Russia will provide land, some facilities, labor and technology, but the bulk of the capital investments will be the responsibility of the U.S. and other nations. In this regard, having $200 million appropriated for this purpose has made the difference in the Russian decision to take this negotiation seriously. President Clinton's Expanded Threat Reduction Initiative pledges an additional $200 million in budget requests for plutonium disposition over the next five years. The agreement we are negotiating would codify our ongoing efforts to develop with other parties a plan for full financing of the Russian disposition effort within the year, including the doubling of disposition capacity, for which costs have been estimated at between $1.5 billion and $2 billion.

Transparency, Verification and Nonproliferation Conditions

The agreement will include commitments that activities on both sides are carried out with appropriate transparency and IAEA verification to ensure that the right material is being used in the facilities, that the disposition rates are as agreed and that the disposed material meets certain agreed standards. Furthermore, both sides will agree that they will not reprocess disposed plutonium until all 34 tons have been disposed of and that immobilized plutonium will never be reseparated. Both sides will also agree that any exports of MOX fuel would be subject to the approval of both parties. The U.S. will have auditing rights to ensure that its assistance is properly used. Russia has not objected to any of these commitments.

Dr. Moñiz asked me to come here today to speak to you about this subject because of the strong link between the department's efforts to dispose of surplus fissile materials and the Institute's efforts to ensure that nuclear materials are properly protected, managed, handled, stored and used for purposes approved by treaty or law. The Department of Energy also employs a variety of scientific disciplines in our efforts to advance U.S. nonproliferation objectives associated with sound nuclear materials practices. Disciplines draw upon the fields of accounting, auditing, mathematics, statistics, physics, chemistry and engineering, to name but a few. And, like you, we too are heavily involved with packaging, waste management, transportation and international safeguards. The similarities don't just stop here but touch upon the work being conducted by each of your six technical divisions.

In the area of international safeguards, we have already placed in excess of 10 metric tons of surplus U.S. highly enriched uranium under IAEA safeguards, and efforts are being made to introduce international safeguards during the downblending process for some 50 metric tons of material that has been transferred to the United States Enrichment Corp. For surplus plutonium, our goal is to place this material under international inspection as soon as practicable. While efforts have focused on negotiations with Russia, I expect that, as soon as a bilateral disposition agreement is in place, most, if not all, of the unclassified portions of the three U.S. disposition facilities will be offered for IAEA verification under appropriate agreements. During the disposition process, the United States and Russia are planning to store, transport, convert, fabricate, immobilize and irradiate many tons of surplus weapons-grade plutonium. Each of these steps will be conducted under the highest standards of material control and accountability, not only to protect against the unauthorized theft or diversion of these materials but also to convince the world community of the irreversibility of the weapons dismantlement process. As I stated earlier in my remarks, our principal focus is on disposing of inventories of surplus weapons-usable plutonium and highly enriched uranium. Denying a potential proliferator access to these materials is the principal barrier to acquiring a nuclear weapons capability. These disposition activities — along with other Administration efforts aimed at dismantling weapons delivery systems, securing nuclear materials and preventing the spread of nuclear weapons knowledge — are part of the Administration's nonproliferation and arms control strategy to reduce the threat from weapons of mass destruction. Built into all of our storage and disposition plans is the need to provide adequate levels of physical protection for these surplus weapons materials. Whether we are talking about the storage of surplus nuclear weapons pits at Pantex, the transportation of mixed oxide fuel to U.S. commercial nuclear power plants or the immobilization of plutonium oxide in ceramic matrices, all will rely on an extensive system of physical security measures to protect the materials from theft or diversion. While Savannah River has been named as the preferred site for all three plutonium disposition facilities, packaging and transportation are essential for moving the material from numerous DOE sites including Pantex, Hanford, Idaho and Los Alamos, as well as from Savannah River to the commercial nuclear reactor sites and, ultimately, transporting the immobilized waste form and spent MOX fuel to a high-level waste repository. Highly enriched uranium, too, requires packaging and transportation from its storage location at the Y-12 plant in Oak Ridge to the downblending facility and, ultimately, packaging and transportation to the commercial utility where it will be burned as low-enriched uranium fuel.

While the disposition of surplus weapons-usable fissile materials addresses U.S. nonproliferation and arms control interests and not waste disposal efforts, we do have a strong relationship to waste management efforts. The Environmental Management Program within DOE focuses on many of these same nuclear materials, but they are found in trace minute quantities on gloves and shop wrenches or spread throughout millions of gallons of high-level wastes. The primary difference is the separation or ready accessibility of the surplus plutonium and highly enriched uranium for use in nuclear weapons. All this is not to say that materials disposition and waste management are totally separate from each other. In fact, the two programs are closely linked. As waste is generated throughout the disposition cycle, it is transferred to Environmental Management for disposal; and, as the stabilization and cleanup process produces quantities of separated plutonium and highly enriched uranium, it is transferred the other way for disposition. One example of our continuing awareness of waste management impacts is shown in our efforts to minimize the generation of waste in the first place. The current design for the pit disassembly and conversion facility relies on a pyrochemical process to convert plutonium to an oxide. This process reduces the amount of TRU waste generated by more than a factor of 10 over the historical aqueous process of chemical dilution. We're also using this process in the immobilization facility. From another perspective, we're generating saltshaker quantities of waste rather than gallons of liquid waste. This is good for my program, and for the department and the environment.

The department's fissile materials disposition program has come a long way in a short time to build the domestic and international consensus necessary to begin disposing of surplus highly enriched uranium and plutonium. The program has led U.S. efforts not only to identify a hybrid strategy for disposing of surplus weapons plutonium, but also the implementation of this hybrid strategy. We have a good program; it's well defined and focused. We have good people doing the work, including many in this audience. And Congress has recognized our accomplishments by funding us at virtually our requested level each year since they created the program. We obviously appreciate that fact.

Laura Holgate was named director of the U.S. Department of Energy's Office of Fissile Materials Disposition in August 1998. This office contributes to national nonproliferation and threat reduction goals by consolidating and disposing of excess weapons plutonium and highly enriched uranium in the United States and Russia. Previously, she served as special coordinator for cooperative threat reduction at the Department of Defense from August 1995 to August 1998, where she provided policy oversight to the Cooperative Threat Reduction "Nunn-Lugar" program of U.S. assistance to Russia and other former Soviet states in eliminating the weapons-of-mass-destruction legacy of the Cold War. She also oversaw Department of Defense policy governing U.S.-Russian cooperation on a wide range of fissile material activities. Holgate served for two years as special assistant to Ashton B. Carter, assistant secretary of defense for international security policy. She spent six months at the Arms Control and Disarmament Agency working on the Clinton Transition Team and as special assistant to Thomas Graham, acting director of the ACDA.

Holgate's academic credentials include a bachelor's degree in politics from Princeton University, a master's degree in political science from Massachusetts Institute of Technology, and two years on the research staff at Harvard University's Center for Science and International Affairs at the Kennedy School of Public Affairs, where she wrote several articles and book chapters. She is a term member of the Council on Foreign Relations and serves on the Executive Board of Women in International Security. In January 1997, Holgate was awarded the Defense Medal for Outstanding Public Service, and, in September 1998, she received the Bronze Palm to that award. Holgate and her husband live in Fairfax, Va.

14th Annual INMM Safeguards Roundtable

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40th INMM Annual Meeting
Phoenix, Arizona, U.S.A.

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Guest:
Laura S.H. Holgate
Director, Office of Fissile Materials Disposition, U.S. Department of Energy

Participants:
Janet Ahrens
JNMM Associate Editor
Physical Protection Division

Obie Amacker
INMM Immediate Past President

Robert Curl
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Vince DeVito
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Bernd Richter
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Scott Vance
JNMM Associate Editor
Packaging and Transportation Division

Dennis Wilkey
JNMM Associate Editor
Material Control and Accountability Division

J.D. Williams
INMM Vice President

Representatives of INMM's Executive Committee and technical divisions met during the 40th INMM Annual Meeting to interview Laura Holgate, the keynote speaker and guest for the 1999 INMM Safeguards Roundtable.

Holgate was named director of the U.S. Department of Energy's Office of Fissile Materials Disposition in August 1998. Previously, she served as special coordinator for cooperative threat reduction at the Department of Defense from August 1995 to August 1998. She also served for two years as special assistant to Ashton B. Carter, assistant secretary of defense for international security policy. She spent six months at the Arms Control and Disarmament Agency working on the Clinton Transition Team and as special assistant to Thomas Graham, acting director of the ACDA.

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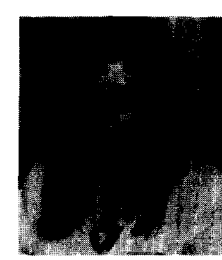
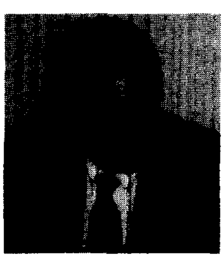
Debbie Dickman: Laura, your program is one some people haven't heard a lot about. What kind of problems have you encountered in getting the word out about your progress, and how might a forum like INMM be of help?



Laura Holgate: Among other information sources, we have a Web site (www.doe-md.com) as a way for people to get more information. It contains much on environmental impact statements, but also many basic fact sheets and updates on what's going on with the program. So that is one method. But the problem is bigger than that. Another source of information is the annual conference that is held in Washington entitled *Management and Disposition of Nuclear Weapon Materials: The Disposition of Weapons Grade Plutonium and HEU*, which attracts people involved on all sides of these multifaceted issues. The conference organizers will publish materials that were presented at that conference. My goal at this year's conference was to get a less nuanced and more hit-over-the-head message that we are moving on this stuff. I attended the previous conference when I was trying to decide whether or not I wanted to take this job. The things that I heard there indicated the U.S. and the Russians seemed miles apart. The U.S. program seemed bogged down with the various NGOs and their differing perspectives, sort of like tying down Gulliver: each of the organizations, pro and con, had tied a string of "dental floss" around the program putting it in a state of paralasys. I felt that was where the U.S. program was a year or a year and a half ago. Then a variety of things that I can't really analytically explain motivated the significant move on the U.S.-Russia front and now that's been able to be played back in the U.S. program. It's actually quite amazing, the changes that have occurred over the last year and a half in this program in its maturity and the narrowing of technologies and the clarifying and resolving of the various policy issues. I think it's really astounding.



James Tape: I think the Russian attitude toward the program is something that we are very interested in. If there's more you could say in this forum, that would be great. Another thing: Is there more you could say about what the sticking points are and what the areas of agreement are?

Holgate: Sure. The areas of agreement make a longer list than the sticking points, which I attribute to the progress we've made in the last several months of negotiations. We all agree that we're talking about 34 tons, that it's from weapons programs, that we're not going to try to confirm weapons origin, as is important elsewhere in some of the U.S.-Russian cooperation programs. We are going to confirm weapons grade as part of the process. Basically, the surrogate for "Is it from a weapons program?" will be "What physical location does it come from?" If it comes out of the Tomsk and Krasnoyarsk facilities, we pretty much know that it was associated with production for weapons. If it comes out of the Mayak Fissile Materials Storage Facility that the CTR guys are building, then we know they have that high threshold that it has to be weapons origin, so we can pretty much accept it when it comes into our disposition program. Those are the only three sources of material that the Russians have told us they expect to tap to find their 34 tons. And those are perfectly fine to us. If it comes out that they have other places that they want to bring it from, we'll have to, of course, look at those and see if they make a reasonable case that it's from a weapons program or associated with a weapons program in some way, shape or form.

We have agreement on what material we're talking about and on when the monitoring starts. We are talking about beginning the monitoring of that material at the time that it goes into the first disposition facility. We're not talking about trying to monitor storage between now and disposition, basically because that's being covered by other parts of the administration's transparency initiatives; the Trilateral Initiative, for example, if it gets up and running, will cover storage, so we're not trying to do that.

The other areas of agreement are that we're both trying to find that middle ground between our two very different visions of the fuel cycle. They obviously remain committed to a closed fuel cycle. We obviously remain committed to an open one. We're trying to find ways that protect nonproliferation concerns without prematurely closing doors in these various fuel cycles. One example is in the reprocessing provision, where the agreement will include a commitment by both sides — but obviously it's the Russian side that you're worried about here — not to reprocess any of the material until after all the material has been burned as MOX fuel. We knew that they would never accept a "no reprocessing forever" goal. But certainly, by the time we end this 34 tons, it may well be that the economics of reprocessing will prove themselves in the negative and the motivation will be reduced. Anyway, it moves that issue into the future, and it prevents an internal recycling where the capacity of these facilities to dispose of material is disrupted by a recycling of material. The goal is to get everything at least through once before doing that. And that has not been a challenge from the Russian perspective either.

Things that have been difficult include the Russian acceptance of the U.S. immobilization pathway. That's basically going to have to be made on a gut level by senior political people in Russia. The Minatom folks across the table from us recognize that this whole notion that we will someday go in — a hundred, 300 years from now — and bring the plutonium out of this immobilized form is fantasy. They know that it's fantasy. But there is this absolute ideological commitment to parity within the Duma and within the high levels of the Russian political structure, and if they see U.S. pursuing two pathways and them pursuing one pathway with plutonium, then they're going to wonder why the U.S. gets to do two. I doubt the Russians would ever turn around and say, "Oh, well, we could do two, too, if we wanted to." We told them, "You can immobilize all 34 tons. You can immobilize however much you want. That is not a problem for us." But, of course, that is not what they are interested in doing. We've even jokingly offered to store the U.S. immobilized material on Russian territory. I say jokingly, as part of our over-and-over explanation that this is not a risk. But they have to find a way — "they" meaning Minatom and the experts — to make these arguments compelling to the political folks. That's a big challenge yet to be faced.

The other big challenge has to do with when the agreement is to end. Are there things that continue beyond this agreement? The U.S. position is that, if the West has helped Russia build these facilities, has invested $2 billion in putting these together and has made one of the conditions of doing that international inspections and transparency in these facilities, then the end-point of getting rid of the 34 tons doesn't mean that the Russians can kick the international community out of those facilities. If they want to operate them for civil plutonium, there's nothing in the agreement that prevents them from doing that, but they need to do it under some kind of international monitoring system. The international monitoring and the Russian commitment to not undertake negative proliferation actions persists beyond the point of disposition of the 34 tons or whatever material may ultimately be included under this agreement. The Russians are very clear about that. They would like to have a disposition agreement that can be terminated at will by one side, and their argument has a sound basis, which is that no one has shown them the money, at least not enough money, yet. They want to say, "Hey, listen, we don't want to be bound by things when we aren't even sure how they're going to get paid for." We've accepted that and tried to meet that concern in other ways.

But unilateral termination rights we think goes beyond the appropriate level of protection for them. What we offer in response to that legitimate concern is that for each of the commitments on the Russian side — to go to two tons per year capacity initially and then, based on completion of a multilateral structure for support and financing, to double that — they're not obliged to do any of it in the absence of certain funding being manifest in the conclusion of those kinds of binding agreements. Those are the two biggest issues at this point, as far as disagreements go. That's pretty manageable in the broad scheme of things, given where we started in February.

Bernd Richter: Coming from a non-nuclear weapons state, I'm interested in learning how you're going to involve the IAEA in this process of plutonium disposition. You are going more toward the option of the direct disposal, so you need safeguards on that, because in the spirit of the Nonproliferation Treaty, the excess material should be submitted to IAEA safeguards or international safeguards. And if the Russians are going the recycling way, their reprocessing should come under international safeguards also. Can you elaborate on that a little?

Holgate: Certainly. On your last point, the executive agreement does call for any reprocessing done by either side to be submitted for safeguards.

Richter: IAEA safeguards?

Holgate: Yes. That's a subpoint to the broader point that the agreement envisions that each side gains bilateral inspection rights over the other as a result of this bilateral agreement. But the agreement also commits each side to develop appropriate agreements between the U.S. and the IAEA and Russia and the IAEA, to allow the IAEA into these facilities and get involved with this material as soon as it becomes unclassified. For the U.S. this will occur at the back end of the pit disassembly and conversion facility and throughout in the immobilization and the MOX fuel fabrication facilities, and certainly to the degree appropriate at the reactors. The Russian system may be a little different because their isotopics remain classified longer than ours do, so that still needs to be worked out.

I don't think either of us is perceiving that the current understanding of full-scope safeguards would be what those bilateral agreements would envision. Rather, it will be something akin to the idea being pursued in the trilateral agreement, in a verification regime, somewhat different from safeguards and more tailored to the reality that the "significant quantity" obviously means something different in a weapons state than in a non-weapons state, as do the termination of safeguards.

Then the agreement provides that, once those bilateral agreements are reached, each side may consider the IAEA's application of those approaches to meet their *bilateral* inspection rights. But the bilateral inspection rights never evaporate. What we don't want to do as a practical matter is have bilateral inspections that duplicate IAEA inspections, but we don't envision delegating that right to the IAEA. We envision allowing IAEA inspections to meet those bilateral rights. So the short answer is we see IAEA involved very quickly, very early and very fully in the disposition process.

Richter: So that doesn't mean that you envision full-scope IAEA safeguards?

Holgate: No, we don't.

Richter: And the final disposal issue: Do you envision using the Waste Isolation Pilot Plant for the material?

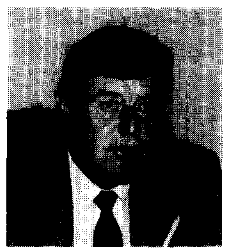
Holgate: The material that's being covered by this agreement will all end up, in one way or the other, whichever disposition path in the U.S., in Yucca Mountain or its analog. Some of our surplus material will go to WIPP, but it's not part of the 34 tons that's being handled by the agreement.

Dennis Wilkey: If IAEA must become involved as a result of the bilateral between the U.S. and Russia, doesn't that imply an expense on our part, and second, does it imply an attempt on our part to help the Russians come under IAEA?

Holgate: How IAEA involvement is funded will certainly have to be part of those parallel bilateral conversations between each of us and IAEA.

Wilkey: But logic and reality say some funds — a lot of money — is going to come from us.

Holgate: Yes, clearly, the funding issues — to a certain degree — motivate a movement toward a verification approach as opposed to a safeguards approach, but even a verification approach would cost money. I don't think we have a very clear picture — we certainly don't have a joint view with the Russians — other than that the Russians are convinced that they won't be able to pay for anything. So on the Russian side, if the IAEA doesn't pay for it, then they're likely to come to the West. But the head of the U.S. delegation negotiating the agreement is involved in the cutoff treaty negotiations as well. His view is "Listen, everybody gains from this, so we ought to create a system where IAEA gets the money it needs to do the job." That sounds great. I hope it works.



Mangan: In your keynote talk, you mentioned five points which I won't elaborate on now, but one that I noticed was missing was with regard to security features, physical protection or MPC&A kinds of activities and any agreement that we have with the Russians in this whole area. Would you care to elaborate on what plans there are for the security side of *this*?

Holgate: Sure. The way the agreement treats MPC&A is it has a clause that the Russians actually beefed up. Initially the clause said something about each country meeting its own national standards on a whole series of things, including MC&A and physical protection, environmental regulations, and so on. It was a one-sentence article. The Russians came back and proposed that we use the IAEA INFCIRC/225 Rev. 4 as the baseline for physical protection and for the new facilities that would be created. We said, "Great!" But, again, it's each country's national responsibility to do that. Obviously, as we look on the U.S. side, that's pretty straightforward; on the Russian side, where you've got other people supporting the Russians, it's more of an international negotiation about what the Russian national standards are. *This* is the overall safety, environmental and health concern and it's a policy decision that's in our future. Clearly, *you* meet Russian standards, but if you've got international support, you may meet higher standards yet. What would be a reasonable set of international standards to meet when it comes to the safety levels for these facilities? As far as physical protection issues, we've got a solid international standard. That's going to be something that we, meaning the Western group of assistors, whoever that turns out to be, will obviously provide adequate funding for as we construct and modify the Russian facilities to meet those standards. The safety ones are tougher. We've included at various points in the agreement references to licensing; that's an important step in getting these facilities actually functioning and getting disposition under way. We have a more explicit set of interactions with them under the July Science and Technology Agreement, where we're helping them; we're actually putting together a plan to get Gosatomnadzor (GAN), the Russian counterpart to the NRC, able to function as the regulator for these facilities. They have a similar situation to the NRC. Russia has not ever had an industrial-scale MOX facility; neither have we. Our NRC is learning, and their GAN has to learn, and we're providing some funding to help GAN do its due diligence and get access to expertise, whether it's in Minatom or in Europe. Now the thing that had been assumed: many people on the Western side believed that the regulatory structure for the light-water reactors would be straightforward, so you could just import huge chunks of it from the European experience. But, what GAN has made clear is that politically and technically that's not acceptable for them. They may be able to use some of that data as input to their analysis, but they're going to do the analysis. So *we're* going to ensure that we have the contracting structures to help get them the funds and the support to do that in a way that that doesn't delay the Russian disposition process.

Mangan: For the $200 million that Congress has appropriated for the Russian side of this disposition activity, do you have an obligation to Congress? Specifically, do you have to go back to them, on a yearly basis say, similar to what's happening in the Mayak program, where they have to go back and say that the material stored there is weapons-origin, and is safe and secure? Certainly, the CTR folks are sensitive to that aspect of the Mayak. Do you have that same kind of obligation?

Holgate: It is, frankly, amazing to me after having worked on CTR for five years — seven years if you count the time when I was at Harvard when we were putting the concepts together — when the legislation was being written. That was such a politically controversial concept, just the whole CTR concept overall, apart from the specifics of Mayak, of providing money from the defense budget to Russia to help them do things that they were already obligated to do. That whole concept became wrapped in this incredible maze of policy hurdles, and those have increased rather than decreased over the years. Every year the defense authorization committees add more hurdles, wrap it up in more and more policy concerns. And when I got the legislation for this $200 million, I about dropped my teeth. It's about a page long. And it's only from the appropriations side; there is no authorization language on that money. The authorization tends to be where you get all those conditions. I have three conditions in that legislation that gives me that $200 million. One is that we get an agreement. Second is that we present Congress with a breakdown of how we'd spent the money, sort of an ex post facto budget justification, because they gave us that money without us asking for it and without us having a clear picture of how it would be spent. It's reasonable for them to ask us to come back and say, "OK, here's how we'd run that *down*." The third is for OMB to do a series of things that have already been done about declaring this an emergency or some sort of "budget-ese" that goes back and forth between the Administration and the Hill. It has do with the fact that this money was included in an emergency appropriation. So that's already been taken care of. Nothing beyond that, and — God willing — it will stay that way.

The other source of funds for this program has been through my normal annual budget requests. It was $25 million for FY 2000, and between FY 2000 and FY '04 we're going to have a total of $200 million requested for Russian plutonium disposition. It'll sort of ramp up over those five years as part of the Expanded Threat Reduction Initiative from the president's State of the Union speech. That money, which does get some scrutiny by the authorization committees, in some cases some of the same people who do the CTR stuff, has also remained amazingly free from policy restrictions. I don't exactly know how to account for that except that it's sort of born anew in a slightly more friendly environment on the Hill to the notion of supporting Russia with U.S. funding. And it's not coming out of the defense budget, which may also help.

Holgate: But Congress, and specifically Senator Domenici, on a frequent basis make it clear that they're holding us accountable and they want to see some action and that that money is not indefinite. We've used this argument to great effect with the Russians, because we almost lost it this summer and we managed to pull it back.

Holgate: We were successful in communicating to an adequate number of people that voted for it that to take the money back in the middle of a negotiation is the surest way to kill it. This was earnest money; this is a downpayment on the negotiations. This was not a budgetarily rigorous request that had all kinds of promises about how quickly it would be spent. Ultimately we were successful in making that argument, but the longer life goes on, the more difficult that argument becomes, and it's going to be a challenge to hold onto it if we don't have this agreement pretty close to when we've been telling people we want it.

Cathy Key: Laura, going back to your discussion concerning GAN, you mentioned their role in this process and talked about the licensing. Is it the intent to use GAN for monitoring this project also, and potentially for measurements?

Holgate: You mean verification-type measurements?

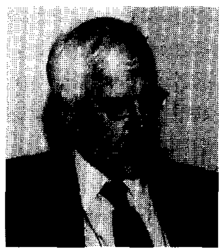
Key: Yes.

Holgate: For those things that will be bilaterally monitored, it will be a U.S. monitoring team. For those things that would be internationally monitored, it would be an IAEA team.

Key: So the GAN role will just be for licensing?

Holgate: Yes. Well, for licensing and whatever their regulatory role is within Russia. We're not limiting that role. If one can conceive of a verification regime that does have some unilateral unconfirmed reporting, it may be that some of those come from GAN-type measurement. I'm just speaking hypothetically here. We certainly don't see them as substituting in any way for a non-Russian confirmation of certain nonproliferation concerns being met.

James Lemley: I wonder if you could say a little bit more about the verification of measurements, etc. For example, you mention that verification of facility of origin was going to be important in accepting weapons program materials, and then you mention weapons grade verification.



Holgate: We do consider it important to have a confirmation of the isotopics. We're looking at sort of a red light/green light approach with information barriers, given that at that stage it will still be a sensitive isotopic ratio from the Russian perspective.

Lemley: Will there be verification activities at the facilities you mentioned, the facilities of origin at Tomsk and Krasnoyarsk?

Holgate: There already are verification activities. Each of the Tomsk and Krasnoyarsk facilities is currently captured in the Plutonium Production Reactor Agreement. There are measures associated with that. The Mayak Fissile Materials Storage Facility will have — God willing — verification measures associated with that facility. Both of those agreements call for those materials to be passed off to an appropriate regime if they move out of those facilities. We don't expect there to be any overlap between the verification measures that are being done at the Tomsk and Krasnoyarsk locations and the verification measures that we intend to do at the disposition facilities.

Charles Pietri: Laura, for the first time in, I guess, nearly two decades, I became excited about a technical program that DOE was getting involved in, and that's the MOX conversion. I don't see any insurmountable technical problem with it, but we know that there are political and social implications that maybe you would like to talk about as to the success of this proposal to do MOX conversion for commercial energy generation.

Holgate: I was really pleased to see that we had such a strong set of bidders for the MOX option and that we were able to select such a strong team. I think the Duke-Cogema-Stone & Webster team has a superb reputation, whether from the design end, from the fuel performance end or from the reactor operation end. Obviously, there is a group of folks who are trying to hold us up. Currently, they're using the environmental impact statement process to try to do that.

Pietri: Do you feel that you have political support for this MOX option?

Holgate: I do. I do. We're just not going to reach our goals any other way than to pursue this.

Pietri: That's great to hear.

Holgate: The Secretary of Energy presided over the signature of the Duke-Cogema-Stone & Webster contract, and he was personally involved in some of the siting decisions. This is a program he's very aware of. I think we're going to get through this initial battle, then the antinuclear organizations are going to come at us when we apply for the NRC licenses. I think that's the next battleground. At some level, there will be a limit to what we can do because those licenses will be requested not by the department but by the contracting team. Obviously, we can work with both the Contractors and NRC. We've been working with the NRC to make sure that they know what they need from us, and that we can provide compelling answers to their questions regarding the licensing process.

Pietri: The news media, of course, doesn't give you this impression at all. It's all negative, and it looks like it's not going any place, that it's foundering, so I'm pleased to hear this.

Richter: If you are going to use MOX, the greatest experience with commercialization of MOX fabrication and usage is in the Western European states. Are you going to involve them?

Holgate: You mean as countries instead of as companies?

Richter: As suppliers. Well, either way, as companies or as nations.

Holgate: Cogema is part of our consortium, and Belgonucléaire is a subcontractor under our broad consortium. I will not be at all surprised if BNFL comes in at some point. So I think we're going to be pretty well covered as far as the corporate side. Now, whether our NRC chooses to involve themselves with any of the European regulatory bodies in terms of seeking to benefit from their knowledge, I do not know. But I think on the technical side, we have the mechanisms we need to get access to experience.

Wilkey: That raises a question in my mind, and I realize it's not really within the scope of issues that you have to worry about, but NRC hasn't done plutonium, of course. How close are they to being ready for this? How much of a chance is it that they're going to be part of the obstacle, not deliberately, but just because it takes time to put a regulation in place?

Holgate: Well, we've been working with them very closely for the last year and a half and sharing our schedules with them and involving them in the technical development of our work so that they're as knowledgeable as possible. They have not thrown up any red flags at this point or said, "That schedule's unreasonable because we need two years," or whatever, to analyze the stuff.

Wilkey: I guess the concern is, unlike DOE, they have to pass a law to get their regulations in place. As far as I know, they always have.

Holgate: That's not been my understanding of the particular regulations that we're working on here. There has been a law passed that gives them responsibility over the MOX facilities. If that's what you're thinking of, we've taken care of that hurdle, where it's clear that the NRC has the legislative authority to regulate the MOX fuel fabrication facilities and obviously any reactors.

Tape: I wanted to ask a different question, since we seem to be in issues on the U.S. side, and that has to do with immobilization. The last I knew, the National Research Council was taking another look at whether or not the immobilization path that you have chosen meets the spent fuel standard. Where does that analysis stand?

Holgate: Let me clarify a little bit what we'd asked the National Academy of Sciences to do. It wasn't "tell us again this is fine." It was "give us some numbers here." The spent fuel standard has been qualitative: as unavailable and unattractive as plutonium contained in spent fuel from commercial reactors. First of all, that's a comparative judgment. Second of all, it's lacking in numbers. We had asked the National Academy to go a little bit further in trying to apply some quantitative standards to spent fuel standards. We are in receipt of an initial draft of an interim reaction from them that is currently going under classification review, and I frankly have not seen it yet. What I'm told is that the bottom line is "Yeah, we're pretty much OK on both of them." But for both — the MOX spent fuel and the immobilization — it doesn't give us much of a handle on the quantitative piece yet. They're still working on that. We will have to wait and see what their final report says. We're not calling it spent fuel standard with the Russians. An annex to the agreement lays out what the parameters are for material before you can consider it disposed. We've been talking to the National Academy, so we've had some sense of their concerns, but we've managed to do this without the answers to the specific questions we asked them over a year ago.

Tape: So there's an agreed end-state with Russia?

Holgate: We're very close to one.

Tape: Well, that's what you're trying to achieve.

Holgate: We will have specifications that are incorporated in the agreement, that clarify in a quantitative as opposed to a qualitative fashion what it is, for light-water reactors, for immobilization and for fast reactors.

Tape: And quantitative in terms of perhaps burnup or radiation fields or parameters of that kind?
Holgate: Yes, Parameters of that kind.

Pietri: I might ask a question that was not quite clear to me because it's the first time that I heard about it. Would you kind of go over the Parallex program?

Holgate: The purpose of the Parallex program is to demonstrate that CANDU reactors are technically feasible for the irradiation portion of this disposition, both for the U.S. and for the Russian side. Now this program began in 1994 and has been in the works for five years. Both sides are proceeding hand-in-hand simultaneously to some minimal level of disposition by irradiation of these gram-quantities in a third country. That makes sense from Canada's vision of itself as a nonproliferation champion.

Now the reason I mention the time factor here is that this test was initially envisioned to have four fuel assemblies made up — we're now only on the first — and that all four fuel assemblies would be made up of both U.S. and Russian material. Now that we have identified a U.S. consortium, where we have adequate reactor capacity in the U.S. to deal with the U.S. material, we do not envision continuing the U.S. side of this Parallex. We will proceed with the Russian side, because really it's the Russian material that the irradiation pathways are limited for. We'll only have the one shipment of this tiny amount of plutonium from Los Alamos to Chalk River. We don't expect there to be any major problems in these experiments. Theoretically it all makes sense, but the answers to these initial radiations will help confirm the technical feasibility of the CANDU reactors.

The political feasibility is a whole separate question and goes to the Canadian public reaction as well as to how it's going to be funded. Certainly, I think it's not credible that the United States would provide the lion's share of funding to support the Canadian nuclear industry. Our point to Canada has been "If you guys want to be part of this, you've got to be players, and one of the ways in which you can be players is to make your reactors available, in other words, converted and technically suitable for this material." So far, we haven't gotten a "Sure, we're with you" but we haven't gotten a rejection either, so we're continuing to push on all of these potential expansion sources when it comes to consumption of Russian material. CANDU is one, French reactors are another, German reactors are a third, Japanese reactors are a fourth, Ukrainian reactors are a fifth, and the potential for new reactor capacity in Russia or expanding the capacity of existing reactors. That's sort of the short set. And none of them are cheap. None of them are easy, either technically or politically. And none of them are fast. This is the real problem, and I'm not prepared to take any of these options off the table while we're still at this early stage, until we start to gel it. That's the list that I usually use, and the thing that I leave off this list was that wonderful news that the Swiss volunteered that they'd be prepared to burn Russian MOX in their reactors. We said "Great, that's 300 kg per year. That works." That starts to be real as you try to double a two-ton-per-year capacity.

Tape: Looking beyond the current state, which I agree seems very encouraging, we think there are significant asymmetries between the weapons plutonium inventories that were produced by the two sides over the last 50-plus years. And we have been very open about our inventory, publishing the "Fifty Years of Plutonium" report. What's your prediction about getting a little more transparency on the Russian side about their inventories and then breaking out of our locked-step symmetry here in disposition, where they have to in fact leap ahead of us if we're going to end up with comparable residual stockpiles sometime in the future?

Holgate: Well, I'll answer that to a certain degree in the negative, which is that our current agreement is not in and of itself intended to cover that move from symmetrical to asymmetrical disposition levels. What it does have is some language expressing the point — and how this actually comes out in the end is still under negotiation — but the concept that the fact that we're doing this in a reciprocal fashion now doesn't mean that we're always going to do this kind of thing in a reciprocal fashion. My personal belief is that you will see some of this asymmetry in some of the START III or START IV agreements. That's really, I think, where the asymmetry will start.

The asymmetry is not just in these plutonium stocks — or the functionally equivalent plutonium stocks. People have come to terms with the concept that for Russia to maintain whatever the ultimate level of weapons stockpile is, whatever reserve they need to maintain, that may be different from ours. It's not necessarily going to be a gram-for-gram or even a ton-for-ton equivalency. So we talk about functional equivalency in terms of stockpile stewardship. There are a lot of areas in which that functional unequivalency right now is very powerfully felt. One is plutonium stocks, second is production facilities on the Russian side, the third is tactical weapons. I think that it's going to make sense to try to break those asymmetrical logjams together in an agreement that's a little bit bigger, in terms of its status as a treaty as opposed to an executive agreement, and in terms of its more far-reaching goals than that of our current agreement. So I suspect it will probably be START III or START IV.

Mangan: In your closing remarks you certainly highlighted the relevancy of your program to the six technical divisions of the Institute. I'm wondering, is there any stronger relationship that could evolve between the Institute and your program? And do you have any ideas on how that might occur?

I can offer, for example, it would be nice to have a special session on your program at one of our annual meetings. We're a great forum for getting that information out. And I realize your program, with all the PEISs and EISs and RODs — the public should be aware of what's going on in this program, on which I compliment you as being one of the DOE programs that's following the NEPA law to the letter.

Holgate: And beyond.

Mangan: But we can offer that kind of an activity if you think it would be worthwhile.

Holgate: I certainly think next year we ought to have a lot of interesting things to talk about. We'll have an agreement concluded. We'll either be done with a multilateral structure or we'll be in the thick of it. We'll have a year's worth of design under our belt on two of the three U.S. facilities. And I think it could be an interesting time to do a session that would address some of the policy questions, but also some of the exciting technology questions that are part of the overall process.

Mangan: We can certainly have two sessions, one on policy and dealing with the Russians, and the other one on technical progress.

Mangan: Laura, again, thank you very much.

Holgate: Thank you. This was fun. I appreciate the opportunity.

International Certified and SI Traceable: The Ultimate Aim for Reference Materials

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Introduction

A special session was included during the INMM Annual Meeting about "International Certified and SI Traceable: The Ultimate Aim for Reference Materials." The morning session included the presentation of seven papers on the preparation and certification of reference materials. The complementary afternoon session then took the form of a panel discussion involving the speakers and audience. A lively discussion session was chaired by M.E.M. Tolbert of the New Brunswick Laboratory and moderated by R. Wellum of the Institute for Reference Materials and Measurements. Areas of both common concern and differences among laboratories in their perception of the requirements and applications of reference materials were highlighted in the discussion. The subjects are summarized here, under the subject headings debated during the session.

Intercomparison of Certified Reference Materials

During the morning session, R. Fiedler, Safeguards Analytical Laboratory, IAEA, presented results of a comparison between measured and certified values of a wide range of Pu isotope reference materials at SAL. Care had been taken to remove biases when measuring isotopes: A multicollector thermal ionization mass spectrometer was employed. Some excellent agreements with certified values were obtained, but some biases were also found. These biases, while significant compared to the reproducibility of the measurements, were in most cases within the stated uncertainty range of the certified values. The suppliers of reference materials considered such overlap satisfactory: In their opinion, the "true" value could lie anywhere within the stated certificate uncertainties. Some discussion was held on this point. It was pointed out that the concept of a true value was difficult to handle, as it involves something that is fundamentally nonmeasurable.

It was widely accepted that intercomparison exercises would be welcomed to increase customer confidence in certified values. Wellum expressed some concern and pointed out that there is fundamental difficulty in combining certified values, and that basically a second measurement and certification can only serve as verification of the original certified value. This point is not widely recognized, and it caused some discussion. It was recognized, however, that intercomparisons on an international basis, made where possible before issuing the certificate, should always be made.

Matching CRMs to Samples

Concern was expressed by some users of CRMs of the need to match the form of the CRM to the samples being measured and that a lack of CRMs for all types of analyses and samples existed. Wellum expressed the view that this was based on an incorrect perception of the purpose of a CRM. A CRM is to provide the traceability link for the measurement and is not there primarily as a validation of an analytical method. However, many participants in the group agreed with the view that the reference material should be comparable in form and type to the material being measured and that the correction from not using a correctly matched RM should be minimized. The difference in the two viewpoints could not be reconciled during the discussion of this point.

The group also debated the point that suppliers of certified reference materials should indicate the way in which the material should be used. This was not completely accepted by suppliers of reference materials present, as in their view the function of the CRM is largely independent of the application.

However, the group considered that the suppliers of CRMs should issue full reports on the preparation and certification of CRMs and issue as many practical details as necessary to allow the user to make the best judgment on the suitability of the CRM for a particular application.

CRMs for Nondestructive and Radiometric Applications

There was extensive discussion over the perceived need by laboratories using NDA methods for certified NDA reference materials. Existing reference materials could not, with few exceptions, be considered appropriate for NDA measurements because they were not certified for all the properties required for NDA, e.g. amount (isotope or element), form, density, activity, etc. These parameters cannot be readily isolated in NDA measurements to allow separate traceability of individual components. NDA users were concerned this would limit the effective traceability of their measurement results.

While there was debate on whether the use of reference materials was applicable to instrument calibration in NDA, it was agreed there is a clear need for the provision of standards to enable NDA users to achieve satisfactory calibration and traceability. The means of supply of these standards and the problem of the establishment of their traceability was not resolved.

Certification by Subtraction of Impurities

During the morning session, a paper was present by M.V. Pen'kin on work undertaken at the V.G. Khlopin Radium Institute on reference materials certified for actinide content by subtraction of impurities from the actinide content of the stoichiometric material (oxides and metals). Other laboratories recognized that this is probably the best method of certifying the content of pure metals, although there was some concern expressed over the application to oxides, where Western laboratories often prefer other methods to measure the actinide content.

However, subject to correct sample pretreatment, it was agreed that the method is potentially an accurate and valuable means of certification. KRI was congratulated on achieving successful certification by this means, and it was observed that such methods should be supported, especially in the Russian Federation, where long experience exists with them.

Future Needs

Future requirements for reference raterials and the raw materials for their preparation were identified and are summarized here.

1. ^{241}Am, ^{243}Am. The requirements of NDA users for Am assay reference materials, plus the increasing demand for traceable measurements for safeguards purposes, highlight a requirement for an Am reference material. This could be based on ^{241}Am metal, but a preferable RM would be ^{243}Am, as metal, as this isotope is also used in IDMS measurements of Am.

2. ^{244}Pu, $^{242}Pu/^{244}Pu$ double spike. The world supplies of ^{244}Pu are limited. The production of this isotope is at present under negotiation, which, if successful, will alleviate the problem. If a supply of highly enriched ^{244}Pu is available, production of a double spike, ^{244}Pu/^{242}Pu, will be possible, which will improve the measurement of Pu by IDMS, especially in environmental samples.

3. Np and Cm. Certified reference materials of Np and Cm are required by safeguards laboratories to allow traceable measurements of Np and Cm isotopic abundances and elemental concentrations.

4. Availability of highly enriched isotopes. Discussion of the availability of Am isotopes (see 1 above) highlighted a wider need within the nuclear and non-nuclear analytical communities for pure isotopes, in particular for IDMS measurements. The group agreed that strenuous efforts should be made on behalf of both European and American scientific communities to maintain an international capability for the production of highly enriched isotopic material.

41st INMM Annual Meeting

The group agreed the value of holding a session on metrological topics during the next INMM Annual Meeting, with the aim of furthering discussion and the exchange of information, to further improve collaboration between laboratories and to attract a wider audience to developments in the certification and application of reference materials. The proposed title of the session is "Metrology in Safeguards: The Extension of the Concept of Uncertainty into All Fields of Nuclear Materials Management."

Conclusions

The afternoon session, "International Certified and SI Traceable: The Ultimate Aim for Reference Materials," provided a valuable forum for informal debate and discussion on the needs and use of reference materials. The following conclusions were drawn from the meeting.

- The group proposed the continuation of the intercomparison of certified reference materials on an international basis and encouraged the suppliers of such reference materials to perform such intercomparisons before the release of CRMs.
- The group agreed to the importance of CRM suppliers providing a full report on the method of preparation and certification of their CRMs to enable users to identify the suitability of a CRM for their application. Correct application was agreed to be the responsibility of the user.
- The group was unable to resolve differences on the needs and certification requirements for specific NDA applications.
- The group encouraged the use of all appropriate traceable techniques for the certification of reference materials and was of the opinion that certification by measurement of impurities was a viable technique in the production of CRMs in countries such as the Russian Federation in particular.
- The group predicted an increasing need for highly enriched isotopes and found the present situation already critical. The international community is strongly urged to support the maintenance of international facilities for isotope production.
- The discussion group agreed about the value of a similar session at next year's INMM Annual Meeting, provisionally titled "Metrology in Safeguards: The Extension of the Concept of Uncertainty into all Fields of Nuclear Material Management."

U.S.-Russian MPC&A Lessons Learned

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Union of Concerned Scientists
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During the INMM Annual Meeting, the Nonproliferation and Arms Control Technical Division sponsored a special session devoted to lessons learned and brainstorming relating to the U.S.-Russian Fissile Materials Material Protection, Control and Accounting Program. Russian and U.S. speakers — representing government, project leads, Russian sites, academia, national laboratories and nongovernmental organizations — focused on particular issues they viewed as important to the program and its future. Following each presentation, there was a discussion with participation by the audience. A large cross section of individuals, mirroring the representation of the invited speakers, attended the session; many participated candidly and authoritatively.

There were several major themes that emerged from the prepared remarks and the discussion, namely U.S./Russian program dynamics, implications for international nonproliferation regimes, nuclear material inventories, Russian governmental commitment, MPC&A training, and Russian nuclear materials consolidation and conversion.

U.S.-Russian Program Dynamics: The extent to which MPC&A is truly incorporated into Russian governmental and facility operational culture was discussed, especially in light of its importance for the sustainability of site MPC&A upgrades. Although this issue has been an open question from the beginning, the economic and political situation in Russia has demanded that it receive new focus.

One recently emphasized approach within the program is to develop or provide low-tech MPC&A measures. The U.S. rationale behind this approach has been that these lower tech solutions should be sustainable at less cost to Russian facilities. Apparently insufficient discussion has been held with Russian counterparts on this subject, because their interpretation in some important cases was that the shift in the U.S. approach represented a lack of confidence in Russian technical capability to implement high-tech MPC&A approaches. This misunderstanding is counterproductive because it sidelines the more important issue of long-term sustainability, which both sides need to address. The point was made that low-tech solutions should be compatible with later changes to more sophisticated systems, once the near-term vulnerabilities are addressed. Even now, some Russians are concerned that promised warranties and spare parts for MPC&A equipment were not provided and were not available through Russian sources.

Particpants expressed a desire to have both sides discuss how they are assessing the status of Russian facilities and their upgrades. Participants identified three gaps in communication: (1) the U.S. imposition of its MPC&A approach on Russian sites without regard for the competence, experience, dedication and historic environment of these sites, (2) lack of communication with the Russians about the results of project reviews and (3) unilateral U.S. declaration of assurances — the means by which the U.S. confirms that the use of MPC&A support is consistent with agreed expectations — as unsatisfactory. Such assurances can range from interviews, videotapes and photos to direct observation or demonstration of MPC&A systems.

In our view, the program should be mature and robust enough to allow the United States to identify for the Russian sites the objective MPC&A functional requirements and then work toward joint or Russian-proposed approaches that incorporate Russian research and nuclear materials processing requirements, sustainability, safety, administrative and regulatory requirements, and culture. The burden does not rest on the U.S. side alone, however, because this mode of operation requires true Russian commitment and planning.

Implications for International Nonproliferation Regimes: Most participants agree that effective Russian domestic MPC&A systems at nuclear facilities are a prerequisite to serious participation in international nonproliferation regimes such as are represented by international safeguards under the International Atomic Energy Agency or might result from a fissile materials cutoff treaty. Internally, Russia will have to address a number of issues, many of which the United States has already faced, e.g., handling of sensitive information, preparation of facilities for inspections, reporting and declarations infrastructure, and long-term nuclear materials management planning. We believe Russian commitment to these regimes will be foreshadowed by its commitment to the principles and implementation of its domestic MPC&A.

Nuclear Material Inventories: The taking of nuclear material inventories for accountability purposes is likely to be a lengthy process in Russia unless some resolution is arrived at to address differences between physical inventories and book inventories that are bound to exist at the start. Apparently, in the past, measured inventories were not routinely performed, quantities of nuclear material could be set aside to make up differences should the need arise, and wastes or processing losses were assigned allowable values, e.g., 10 percent to 15 percent of throughput quantities.

To address Russian nuclear site personnel concerns of liability, punishment, etc., a planned, controlled Russian governmental moratorium on physical inventories and book reconciliation should be called as soon as possible to allow a defensible baseline inventory to be documented. Several speakers and participants alluded to current MPC&A program efforts to measure inventory quantities and difficulties in maintaining consistency in error limits, procedures, etc., given the presently inherent, systemic problems mentioned above. In the meantime, Russian personnel are becoming adept at taking measurements, developing inventory procedures, sampling plans, analyzing results, etc. In at least one case where measurement instruments were used in checking material upon receipt, an instance of accidentally swapped labels was detected. The Russian sites appear primed to take true physical inventories, given a moratorium or other creative solution from the government.

Russian Governmental Commitment: Russian governmental commitment to MPC&A was expressed quantitatively by one Russian facility representative: "I have not seen any documents coming out of Minatom over the last 18 months that do not mention MPC&A." Reportedly, facilities are being exhorted to solve MPC&A issues at the facility level. An interesting distinction was made between Russian technical and scientific facilities (such as VNIITF, VNIIEF and IPPE) and production cycle facilities, both in appreciation of the need for and practical operational implementation of MPC&A.

In our view, it should be easier to implement MPC&A at scientific and technical facilities, which have some discretion about modes of operation. On the other hand, the nonproliferation threat posed by some of the production cycle facilities, particularly with respect to processed, or handled, nuclear materials quantities and attractiveness, makes their commitment to MPC&A extremely important. We believe that if there is a real divide between the two types of Russian facilities in this respect it needs to be addressed within the program as a whole.

Enforcement of Russian nuclear material rules and regulations was questioned. Some voiced concern about the lack of resources at the Russian civilian regulatory authority Gosatomnadzor. The question was asked whether any penalties had been issued for noncompliance with Russian regulations. Russian views were that GAN had responsibility for licensing at nondefense sites and was enforcing this aspect of its responsibilities. U.S. support for GAN, including help with the licensing process where necessary, was advocated. However, there were both sincere and cynical statements made about effectiveness of and respect for regulations that either are not implementible under current circumstances or are not enforced.

MPC&A Training: Some participants expressed concern that there has been inadequate training at the site level, particularly for managers. Management buy-in to the MPC&A concept is essential if it is to receive sustained indigenous support. One suggestion was to get senior managers together, away from their sites, to give them a chance to be exposed to the training their personnel were receiving and to share experiences. The program has determined that site-level training is most effective if it incorporates existing training materials into the individual site-training organization and helps to tailor it to the site. One area of training that needs emphasis is that of new Russian rules and regulations. Regulations are being developed and implemented, but many managers are unaware of new requirements.

Russian Nuclear Materials Consolidation and Conversion: The issue of consolidation was of considerable interest. The first consolidation and conversion project supported by the MPC&A program is being conducted at one Russian site. From a sustainability and security standpoint, consolidation is a good solution. Conversion (i.e., highly enriched uranium blended down to low-enriched uranium) can permit less sophisticated security requirements. Criticality safety and radiological control issues must be addressed. There are Russian nuclear facility institutional issues that need to be faced. For example, prestige and extra pay have historically accrued to those responsible for fissile nuclear materials. Russian long-term plans for its nuclear materials and corresponding nuclear facilities will need to address this issue, particularly in light of a significantly changed economic, political, social and international situation.

Conclusions: Many participants urged that this type of lessons learned exercise happen more frequently. A number of gaps in communication between U.S. and Russian counterparts were identified, particularly related to perceived attitudes about competence, interest, applicability of U.S. systems, etc. The area of assurances appears to need quick, serious dialogue. This can and should dovetail with renewed joint development of appropriate approaches to upgrade priorities that are consistent with nuclear materials safeguards principles as embodied in program guidance. Rational thinking indicates that the ball is in the Russian government's court on nuclear materials inventories. Further, Russia can prove its commitment to MPC&A by participating in international nonproliferation regimes. Consolidation and conversion are expected to have profound impacts, potentially difficult in the short term but positive in the long term.

Global Nuclear Materials Management: Summary of the Closing Plenary Session of the 40th INMM Annual Meeting

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Introduction

The theme for the Closing Plenary Session of the 40th Annual Meeting of the Institute of Nuclear Materials Management, held in Phoenix, Ariz., U.S.A., July 29, was global nuclear materials management. Tom Sellers of Sandia National Laboratories chaired the session and gave an introduction to GNMM. As our Institute name suggests, this is not a new topic; however, the dissolution of the former Soviet Union and the end of the Cold War have provided a new emphasis for addressing the weapon states' excess nuclear materials and the threat of the loss of nuclear materials in the former Soviet Union. The Center for Strategic and International Studies in Washington, D.C., has devoted two recent conferences — in December 1998 and July 1999 — to GNMM. These conferences focus on policy recommendations for the U.S. government regarding the growing threat of unauthorized use of nuclear material and on rebuilding the nuclear expertise that provides the basis for U.S. leadership in these areas. The INMM Closing Plenary provided overviews of the five CSIS working groups' recommendations and broadened this dialogue to include international activities that might be undertaken on a global basis to address these problems.

There is a vision for GNMM being developed by the three U.S. nuclear weapons laboratories for the U.S. Department of Energy that provided important input to the CSIS study in Washington, D.C. This vision encompasses the global management of nuclear materials to ensure their safe, secure and transparent use from cradle to grave. These nuclear materials issues exist and must be addressed through some international framework that includes all states with nuclear materials; the International Atomic Energy Agency is currently the best framework to that end.

The world inventory of plutonium is steadily increasing, including nonseparated Pu in spent fuel, separated Pu from weapons programs (some of which has been declared excess to military needs) and a burgeoning stockpile of weapons-usable separated Pu in civilian programs, which may surpass the global stockpile of military separated Pu within a few years. The global supply of highly enriched uranium is predominately from military programs, including hundreds of tons of material declared excess to those programs, with a modest additional amount in use at research reactors. GNMM must provide transparency to build confidence that nuclear materials are being used as declared, are secure and accounted for, and are being stored and handled safely. These principles must apply to all nuclear materials that exist in weapon programs, are declared as excess and

* The authors are all members of the INMM Government-Industry Liaison Committee, chaired by John Matter.

are used in civilian applications. The United States wants to set an example and take the initiative with its domestic programs, in bilateral efforts with Russia and in the international arena.

Funding Nuclear Security

Remarks by Matthew Bunn, Harvard University
Summary by Terri Olascoaga

Introduction

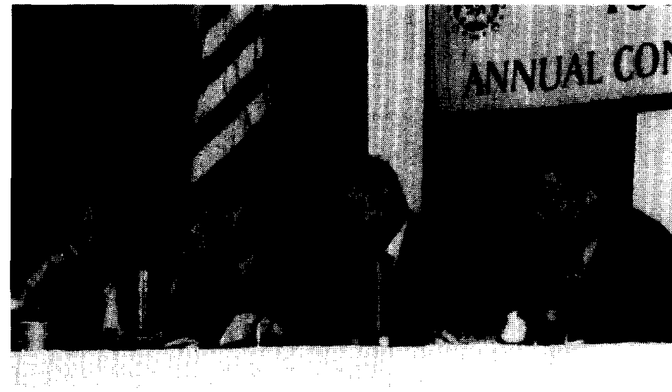
Matthew Bunn of the John F. Kennedy School of Government at Harvard University is vice chair of Task Force 1 of the Center for Strategic and International Studies' Global Nuclear Materials Management Project. Bunn presented a Task Force 1 report to the Institute of Nuclear Materials Management by video link during the Closing Plenary session focused on GNMM. Currently, there is a broad range of programs in place to address the risk of nuclear proliferation posed by eroding controls over nuclear material in the former Soviet Union. Task Force 1 is charged with examining whether there are additional steps that could be taken to reduce this risk more effectively and more rapidly if additional funding was made available.

Bunn began by emphasizing that one of the most urgent national security problems facing the United States today is the risk of nuclear weapons falling into the hands of rogue states or terrorist groups. In particular, the problems in the FSU posed by inadequately secured and oversized nuclear stockpiles, managed with very little transparency, and an oversized and underfunded nuclear complex are fundamental to the entire future of global efforts to prevent the proliferation of nuclear weapons. Bunn noted that there are documented cases of theft of kilogram quantities of weapons-usable nuclear materials in the FSU. The urgency of this problem is that if these materials are not adequately protected, this could lead to dramatic nuclear proliferation, posing huge new security threats to the international community with very little warning.

Current Nonproliferation Programs

Task Force 1 examined the various U.S. programs, funded at a cost of hundreds of millions of dollars per year, already in place to address the threat of nuclear weapons proliferation. These programs, categorized under five general areas, include:

- Direct measures to prevent theft and smuggling, such as the Nuclear Material Protection, Control and Accounting Program and nuclear smuggling efforts;
- Measures for stabilizing nuclear custodians, including programs aimed at re-employing excess nuclear workers in the FSU, for example, the Nuclear Cities Initiative, Initiatives for Proliferation Prevention, and the International Science and Technology Centers;
- Measures for monitoring stockpiles and reductions, including monitoring to build confidence that agreed stockpile reductions are taking place, assurances that U.S. taxpayer-funded assistance is being spent appropriately, and assurances that excess fissile material is not being returned to weapons;



The closing plenary session concluded with a panel discussion and question-and-answer period. Participants include, from left to right, Pierre Goldschmidt, Donald Cobb, Roger Howsley and Peter Lyons.

- Measures for ending further production of fissile material, such as the conversion of Russian plutonium production reactors;
- Measures for reducing stockpiles of Cold War nuclear materials (enriched uranium and plutonium), including the U.S.-Russian Highly Enriched Uranium Purchase Agreement and plutonium disposition.

The task force examined these existing programs and their proposed expansion under the Clinton Administration's Expanded Threat Reduction Initiative. In reality, this initiative simply maintains flat funding for programs that had previously been projected to decline; it does not provide for significant funding increases or new initiatives, except in the area of stabilizing nuclear custodians. The task force believes that currently funded programs are among the most cost-effective investments in U.S. national security found anywhere in the U.S. budget but argues that the scale of the effort under way simply does not match the scale and urgency of the threat or the opportunities to address it.

The task force also considered the wide range of obstacles, other than money, that limit the pace of cooperation in securing nuclear material in the FSU, particularly in Russia. These obstacles include souring political relations between the U.S. and Russia, fundamental differences in view and in national interests, enormous difficulties in obtaining assurances that U.S. taxpayer dollars in assistance are in fact spent appropriately, the widespread corruption in Russia and persistent Russian efforts to tax U.S. assistance. The task force also examined difficulties that originate from bureaucratic disorganization, lack of sustained high-level leadership, frequent changes in government personnel, a wide range of competing priorities and other issues that affect both the U.S. and Russian governments. In spite of these obstacles, the task force was convinced that there are opportunities for new initiatives that could result in dramatic progress in reducing the security risks posed by inadequate management of material in the FSU.

Task Force Recommendations

The task force outlined a menu of options for additional steps that build on the programs that are already under way and on those that are proposed in the Expanded Threat Reduction Initiative. The options in Task Force 1's report are described as modest steps (requiring tens of millions of dollars), significant strides (requiring hundreds of millions of dollars) and great leap" (requiring billions of dollars).

The following are some specific suggestions from the report:

1. The MPC&A program should have a funding-unconstrained budget; that is, the program should be funded based on how quickly critical work can be completed, not on how much funding is available. Critical work includes:
   - Consolidation of weapons-usable nuclear material to the minimum number of buildings at the minimum number of sites;
   - Providing upgrades and associated training to secure the material at these sites;
   - Providing the resources and incentives for Russia to sustain security at these sites over time.
2. The Nuclear Cities Initiative or other programs designed to re-employ the excess nuclear workers in the Russian complex require greater investments. In addition to purely private-sector commercial employment, there are substantial opportunities to employ people in areas that benefit the United States directly, for example, in nonproliferation and arms control analysis, environmental and energy research, and nuclear cleanup research and development. Task Force 3 addresses this issue in greater detail.
3. Increased transparency in the management of nuclear warheads and materials — critical to a wide range of nonproliferation objectives — should be encouraged by providing new financial and strategic incentives to make transparency progress in Russia's own interest and by beginning with small steps to build a foundation for trust. (This could be done through some exchanges and demonstrations of technologies and procedures, coupled with a broader package of incentives.) Task Force 4 deals with transparency in greater detail.
4. The HEU Purchase Agreement, under which the United States is purchasing blended-down HEU from Russian dismantled nuclear weapons, is considered by the task force to be the most important and successful of the nonproliferation programs, although it should go further and faster:
   - Offer to buy not only HEU from dismantled warheads, but the small, vulnerable stockpiles located at small research facilities that can no longer afford to secure them, not only in Russia, but in all of the FSU;
   - Offer to buy substantial additional quantities of HEU beyond the 500 tons in the original purchase agreement, with additional government money, rather than relying on the commercial market. (As a first step, the United States should purchase an additional 50 tons at a cost of roughly $1 billion, stipulating in the contract that the Russians spend a substantial fraction of the proceeds on nuclear security measures. These measures are to ensure that nuclear guards and workers are paid and that MPC&A systems are operated, maintained and improved.)
   - Offer to provide the needed capital investment and significant financial incentives to allow all of Russia's excess HEU to be blended down to a non-weapons-usable form, perhaps to an intermediate level of 19-percent enrichment, within a very few years.
5. Plutonium disposition (a long-term issue requiring urgent action) poses a more difficult problem than HEU because Pu has no commercial value at current uranium prices. The United States should provide the required funding to finance the needed plutonium disposition facilities in Russia. It is clear that plutonium disposition cannot be financed completely by the commercial sector, although it may be able to make some contribution. The U.S. investment would be small compared to the security stakes involved.
6. Generation of additional funding to sustain these and other nuclear materials management efforts is urgently needed and should be explored. It could include the following:
   - Additional purchases of HEU, as already mentioned;
   - Revenue from spent fuel storage;
   - Additional exports by Minatom of nuclear fuel and nuclear services. (This probably would require action by the U.S., Japanese and European governments to loosen some of the market restrictions that they have imposed on Russia's ability to export.);
   - A debt-for-security swap, in which creditor countries agree to cancel a certain amount of Russia's debt in return for its agreement to put smaller amounts of money into a fund to pay for nuclear security projects. (The fund usually ends up being a third to a fifth as large as the amount of debt cancelled, and the money going into the fund is in the local currency rather than hard currency, which makes it more attractive to the debtor country.)
7. Sustained high-level leadership in the United States, from the president on down, is a fundamental requirement. This leadership is essential if existing programs and new initiatives are to be effectively managed, coordinated and integrated, and if they are to be supported on Capitol Hill and sustained by Russia. Ideally, a senior official should be assigned to the White House with direct access to the president and with no other duties (comparable to what former Secretary of Defense Perry has recently been doing on North Korea), if this effort is to move as rapidly and effectively as possible.

Conclusion

Sustainable effective management of nuclear weapons and the nuclear materials needed to make them is ultimately the responsibility of those countries that possess them. Thus, these endeavors must be a partnership with Russia and the other states of the former Soviet Union. It is their nuclear material, so all of this must be accomplished in a spirit of cooperation and partnership with Russian experts and leaders throughout the effort. All of these actions involve costs and risks, but the costs and risks of failure to act will be dramatically higher than those of timely preventive action before a catastrophe occurs.

Despite the many obstacles that exist, the time is right for major new U.S. and international initiatives to reduce the critical threats to U.S. and international security. Sufficient funding and senior leadership attention on the U.S. side are among the major factors affecting faster and more effective actions to reduce these serious security threats. A new program for nuclear materials management in Russia and the other countries of the FSU, such as that reflected in the task force's recommendations, is needed. Such a program — focused on increased efforts to buy, consolidate, secure, monitor and reduce weapons-usable nuclear material stockpiles and to shrink the Russian nuclear complex — is essential to ensure sustainable global security for the future.

Proposal for an International or Regional Spent Nuclear Fuel Storage Facility or Radioactive Waste Repository

Remarks by Atsuyuki Suzuki, University of Tokyo
Summary by Terri Olascoaga

Introduction

Atsuyuki Suzuki, professor of nuclear engineering at the University of Tokyo and chairman of Task Force 2 of the Center for Strategic and International Studies' Global Nuclear Materials Management Project, addressed the Institute of Nuclear Materials Management during the Closing Plenary Session focused on GNMM via a videotape of his CSIS presentation. Task Force 2 is charged with addressing the question of whether the United States and other parties should support Russian security efforts to better protect nuclear materials and bolster expertise through the establishment of international or regional facilities for storing or disposing of spent nuclear fuel and/or nuclear waste. A related question is whether such facilities can produce significant revenues to reduce the nuclear dangers posed by the breakup of the former Soviet Union.

Suzuki began by reviewing two competing challenges that the international nuclear and arms control community is currently facing. First, significant challenges need to be overcome to help ensure that sensitive nuclear materials and facilities in Russia are placed under far better control. This is a subject that urgently requires much higher sustained attention in the United States and elsewhere. As a case in point, there is an urgent need to identify resources to enable Russia to move forward more aggressively with comprehensive programs to better secure its existing nuclear material and to convert the sizable stocks of excess weapons plutonium to the spent fuel standard. Secondly, within the nuclear sector there is a need to identify and develop additional options that will enable countries with rapidly accumulating inventories of spent fuel to better manage these inventories under conditions that are fully compatible with nonproliferation and environmental values. Fortunately, some new ideas are being proposed that hold out some hope of constructively contributing to both of these objectives.

Proposals

It has been suggested that the establishment of international facilities that would store spent fuel from several countries and possibly also dispose permanently of nuclear waste be given serious consideration. A concept is surfacing that international spent fuel and nuclear waste facilities should be established in some host country with the idea that a substantial fraction of the profit might be devoted to improving the security of nuclear materials, including existing plutonium in Russia.

Task Force 2 surveyed several proposals recently floated by a number of independent groups or persons. It identified obstacles or conditions that could affect the success of these proposals and looked at the benefit associated with international spent fuel storage and nuclear waste repository. Hafele and Starr have advocated the concept of an international monitored retrievable storage system. The objective is to establish an international framework featuring a monitored retrievable storage system for spent fuel generated worldwide from power stations and also from surplus plutonium. They proposed that spent fuel and plutonium be placed into storage within this highly transparent framework, thereby buying time until further decisions are made.

Nikipelov and others from Minatom have disclosed the idea that Russia is considering the possibility of storing spent fuel shipped to them from other countries. In compliance with the current Russian federal law that prohibits the receipt of spent fuel as a waste, the Minatom proposal is designed to eventually provide reprocessing services. Russia's ability to provide a spent fuel storage service without any commitment to the reprocessing option is a critical issue to the Russian proposal.

Another proposal, recently presented by Bunn, Numark and T. Suzuki, suggests that Japanese electric utilities might be the principal beneficiaries of new spent fuel storage and MOX fuel fabrication facilities to be built in Russia's far east region. These utilities would secure low-cost contracts to store their spent fuel at the facility and low-cost contracts for supply of MOX fuel using Russian excess weapons plutonium.

Cochran and Paine of the National Resources Defense Council have also made a proposal about storing spent fuel from Asia and Europe. The idea is to establish an international facility in Russia in a collaborative arrangement between a private U.S.-based nonproliferation trust and Minatom. Under this proposal, the trust would take title to foreign commercial spent fuel that would be moved to Russia for storage.

Suzuki has proposed another, broader scheme that is designed to provide potentially long-lasting funds for Russia and to create benefits for both reduction of nuclear arms and future development of civil use of nuclear energy. Specifically, as part of the project, Russia would provide spent fuel storage services so that Taiwan, South Korea and Japan, for instance, would ship their own spent fuels to store there for a definite period of time, for example 50 to 100 years. Under the proposal, the location of such a spent fuel storage facility would be at the Minatom facility where the required infrastructure is available.

Finally, another new regime to establish an international facility has been proposed by Pangea Resource Ltd., chaired by David Pentz. This idea calls for establishing a prominent geological disposal facility in Australia, where the geology and biosphere conditions provide excellent features of simplicity and robustness that can demonstrate whether the facility will fully meet the highest international safety and safeguards standards. One option under the proposal is that the facility would be devoted to holding surplus weapons plutonium from the United States and Russia as well.

Success Factors

The task force identified conditions required for any successful proposal. First, no proposal will be seriously pursued unless it is commercially viable for the host country and consumer nations. Beyond that, the task force thought that the establishment of any such facilities would have to meet some very basic tests and overcome some significant hurdles if they are to be truly viable. Second, an international spent fuel storage or waste repository will need to be acceptable to the government and population of the host country and most likely some of its neighbors. There will have to be high local confidence that the benefits will offset any cost, that the proposed facility will be constructed and operated under conditions that will offer no significant risks to the public health and safety and to the environment. Third, from a technical perspective, there will also have to be high confidence that a project is well conceived and designed from a technical, scientific and engineering perspective. The project will also have to be well defined to ensure the timely implementation of the venture, ranging from the presence of the necessary roads, the port facilities and the rail lines to the presence of adequate technical engineering personnel. Fourth, the host state will have to have the requisite regulatory infrastructure to review and oversee the venture, and there will have to be high confidence that the project will be able to meet the applicable laws, rules and regulations that are in effect. As an example, sending spent fuel to Russia for storage or permanent disposal will require the processing of a new law through the Duma. Fifth, since spent fuel has a sensitivity from a nonproliferation perspective, there will have to be high confidence in the political and institutional stability of the host country on the part of all other countries whose concurrence will be required to enable the venture to move forward. This obviously will include the prospective customers as well as any supplier country whose approvals might be required to permit transfers of material to go to the host country. Sixth, there will have to be a basic compatibility of views on nonproliferation policies and conditions that should apply to the materials involved between the host, customer and supplier countries that may have prior consent rights over the nuclear materials involved. Under U.S. law and the terms of all applicable agreements, the U.S. government would have to give its prior approval for any U.S.-origin materials, and it could not be expected to approve any such transfers unless it was fully satisfied with the nonproliferation conditions. Finally, under U.S. law, it would not be possible for the United States to approve any transfers of U.S.-obligated spent fuel from a client country to an international storage site in another country unless the United States has a suitable agreement for cooperation with the host government. The United States has no such agreement for cooperation in force with Russia, while it does have a suitable agreement in force with Australia.

Benefits

The task force also considered the benefits expected from an international spent fuel storage or nuclear waste repository. Some international nuclear security, safety and environmental issues could be considerably ameliorated with the prudent establishment of such international facilities. Some proposals for the establishment of international spent fuel and/or waste facilities present some potential for a constructive contribution to global nuclear materials management objectives. For example, establishment of these facilities may provide funds for improving the security of nuclear materials, including excess weapons plutonium, in Russia. Also, a facility would be able to meet high international standards for public health protection and accountable management of materials while also adding a barrier to nonpeaceful diversion of spent fuel. In particular, a potentially significant benefit is associated with the transparency that could be achieved. The issues surrounding the nuclear program in North Korea, directly related to the question of plutonium extracted from nonpeaceful reprocessing of spent fuel, were compounded by the lack of transparency and accountability. This suggests the potential advantage of an international spent fuel storage facility that is multilaterally managed and subjected to international safeguards. An international storage facility or regime could also significantly contribute to mutual confidence building. A new international storage facility would help promote constructive cooperation and partnership between the participants in various other ways. If the facility was located in Russia, this would provide additional transparency about the Russian situation, and it would provide useful jobs for Russian scientists and engineers who might otherwise find it difficult to be employed in constructive peaceful activities.

A number of small countries with small nuclear power programs face serious problems regarding the management of extended interim storage and disposal of their spent nuclear fuel. These countries find it too expensive to construct their own away-from-reactor storage facilities and/or geological storage repositories because of the limited amount of spent fuel and, in some cases, geographic constraints. The establishment of regional or international facilities could resolve the problem. An international facility could also provide more flexible choices for participating partners to solve their spent fuel management problems. If a client country believes that its future decisions regarding processing or direct disposal must be flexible enough to be compatible with the future global energy situation, then it could buy time until conditions for the use of plutonium are better clarified. It could do this by placing its spent fuel in storage within an international framework.

The International Atomic Energy Agency, for instance, estimates that the world's total accumulated amount of spent fuel may surpass 340,000 tons by 2010. In this case, if 100,000 tons of spent fuel (which is less than one third of the total amount expected by 2010) was stored internationally, the host country could receive approximately $10 billion. This assumes a storage cost, roughly estimated, of about $100 per kilogram of spent fuel, which is comparable to the current world cost estimate for much smaller facilities, such as reactor storage. The storage cost decreases significantly with the increase of scale; a large portion of the $10 billion revenue would be expected to be profit available for funding the Russian transition problem. If the international facility is a final repository, then the revenue might be even larger, so the cost of final disposal depends on various factors such as geological involvement, capacity of the repository and so on. Disposal and storage estimates can be derived from estimates used in the United States for the Yucca Mountain repository; disposal of 70,000 tons of spent fuel is estimated at more than $36.6 billion. This suggests that revenue of billions of dollars could be expected from an international repository. On the whole, it would appear that international or regional facilities could provide significant revenues to finance the transition of the Russian nuclear establishment if the profit realized is properly managed and dedicated to such assistance.

Task Force Recommendations

The task force concluded that several of the concepts for establishing international spent fuel storage or radioactive waste repositories merit further considerations. The U.S. Executive Branch and Congress should be prepared to encourage the further development and elaboration of these ideas, recognizing that to be credible they will have to meet some crucial tests and preconditions. The U.S. Executive Branch should be prepared, if so requested, to outline criteria that would allow special nuclear materials that are subject to U.S. consent rights to be transferred from various countries to host sites. The U.S. government should also be prepared to engage in dialogue about how prospective projects might be shaped to enhance the likelihood of U.S. support. In this regard, several Task Force 2 members strongly believe that, within the current international climate, proposed international storage or disposal facilities will stand the greatest chance of successfully gaining international support if it can be demonstrated that (1) these facilities will contribute to the solution of the plutonium disposition problem in Russia and (2) these facilities will help nations practically deal with their growing inventories of spent fuel and nuclear waste.

It will be important to conclude a new U.S.-Russian agreement for cooperation to permit any U.S.-origin spent fuel to be transferred to Russia for long-term interim storage or final disposal. Thus, it is recommended that early discussions be initiated between the U.S. and Russian governments regarding Russia's interest, the political conditions required to enable the two countries to negotiate such an agreement and the nonproliferation conditions that would have to be included in any such agreement. The U.S. government — and notably its Department of Energy — should also underscore a willingness to share with all of the interested parties the full benefit of the technologies that have been developed by the United States.

In addition, the task force strongly believes that if the United States is to remain a credible collaborator with other countries in solving international nuclear waste and spent fuel problems, it must first bring its own nuclear waste problem to some form of closure under conditions acceptable within the United States.

Finally, the leading concept being discussed largely focuses on the merits of offering new options for spent fuel management to countries like South Korea, Taiwan and Japan, as well as some nations in Western Europe. Clearly the attitudes that these countries have toward any storage or repository proposals as supplements to their own national problem will be crucial to their success.

Japan is in a special position to help advance some of the regional storage concepts that have been proposed because it is running out of domestic repositories for spent fuel storage. Thus, Japan has an urgent need to assist and develop alternatives. More importantly, however, Japan has a strong historical interest in nuclear disarmament as one of the most advanced nuclear non-weapon states. In addition, Japan will be hosting the G8 Summit in 2000. The Japanese government should be encouraged to take a leadership role at the summit in discussing options for advancing arms control and nonproliferation goals, and it should be encouraged to initiate an early dialogue with the United States and other G8 countries on that subject.

Conclusion

There are various proposals for the establishment of international spent fuel storage and waste disposal facilities, particularly for facilities in Russia. The potential benefits to nuclear material management and international security are many, so these proposals merit careful consideration and support. In particular, these facilities, if successful, could contribute to solving several very difficult problems, namely plutonium disposition, increasing world inventories of spent fuel and the needed financial resources to sustain nuclear security improvements in Russia.

Commercializing the Excess Nuclear Defense Infrastructure

Remarks by Roger Howsley, British Nuclear Fuels plc
Summary by James Lemley

Task Force 3 of the CSIS-sponsored study on global nuclear materials management addressed prospects for commercializing the excess nuclear defense infrastructure. Roger Howsley, British Nuclear Fuels plc, chairman of Task Force 3, summarized possible paths for commercialization. The task force concluded that the following issues arising from the Cold War legacy of excess nuclear defense infrastructure need to be addressed:

- Conversion of excess defense nuclear facilities and other assets to transparent, nondefense use;
- Treatment of weapons-grade nuclear material;
- Decommissioning of nuclear submarines;
- Treatment of spent nuclear fuel;
- Environmental cleanup of contaminated military nuclear sites;
- Deployment of staff and skills from defense and research establishments such as the Russian closed cities.

The task force examined the conditions necessary for commercialization to make substantial contributions in each of these areas.

It is important to distinguish between defense conversion and commercialization. Defense conversion is necessarily government-led activity to make former defense activities fit for civilian purposes related to current and anticipated needs. Commercialization refers to activities, possibly resulting from conversion activities, where new products or services become profitable and, therefore, sustainable in a market-based economy.

Before commercial companies can assist in the defense-conversion process, governments must first establish clear, achievable strategic objectives that industry can target. In the case of the Russian nuclear defense conversion, three key objectives are to ensure that:

- All weapon-usable nuclear materials are kept under safe and secure conditions;
- The scientists and technologies associated with nuclear weapons are not redeployed to internationally undesirable activities;
- Nuclear environmental problems of actual or potential international significance are adequately addressed.

Although the task force focused primarily on the complex Russian perspectives, there are some important lessons to be learned from the U.S. experience and, in some cases, similar experience in Western Europe and China on a smaller scale. The United States is downsizing its weapons complex and is consolidating at a few sites both the enduring defense-related activities and the new initiatives related to defense-threat reduction. Excess highly enriched uranium will be blended down for manufacture of commercial low-enriched uranium fuel. Disposition of excess plutonium from weapons is dual-track, one branch being manufacture of MOX fuel and irradiation in commercial nuclear power plants, and the other being immobilization in ceramic matrices followed by geologic disposition. DOE has established a worker-retraining program and provides preferential hiring of this old workforce for new programs at the site. Environmental cleanup is now the main activity and the main source of jobs at most of the former weapons production sites. Funding for environmental cleanup runs at approximately $6 million per year. Contractors at DOE sites receive incentives to assist the communities in developing new business to replace the weapons missions. Old uranium-enrichment facilities are being decommissioned and decontaminated, and the remaining facilities and infrastructure have been transferred to the commercial U.S. Enrichment Corp. The DOE complex is also supporting the proliferation prevention and arms control missions of the U.S. government.

It is important to recognize the difficulties that have been experienced in achieving successful commercialization for civilian applications of assets of the DOE program. The survival rate of new businesses formed as a result of defense conversion activities is approximately 20 percent after five years. The true commercial worth of many former defense assets has been far less than their perceived value.

It is assumed that handling the Russian nuclear defense excess will cost about the same as the U.S. problem, the order of tens to hundreds of billions of dollars. While the U.S. economy can support costs of this magnitude, the Russian economy clearly cannot without very substantial international support and the generation, by Minatom, of significant export markets worth billions of dollars. Unless fundamental changes in the Russian financial, legal and regulatory systems are made, Western governments and commercial organizations will not have the confidence to make the scale of financial investment that is necessary to provide the West with the desired political assurances it wants regarding the threats posed by the Russian excess nuclear defense materials.

Barriers to Western investment found in the Russian defense infrastructure include the following:

- Unlike the past, it will be necessary to separate military from civil (peaceful) nuclear activities to provide the accessibility and transparency required by Western institutions;
- The institutional attitude toward closed cities inhibits Western investment and normal commercial activities and must be reformed, consistent with Russian national security;
- Russian tax laws, customs procedures, liability issues and assurances over repatriation of foreign investment all need radical reform;
- Bilateral trade agreements need to be negotiated with other countries, including the United States, if Russia wishes to exploit global nuclear markets in full.

The following Russian defense conversion initiatives potentially offer commercial opportunities:

1. Treatment of Russian weapon-grade nuclear material and international spent fuel management services. Earlier this year, with the blessing of the U.S. and Russian governments, Western companies signed a contract with Russia's Techsnabexport (Tenex) for purchase of up to 260,000 pounds of uranium from downblended warhead HEU over the period of 15 years. A key element of the DOE-Minatom agreement is the creation of uranium stockpiles in Russia and the United States. The DOE is to maintain a stockpile of 22,000 metric tons of uranium for 10 years. Uranium that Western companies do not buy will be returned to Russia to establish a comparable stockpile. The U.S. government is allowed to use its stockpile to ensure reliability of delivery and stability of prices.

The major obstacle to the disposition of plutonium from

Russian weapons is Minatom's inability to finance a program that includes the costs of converting the plutonium to oxide, fabrication of MOX fuel and modification of Russian reactors, all of which could cost billions of dollars. Several schemes have been proposed to finance this program, but none has been implemented. One proposal is to use revenues from the sale of uranium (beyond the 500 tons in the U.S.-Russian deal) to finance disposal of Russian plutonium. Another proposal involves establishment of facilities to store spent fuel in Russia and use of the revenues to build a MOX plant in the Russian far east for supplying MOX fuel to Japan. At a minimum, this scheme would require negotiation of an agreement for cooperation between Russia and the United States, since the U.S. retains consent rights for the transfer of U.S.-origin materials to Russia. The United States has declined to negotiate such an agreement because of Russian assistance to the Iranian nuclear program and because of U.S. policy not to encourage commercial reprocessing and a plutonium fuel cycle.

2. Russian submarine decommissioning, reprocessing of the spent fuel and cleanup of naval defense sites. Norway, its Nordic neighbors and the United States have contributed to remedial activity in the northwest region of Russia. A parallel development in the Russian far east is to be funded by Pacific neighbors. These projects address local interests such as environmental threats to regional fishing industries. As the primary reprocessing facility serving both the Arctic and Pacific naval defense sites, the Mayak Production Association will be involved with both projects. Major nuclear accidents in the 1950s and 1960s left major areas of contamination in the Mayak area that need to be addressed. Western commercial interests can support these initiatives.

3. Conversion of Russian defense establishments to commercial civil tasking. One example of at least limited success resulting from Western support is the Nerpa shipyard on the Kola Peninsula. At the end of the Cold War, it was unable to remain financially viable. The U.S. Department of Defense, as part of the Cooperative Threat Reduction Program, pays for the decommissioning of two nuclear submarines per year. The program serves four objectives. It reduces the military threat from the Russian submarines and the linked environmental threat. It provides employment to a skilled Russian workforce that might otherwise engage in less desirable activity elsewhere. It helps to maintain a shipyard capability that provides commercial service to Russian fishing vessels and the civil icebreaker fleet. Although this project has not yet enhanced current Western commercial prospects, it could in the future, for example, by servicing a Nordic fishing industry and by reducing the environmental threat to that industry.

The submarine decommissioning process releases large quantities of metals, such as titanium, copper and steel. There is an estimated 250,000 tons of titanium in the Russian submarine fleet (Typhoon class). However, commercial margins would be tight, depending on the costs of decontaminating, where necessary, and recycling these materials.

4. Russian Defense Ministry conversion programs. The Russian Defense Ministry runs commercially oriented programs, for example, mini-reactors (uranium-plutonium mononitride-fueled reactors) and systems for location, decontamination and purification of radioactive waste. The commercial advantages for Western companies are not yet clear.

5. Redeployment of staff from Russian "closed" cities. In the 10 Minatom "closed" nuclear cities, there are 125,000 workers, 750,000 residents and the largest concentrations in Russia of weapons-production capability and know-how, weapons-usable material, and HEU and plutonium processing capability. In the current Russian economic climate these "caretakers of nuclear materials and keepers of nuclear secrets" have little prospect for adequate employment to pay for the basic necessities of life. These people and their skills need to be redeployed in civilian activities. The closed-city infrastructure lacks the mobility of labor that would enable these people to seek employment elsewhere, as they might in a Western market economy.

The purpose of the U.S.-Russian Nuclear Cities Initiative is to facilitate "civilian production that will provide new jobs for workers displaced from enterprises of the nuclear complex." However the resources from this and other government and commercial programs are insufficient to retrain and redeploy such large numbers of workers.

The task force believes that where resources are limited, they should be focused on those people and facilities where the risk is high. Their analysis suggests that only a few percent of the 125,000 workers in closed cities have knowledge that would be of direct strategic value to a state seeking a covert nuclear capability. Resources should be focused particularly on the nuclear design facilities, Arzamas-16 and Chelyabinsk-70, and on the reprocessing facilities at Tomsk-7, Krasnoyarsk-26 and Chelyabinsk-65 (Mayak). However, the conversion of such large numbers of defense workers to commercial ventures will not happen quickly. A complementary component of the NCI should be for governments and industry to contract directly with the institutes in closed cities for research programs with commercial interest. No quick and easy answers were offered. The path to commercialization will be long, hard and slow.

Howsley noted most emphatically that a strong, healthy commercial nuclear industry in the West is absolutely essential for commercialization to contribute substantially to the reduction of risk from the Russian nuclear defense excess. Contributions from the Western commercial sector include both direct investment in Russian enterprises and also commercially viable nuclear commerce with Russian institutions. Howsley suggested that favorable re-evaluation of the nuclear industry in the West could be promoted by enlisting environmentalists as allies. The nuclear industry must convince the environmental movement that nuclear power can contribute dramatically to reducing the risk of climate change caused by increasing levels of atmospheric carbon dioxide from use of fossil fuels. At the same time, the nuclear industry must demonstrate that those civilian nuclear activities and the associated nuclear commerce can be carried out with acceptable risk in relation to the risk of long-term global warming.

Task Force 3 recommended that Western governments must continue to focus on the three strategic objectives of (a) achieving safe and secure nuclear materials management, (b) avoiding the transfer of nuclear weapons know-how and technology to undesirable international markets and (c) addressing potential or actual environmental hazards of international significance. However, the task force found that international leadership and coordination are lacking at the current time and recommended that Western governments should give urgent attention to these areas. Governments must also lay the legal and regulatory foundations to allow the Western nuclear industry to explore longer-term commercial opportunities in tackling problems of the Russian excess nuclear defense infrastructure. Specific actions are for:

1. Russia to relax relevant domestic barriers and attitudes to closed cities to allow reliable, timely and sustained access by foreign commercial companies that seek to support Russian commercialization of the defense infrastructure;
2. Russia to accelerate the pace of change in its tax, customs and liability laws to provide a climate for investment and enterprise since foreign companies will not invest until this happens;
3. Russia to establish an integrated defense conversion plan, including a nuclear materials stewardship program, with the objective of separating its defense and civil activities and reducing the number of sites;
4. Western governments to facilitate the commercialization process by supporting Russian initiatives to win international civil business;
5. Western governments to be encouraged to remove regulatory and other obstacles to the international consolidation of the Western nuclear industry, which needs government support and encouragement in pursuit of these long-term political/security objectives;
6. All governments to recognize the important environmental role that nuclear power already plays in mitigating climate change (caused by the burning of fossil fuels) and to promote the expanded use of nuclear power where it is safe and economical;
7. Russia and the United States to re-examine their plutonium disposition programs to establish the scope for integrated bilateral cooperation, perhaps making it unnecessary to duplicate all plutonium-related disposition facilities in both Russia and the United States.

The task force recognized the difficulty in achieving these objectives and that commercialization would be long, hard and slow. However, they believe that world peace and security deserve that effort.

Nuclear Materials Transparency

Remarks by Donald Cobb, Los Alamos National Laboratory
Summary by Amy Whitworth

Don Cobb of Los Alamos National Laboratory spoke about nuclear materials transparency and the international confidence it provides that nuclear materials are used in a safe, secure manner consistent with international treaty obligations. Cobb opened by stating that transparency, as openness, is not a new concept; however, since the end of the Cold War, the scope and applications of transparency measures have broadened.

Cobb noted that a universal understanding of the meaning of transparency does not exist, so for the purposes of his discussion transparency would be defined as a cooperative process that is based on thorough risk/benefit assessments and that (1) increases openness and builds confidence, (2) promotes mutual trust and working relationships among countries, national and international agencies, and the public and (3) facilitates verification and monitoring measures by information exchanges related to safety, security and legitimate use of nuclear materials consistent with protection of national security and proprietary interests.

Some issues associated with transparency were discussed, including legitimate reasons for nations to be opaque about certain activities/facilities; the differences between transparency, monitoring and verification; and the trends, risks and limits of transparency.

Cobb defined global nuclear materials management as a vision of the effective management of civilian, defense and excess defense nuclear materials worldwide to ensure safe, secure and transparent use of these materials from cradle to grave. The near-term goal of GNMM is to:

- Continue to build on the excellent U.S. record of success in the safety and security of civilian materials;
- Incorporate excess defense materials into the procedures and processes for materials management;
- Expand the perspective of organizations owning materials or involved with materials management to include transparency in an efficient manner.

Note that, if these activities are fully realized, then the resulting environment — the product and goal of GNMM — will support the future of nuclear energy, nuclear arms reductions and nuclear nonproliferation.

GNMM has safety, security and verification elements, all of which can be served by well-designed transparency measures. In this context, under an effective GNMM regime, the international community will be charged with supporting transparency measures to provide confidence to all appropriate parties that at all times the handling of nuclear materials meets global norms for safety, security and assurance of declared use. This will apply to production, storage, processing, transportation and disposition of these materials.

Although GNMM remains a vision, many cooperative steps have already been taken to improve and ensure the effective management of nuclear materials. The International Atomic Energy Agency has long served the community as a resource for technical advice and state-of-the-art nuclear material safety, control and accounting practices, and the agency is expanding the role of transparency in its safeguards and other missions. However, it remains true that in many cases the international conventions and agreements guiding materials management are voluntary and contain no verification or transparency measures.

Traditionally, international concern about materials management has been limited to civilian materials. Defense materials and excess defense materials are now also being considered in this context. At present, this new material is in transition: Defense material is being declared excess, and excess material is being managed through a transition to civilian use or by other means.

The international community's involvement in development of effective standards for the safe, secure and transparent use of all materials should increase, and the resulting standards should become an international norm, with appropriate regional measures designed to address unique problems and issues. All states that possess nuclear materials, whatever their policy towards nuclear power and nuclear weapons, should help build and subscribe to an effective international transparency regime with appropriate inspection and monitoring rights.

Achieving the vision of GNMM will require additional effort and cooperation among all parties involved in materials management. If this is forthcoming, GNMM could become not just another technique for materials monitoring, but rather a new, cooperative way of doing business.

If transparency is to play the desired role in GNMM, it is essential to fully understand the risks and benefits of these measures. A thorough analysis of specific transparency measure proposals will ultimately be necessary. In the following, general benefits or incentives for transparency are discussed, followed by potential risks, disincentives or impediments to transparency measures.

The major benefits to greater transparency include building confidence that a state is behaving in a certain fashion, or that its activities are in conformance with certain agreements, standards and norms. The risk or impediments to transparency are less well understood, but understanding them is vital to analyses of the desirability of general and specific transparency measures. First, it must be recognized that different states may have very different levels of openness, due to cultural, economic, legal and political factors. This asymmetry may make it difficult to develop effective, mutually beneficial transparency measures. In practice, it limits the prospects of transparency, especially for the countries of the world that are least open. Cobb cautioned that the benefits of transparency must be carefully balanced with the protection of national security and proprietary information.

For the concept of GNMM to be furthered, a series of transparency measures of differing impacts and levels of difficulty are desirable. Cobb identified a number of potential transparency measures or activities that could move current nuclear material efforts towards the vision of GNMM. The categorization in terms of near term (6–12 months), mid-term (1–3 years) and long term (3–5 years) refers primarily to implementation timing, although there is a correlation between impact and level of difficulty in achieving the proposed measure or activity.

Near-term recommendations include renewing or renegotiating the Nuclear Warhead Safety and Security Exchange Bilateral Agreement to include the appropriate provisions for the continuation of the Russian-U.S. lab-to-lab transparency activities; implementing U.S.-Russian agreements on data exchanges on the aggregate stockpiles of nuclear warheads, on stocks of fissile material, and on their safety and security; supporting a series of joint bilateral U.S.-Russia transparency experiments, starting at nonsensitive facilities and with nonsensitive activities; promoting the development of bilateral transparency norms/standards for the safety and security of excess and defense nuclear materials; and completing the U.S.-Russian-IAEA Trilateral Agreement.

Mid-term recommendations include placing all nuclear materials declared excess by the P-5 under U.S.-Russian-IAEA Trilateral-type agreements; improving international safety, security and transparency standards for nuclear materials in spent fuel and waste from P-5 civilian and former weapon material-producing fuel cycles through cost-effective technologies; negotiating, concluding and implementing a data exchange among the P-5 on nuclear weapons inventories and supporting infrastructure modeled after the U.S.-Russian efforts; promoting the development of transparency norms and standards for the safety and security of defense nuclear materials among nuclear weapons states; and re-examining the current U.S. linkage in START III policy statements between the numerical reductions of strategic nuclear forces and the irreversibility of force reduction through transparency of strategic nuclear warhead inventories and the destruction of strategic nuclear warheads.

Long-term recommendations include establishing international safety, security and transparency norms for all states' nuclear fuel cycles; negotiating and initiating safety, security and transparency norms/standards for defense materials within the P-5 community; and negotiating and initiating international safety, security and transparency standards for materials in the civilian fuel cycle.

Cobb summarized by stating that changes in the world have affected the way we look at nuclear materials and the management and control regimes that surround them. The nuclear enterprise is evolving slowly toward greater openness and transparency in all the areas of interest — defense nuclear materials, excess nuclear materials and civilian nuclear materials. The vision of GNMM is to provide greater transparency regarding safety, security and legitimate use for the entire spectrum of nuclear materials from cradle to grave. However, there will remain significant limits on transparency for at least defense materials for the foreseeable future.

U.S. Domestic Infrastructure and the Evolving Nuclear Era

Remarks by Peter Lyons, Staff of U.S. Senator Pete Domenici
Summary by Bruce Moran

Peter B. Lyons represented Task Force 5 from the Center for Strategic and International Studies study. John Taylor, the former vice president of Electric Power Research Institute, chaired the task force. Task Force 5 set out to answer the question "Do current trends and policies on research, development and use of nuclear technologies enable the United States to exert global leadership?" The presentation provided the rationale for the task force's answer of "no" and for their recommendations.

Atoms for Peace in the 1950s placed a strong emphasis on measures that exchanged an agreement for peaceful uses of nuclear energy with an agreement to forgo weapons programs. The Nonproliferation Treaty in 1968 furthered this commitment. In the earlier days, the United States rendered assistance to many different countries in helping them to develop peaceful uses for nuclear energy. The terms of those agreements generally set conditions that the assistance was contingent upon nuclear materials use being consistent with the nuclear regulatory guidelines of the United States. Thus, the United States promulgated a set of nuclear safety standards in the early days of the nuclear era.

In industry, government and university, the technical strength of the United States in nuclear energy infrastructure is fading. The U.S. has lost the lead in nuclear energy technology, especially test facility capabilities, nuclear plant fabrication and construction, and nuclear fuel production. Many examples, events and occurrences have led to this situation.

The anti-reprocessing decision of President Carter in 1977 not only ended commercial reprocessing in the United States, but effectively lost the U.S.'s seat at the table where alternative reprocessing standards are being discussed.

- No civilian reactors have been built in the United States for a long time. This leads to the atrophy of nuclear capabilities. Deregulation of the electric utility industry will place severe strains on the entire utility industry, and the U.S. nuclear industry may not be well-positioned to play in this deregulated environment. Capital costs of new plants cannot compete with other alternative sources of energy production today. Cost-effective approaches for new nuclear plants are needed. In addition, there is not a level playing field between different types of energy production in this country. Nuclear power is the only energy source that internalizes all the costs of safety and environmental compliance. This is a tremendous burden for nuclear power that is not shared by the fossil-fuel industries. The emission credits policies of the Environmental Protection Agency do not benefit the nuclear industry. There are also other federal and state policies that favor the non-nuclear sources of power.
- A large number of mergers of U.S. nuclear companies have occurred with international companies, e.g., Westinghouse with BNFL and Combustion Engineering with ABB. This highlights the fact that the days of U.S. leadership are behind us. The United States is now in an international framework where the U.S. is but one of many players.
- The number of U.S. undergraduate students in nuclear engineering has decreased by 62 percent since 1992. Only 20 nuclear engineering departments are left in the United States.

Toward the end of what might be called the first nuclear era, the United States is withdrawing from international leadership that is needed to support its global nuclear policies. However, there are bits of good news. The U.S. Navy's nuclear propulsion program has produced 33 new reactors in the last decade. The U.S. Navy has launched over 200 nuclear-powered ships, and 85 of them are operational today. The safety record of the U.S. Navy is such that there has not been a single incident of fuel degradation or significant incident in the entire naval program. Another bright spot is that the availability of civilian plants increased from 63 percent in 1980 to 82 percent in 1997. If one looks at today's nuclear energy production cost, excluding the capital cost, the cost is very competitive. Production costs are around 2 cents/kWh, which is comparable to coal. Gas is approximately 3.5 cents/kWh, and oil is approximately 4. However, capital costs must be reduced if the U.S. nuclear industry is to move into the future with additional plants.

Congress has provided substantial leadership to try to rejuvenate issues related to nuclear technology. Senator Pete Domenici has been the lead on this. John Holdren deserves accolades for the reports from the President's Committee of Scientific and Technical Advisors that have pointed out the role of nuclear energy. Congress has approved the Nuclear Energy Research Initiative program, which increased support for university research as well as for university reactors.

The Executive Department has proposed $41 million in research and development for nuclear energy for the year 2000. In contrast, $1.24 billion was proposed for research on energy efficiency and renewables. More of a balance is required, especially with respect to the amount of power produced by renewables today versus the amount of power produced by nuclear power.

Congress has taken a strong role in some nonproliferation activities. Congress saved the highly enriched uranium purchase deal with a $325 million infusion last year. Congress jump-started the plutonium disposition agreement with $200 million that was vital to the significant progress made by the departments of State and Energy. The Senate has proposed $20 million increase in material protection, control and accounting this year, with emphasis on the opportunities in Russian naval nuclear fuels. The Senate has also taken a lead in reorganizing the Department of Energy to bring together, under one undersecretary, Defense Programs, Nonproliferation and National Security, Materials Disposition and Naval Reactors. The reorganization has the potential to provide better management and leadership for the most critical programs.

The task force's recommendations for policy, direction and action are as follows.

1. Government leadership. A prerequisite for global leadership is national leadership, which currently does not exist in this country. To implement present global nuclear policies, three different areas were identified.

- Fissile material control and nuclear arms reduction. Effective progress has been made towards a September agreement for a bilateral protocol with Russia. Improvement of fissile material controls is probably the best way to strengthen international safeguards.

- International nuclear plant safety. An international consensus is needed on proliferation-resistant standards for commercial nuclear programs. Increased G7 funding and coordination is needed for the Soviet-bloc reactor safety program.
- International spent fuel and nuclear radioactive waste management. Regional storage facilities, such as in Russia and Australia, may prove to be attractive. The 1997 IAEA Joint Convention on Safety and Spent Fuel and Radioactive Waste Management needs to be supported. Congress seeks to create an Office of Spent Nuclear Fuel Research within the Department of Energy to review spent fuel policy.

2. *Nuclear energy policy.* Nuclear energy policy needs to be redirected through both near-term and long-term actions. For the near term, seven areas were identified.

- Provide consistency to safety and environmental regulations for all energy-generation alternatives;
- Eliminate overlapping regulatory restrictions (e.g., NRC and EPA);
- Provide for expeditious license renewals;
- Develop performance-based, risk-informed safety regulation;
- Improve national spent fuel management;
- Increase the low-level radioactive waste storage capability;
- Determine low-level radiation health effects.

The task force's long-term goal is the realization of the full potential of the nuclear fuel supply and assurance of centuries of combustion-free power. Re-engagements by the United States in international cooperative studies are required on advanced fuel cycles. Parallel development of international standards is needed to ensure that nuclear materials cannot be diverted to weapons use from commercial uses. Nuclear issues and global nuclear material management need to be pursued through partnerships and international cooperation. This applies to advanced reactor development as well as nuclear materials. National cooperative efforts must start between universities, the national laboratories, the environmental community and industry. The environmental community, given its strong interest in clean air and global climate change issues, stands to benefit tremendously from improved policies and progress on nuclear energy. In providing national leadership, Congress is stepping up to the plate, and it remains for the Executive Department to do so also.

Panel Discussion

Summary by John Matter

Introductory Remarks by Pierre Goldschmidt, IAEA

Pierre Goldschmidt, the new deputy director general for the International Atomic Energy Agency and head of the IAEA Department of Safeguards, moderated the panel discussion of the previous five invited speakers and began with some comments on his perspective of global nuclear materials management. Implementing GNMM raises significant technical challenges and will require considerable political tenacity. Nuclear nonproliferation control rests on the three pillars of material accountancy, physical protection and international safeguards. These elements are interdependent and must be applied irrespective of who owns the material, where it is and how it is being used.

Pierre Goldschmidt, deputy director general of the International Atomic Energy Agency, shared a few thoughts with session attendees before moderating the panel discussion.

Regarding material accountancy, measurement techniques continue to be improved in terms of accuracy, speed and ease of use, and some states are providing bilateral support to help others improve their national systems. In the area of physical protection, a great disparity exists among states, and a clear commitment by all is needed to apply strict physical protection measures domestically. Here again, several countries are working bilaterally or with the IAEA to help other countries with training, standards and field implementation. In November, there will be a preparatory meeting of states that are party to the IAEA Convention on the Physical Protection of Nuclear Material; consideration will be given to extending this convention beyond its present scope of international transfers. For international safeguards, the IAEA is beginning to implement the Additional Protocol that provides it with more information and a more investigative role, using new competencies and technologies. More than 40 protocols have already been approved, and after it becomes universal this new international safeguards regime should be significantly more effective in preventing further violation of the Nuclear Non-Proliferation Treaty.

Implementing GNMM requires coordination and cooperation among international organizations, states and industry. The Trilateral Initiative of the United States, the Russian Federation and the IAEA — to place weapons-grade nuclear material that is excess to defense needs under international control — is encouraging. Lack of progress for a fissile material cutoff treaty is cause for concern. Progress is needed in both these areas, along with further disarmament initiatives and increased confidence among states to reach the ultimate goal of the elimination of nuclear weapons. In summary, GNMM is a necessary prerequisite to the expanded peaceful use of nuclear science and technology as a reliable, sustainable and environmentally friendly source of energy that should contribute to the prosperity of future generations throughout the world.

Audience Questions and Panel Responses

Following Goldschmidt's opening remarks, there were numerous questions from the audience and responses from the panel of invited speakers.

- *U.S. leadership in nuclear matters.* The environmental community must be convinced that nuclear energy is one of their best hopes. Education must extend beyond the professional community to the public schools.
- *Rebirth of nuclear research.* What gets funded may be controversial. Reprocessing is an example. The United States may need research on advanced reprocessing schemes to participate in international discussions. The U.S. needs to re-enter discussions on future nuclear fuel cycles. The U.S. will not be able to exert global leadership until the government and utilities resolve the spent fuel issue.
- *Low-level waste definition.* There is no universally accepted standard. Radiation standards should be based on science rather than just legislated based on public fear and political concern. The question remains whether there is a lower limit below which there is no regulatory concern.
- *Promoting international cooperation.* More leadership is needed from the heads of the major nuclear states, and the particular international forum is less important. New international ventures may be needed to implement and sustain major programs such as the disposition of excess plutonium.
- *CSIS GNMM task force report.* A draft of the Senior Policy Panel report was released at the CSIS conference July 23. The final version and the five task force reports were to be published six weeks later. The CSIS Web site — http://www.csis.org — has video of the entire one-day conference.
- *Support for the next safeguards generation.* To be successful in GNMM, we need a whole new generation of safeguards, nonproliferation and arms control experts. Grants and scholarships are needed to attract new workers into the nuclear field.
- *Financial support for the IAEA.* While many new jobs are being proposed for the IAEA, it has been living with zero budgetary growth for several years, which amounts to doing more with less. The implementation of the Additional Protocol will have increased costs for the IAEA, at least during the transitional period. The cost of transparency measures will be addressed in the future bilateral and trilateral agreements. It is in our common global interest to increase the IAEA budget.
- *Public support during national elections.* Some in the nuclear community would like to see nuclear issues addressed in the forthcoming national elections in the United States and Russia. The INMM, ANS and NEI share this interest and might be more effective if they joined forces for that purpose.
- *Regional spent fuel storage.* International repositories have been proposed for Russia and Australia, which have several advantages and difficulties. If they are to be successful economically, the key may be in international consolidation of the nuclear industry, such as has occurred in the oil and automobile industries. This needs to be politically acceptable and could lead to a civilian nuclear industry in Russia, which in turn might help gain FMCT approval there.
- *Different safeguards standards for civilian and defense materials.* The question is whether there will be different standards implemented for safeguards of voluntary offer materials, verification of excess material and disposition, and/or FMCT. This was recognized as a major looming issue, but no definitive positions were presented.

The Consensus Standards Process for Nuclear Analytical Chemistry and Radiation Physics

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Abstract

Written standards for every nuclear measurement or requirement need not be specified by a regulatory body but can instead be contained in consensus standards, written by voluntary bodies of experts, and accepted by the regulatory organization. Details of such consensus standards writing and the associated balloting processes encountered in two voluntary organizations are provided to facilitate and encourage increased participation by experts.

Introduction

The process of writing and balloting consensus standards for the nuclear industry[1] is as varied as the organizations and experts producing them. Individual standards producing bodies such as the American National Standards Institute, the American Society for Testing and Materials and the International Organization for Standardization have their own World Wide Web sites, which provide information on their organizations and the standards they produce.[2] ANSI also operates a National Standards System Network[3] Web site, which provides access to over 65,000 references to standards and specifications from the U.S. government, U.S. private sector organizations and international standards organizations.

On March 7, 1996, the president of the United States signed the National Technology Transfer and Advancement Act (PL 104–113) into law. The act directs the National Institute of Standards and Technology to coordinate with other federal government agencies to achieve greater reliance on voluntary standards and reduce dependence on in-house regulations. ANSI and NIST have a memorandum of understanding, signed Sept. 24, 1998, in which there is agreement to enhance and strengthen the national voluntary consensus standards system of the United States. The Office of Management and Budget Circular A-119, dated Oct. 20, 1993, and revised Feb. 10, 1998, instructs federal agencies to reduce government-unique standards to a minimum.[4]

Within the Department of Energy, participation in consensus standard writing is encouraged. The question of government employee participation in such organizations has been reviewed and approved.[5] The first Federal Technical Standards Workshop was held Aug. 4–6, 1998, in Washington, D.C. The goal of the workshop, which was sponsored by DOE and NIST among others, was to further the implementation of PL 104-113.

The two consensus standards writing bodies in which the authors, DOE employees, participate are ASTM Committee 26 (C26) on nuclear fuel cycle and ANSI Working Groups N13.29 and N13.37 on environmental dosimetry. Experiences with those two organizations will be used to describe the general types of information and interactions required to successfully navigate the consensus standard process.

ANSI does not develop standards itself but relies on organizations that it accredits to develop and maintain its standards. The purpose of ANSI is to facilitate consensus among these groups. ANSI approval signifies that the principles of openness and due process have been followed and that a consensus of those directly and materially affected by the standard has been achieved.[6] ANSI was founded in 1918 and now has about 13,000 approved American national standards.

Organized in 1898, ASTM provides a forum for producers, users, consumers and general-interest members (representatives of government and academia) to meet and write technical standards. ASTM has 132 standard-writing committees composed of more than 34,200 members. These committees produce more than 10,200 standards that are sold worldwide. ASTM publishes its own standards and is also an ANSI-accredited standards developer. ASTM committees decide on an individual basis whether to submit their standard to ANSI; approximately 30 percent do so, and their standards bear both ASTM and ANSI imprimaturs.

ASTM committee members and ANSI standards developers voluntarily contribute their time and effort for the development of ASTM and ANSI standards. The initial foray into a meeting of one of these groups may be both confusing and intimidating to the new participant. Additionally, writing and balloting a first standard can be both professionally and personally challenging.

ASTM Standards Development

The purpose of ASTM, according to its charter, is "the development of standards on characteristics and performance of materials, products, systems and services; and the promotion of related knowledge."[7] The bylaws and regulations of the ASTM assure full consensus and due process to all interested parties.

ASTM Structure

ASTM's governing body is the board of directors, elected by the membership. The board develops basic procedures that guide technical committees in the principles to be applied in the development of standards. The basic principles of the voluntary consensus standards process are part of ASTM's bylaws. Technical (main) committees write their own bylaws, which are subject to ASTM approval, and they elect their own main committee officers. Although a technical committee's scope is approved by the board, the structure within a main committee, i.e., division into subcommittees and task groups, is at the discretion of the technical committee. A technical committee has an executive (administrative) subcommittee that provides direction to subcommittee operations. Technical subcommittees and task groups are set up as needed to address specific subjects that are within the scope of the committee.

The exact number of main committee officers differs by committee. A chair, at least one vice chair and one or more secretaries comprise the roster of committee officers. In addition, the business management of ASTM assigns a staff manager to each technical committee to assist the executive subcommittee and subcommittee chair with the meeting and voting process.

Subcommittee chairs are appointed by the committee chair with the consent of the executive subcommittee. Subcommittee chairs are expected to provide administrative leadership to the subcommittee. The purpose of the subcommittee is described in its scope as approved by the executive subcommittee. The subcommittees may be divided into sections or task groups. Task group leaders are appointed by the subcommittee chair. Task groups are ideally composed of four to six individual experts who need not be members of ASTM nor of the committee. This exclusion allows assistance from experts in the field by a group that may be discharged when their mission is completed.

Example: C26 Committee Structure

ASTM Committee 26 on nuclear fuel cycle has listed the following formulations for the nuclear fuel cycle (exclusive of nuclear power plants) within its scope:

1. Test methods;
2. Specifications;
3. Terminology;
4. Practices;
5. Guides related to the nuclear fuel cycle products, facilities and processes.

C26 has the structure of subcommittees and task groups. C26 has 12 technical subcommittees and two administrative subcommittees which meet two weeks each year, one in the winter and one in the summer. At these two meetings, a subcommittee meets a minimum of once during the week to discuss standards being developed, review standards and identify new standards that are needed. Many attendees are interested in standards being discussed at several different subcommittee meetings so scheduling meetings without conflicts becomes difficult.

Participation

Participation in the ASTM voluntary consensus process is open to all interested parties for deliberations and discussions on both procedural matters and proposed standards. However, a person must first join ASTM and then the specific committees and subcommittees of interest to have potential voting privileges on proposed standards and changes to existing standards, and for the election of officers for both the society and the technical committees.

There are several types of ASTM memberships. A representative member is, as the name implies, a representative of a company's organization to ASTM or the society's technical committees. Individual members are usually either technical or affiliate members. Technical members of the society are individuals who participate in committees. Affiliate members are individuals invited by the executive subcommittee to participate on a committee because of their special knowledge. On occasion, there may be exempt, honorary and senior individual members designated by an executive subcommittee. The type of ASTM membership is indicated for each member in the membership roster held by the committee membership secretary. Committee bylaws provide rules for determining how official votes are apportioned to committee members.

Writing

The initial standards document is prepared by a technically competent individual who volunteered or was asked to write it. The expectation is that the task group and subcommittee membership will provide technical and editorial input into the standard before it is submitted for ballot. A subcommittee chair or task group leader may request additional experts to review and comment on the adequacy and completeness of the standard.

Assistance in identifying the type of standard and the required and optional information to be included in a standard is available from ASTM and other subcommittee and committee members. Committees may have an editorial subcommittee, which ensures that all standards submitted for ballot are appropriately designated and formatted. Otherwise, those determinations are the responsibility of the subcommittee submitting the standards for ballot. An approved standard will be edited by the ASTM business group's editors with approval of changes by the subcommittee chair or designated alternate prior to publication.

The Form and Style Manual for ASTM Standards, commonly referred to as the "Blue Book," is a comprehensive guideline for preparing ASTM standards. The six major different types of ASTM standards are as follows:

1. Test methods;
2. Specifications;
3. Classifications;
4. Practices;
5. Guides;
6. Terminology.

The guidelines used in the determination of the type of standard to be written and the format requirements are found in the Blue Book. In addition, editorial training sessions are provided by ASTM business staff editors when committee meetings are held during a Committee Week, which includes multiple committees meeting at the same time and place.

Presenting, Reviewing and Revising

Typically, an individual will volunteer to write a standard for which a need has been identified by a subcommittee or task group. If the expertise required to write a standard is not resident in the subcommittee or task group, new members or outside experts may be recruited.

C26 has begun tracking the title and authorship of draft standards when the standard is initialized to assist subcommittee chairs and ASTM staff in maintaining accurate records. This tracking is begun with a form submitted by the task group leader or the subcommittee chair to the C26 staff manager.

The author brings the draft standard to one of the meetings or submits it to the subcommittee chair or task group leader to be discussed at the meeting in the author's absence. The individual subcommittee or task group members are provided with copies of the standard for review. If the process of writing is being accelerated, the author will distribute the draft standard before the meeting.

The first draft of a standard is reviewed line by line during the meeting if prior copies were not provided. If time does not permit a line-by-line review at the meeting, members are asked to review the draft standard and provide comments to the author before the next meeting. The author provides a revised draft at the next meeting.

Comments and suggestions for inclusion are provided to the author of the standard by the members of the subcommittee or task group. If there is insufficient expertise to settle any technical questions concerning the draft standard, additional outside experts can be asked to review the standard or a section of the standard.

Committee members receive regular mailings from ASTM, including copies of meeting minutes from which they may identify standards of interest to them. Individuals who are not society or committee members but who are interested in certain standards that are being written may request copies of meeting notes and standards from subcommittee chairs or task group leaders and provide comments.

Subcommittee Ballot

When the author, the task group leader and the subcommittee chair are in agreement that a new standard is ready for subcommittee ballot, it is submitted as specified by the subcommittee chair for the next scheduled ballot. Subcommittee ballots may be scheduled at any time by the subcommittee chair. Subcommittee ballots mailed by the ASTM staff manager for the committee are scheduled on a less frequent basis.

A new standard cannot be submitted for concurrent subcommittee and committee ballot the first time it is balloted. Once through its first subcommittee ballot (even if it did not pass the subcommittee ballot), the standard can be submitted for concurrent subcommittee and committee ballots.

To pass a subcommittee ballot, at least 60 percent of the ballots must be returned. Of the votes cast, at least two-thirds must be affirmative; all negative votes must be considered; and no negative vote can have been ruled by the committee to be persuasive.

It is not unusual for a standard to require more than one subcommittee ballot before successfully passing. The reasons for not passing a subcommittee ballot are varied but often involve a persuasive negative on a technical matter that had not been considered by the author or the members reviewing the standard before ballot submittal. To reduce the efforts required for multiple ballot reviews of an inadequately prepared standard, it is important for the task group and subcommittee to thoroughly review both the technical content and the format of the new standard. The standard presented for ballot should be of high quality and should reflect a group effort to ensure that quality.

Within C26.05, Analytical Test Methods, the statistical section of the standards has, in particular, been insufficiently developed prior to submission of a standard for ballot. There are guidelines available to task group leaders and subcommittee chairs to assist standard writers in adequately addressing the precision and bias statements for analytical test methods. In addition, members of C26.06, Statistical Applications, have generously given of their time to work with those preparing standards in C26.05 during and between meetings.

Committee Ballot

A new standard that has passed subcommittee ballot can be submitted for one of the scheduled committee ballot dates. A completed submittal form, signed by the subcommittee chair or designated alternate, is required for a standard to be placed on committee ballot. All committee ballots are issued by ASTM headquarters.

An old standard that has been revised can be submitted for concurrent subcommittee and committee ballots. However, for revisions it is best to ballot only those parts of the standard being revised rather than the entire standard. An old standard needing no revisions is submitted for reapproval; reapprovals require concurrent main and society ballots only.

For a standard to pass committee ballot, at least 60 percent of the ballots must be returned. Of the votes submitted, 90 percent must be affirmative; all negative votes must be considered; all negative ballot forms must be completed and returned to the ASTM staff manager for the committee; and no negative vote can have been ruled persuasive by the committee.

Resolving Negatives

Negative ballots can be cast on a subcommittee, committee or society ballot. Each negative vote must be accompanied by a written explanation of the reason for the negative. The reasons may be technical issues, procedural evidence that ASTM regulations were not followed, a claim of ambiguity or any other reason that a voter chooses to oppose a ballot item.

Editorial corrections (nontechnical changes) can be made without reballoting a standard and should be indicated with comments on the ballot rather than a negative vote. Though a technical change requires another ballot on the standard, clarification and completeness of the necessary changes at the subcommittee ballot level is the most desirable. Multiple subcommittee ballots are possible between meetings so negatives cast at the subcommittee level will result in less delay of subsequent ballots.

The major responsibility for handling negative votes falls to the subcommittee chair. The main ways of assuring adequate response to any negative voter are communication, consideration and documentation.

For subcommittee ballots, the negative vote must be acknowledged within 30 days of receipt. Formal consideration of negative votes normally occurs at the next subcommittee meeting. The voter must be notified as to the disposition of their negative vote.

On committee and society ballots, the negative voter must also be acknowledged within 30 days. Negative votes on these ballots are considered first at the subcommittee, then the committee level for disposition. Both committee and society negatives require formal documentation by the subcommittee chair or a designated alternate on a form generated by ASTM headquarters. Negative votes may be resolved by one of the following means:

- **Withdrawn:** The negative can be voluntarily withdrawn by the voter after discussion or with an editorial change only.
- **Not Related:** A two-thirds affirmative vote must be obtained on a motion at the next subcommittee/committee meeting that the negative vote is not related to the item. "Not related" means that the voter's comments relate to material that was not part of the item being balloted.
- **Not Persuasive:** For subcommittee negatives, a two-thirds affirmative vote must be obtained on a motion at the next committee meeting that the negative vote is not persuasive. A count of the votes must be taken. If the motion passes, the vote count and the reason must be recorded in the minutes. The text of the negative and the result of the decision of "not persuasive" must be sent to headquarters if the item is a subcommittee ballot item. (Committee and society negatives are documented on ASTM forms using instructions contained therein).
- **Persuasive:** Persuasive negatives are those determined by the author, task group, subcommittee or committee to have merit. If a two-thirds affirmative vote is not obtained on a motion that a negative is not persuasive, then the negative is considered persuasive. If the subcommittee agrees to make substantive changes, the revised document is then submitted for another subcommittee or concurrent sub/main ballot.

Society Ballot

After a standard passes subcommittee and committee ballots, it is placed on society ballot by the ASTM staff member. Society ballots are published in the ASTM monthly magazine, *Standardization News*. Any negative vote on a society ballot must be considered. All negative ballot forms must be completed and returned to the ASTM staff member. No negative vote can have been found to be persuasive by the committee if a standard is to be approved.

Publication

The ASTM staff member submits the standard with a ballot summary and handling of negative votes to the Committee on Standards. That committee determines whether a satisfactory consensus has been reached. If that committee approves the standards action, the standard is published by ASTM.

The approved standard will be given a standard designation by ASTM. A staff editor will prepare a galley copy of the standard, which will be sent to the author or designated reviewer for approval of any changes. The author and committee officers will receive a complimentary copy of the standard. ASTM publishes 70 volumes of standards annually in 15 sections. Though the latest annual ASTM volume in which the standard is to appear may not be published for several months, the new standard will be available for purchase as a stand-alone.

Five-Year Review

Each ASTM standard is required to be reviewed, at minimum, every five years. Typically the task group or subcommittee that originally prepared the standard will begin a review four years after a standard's publication date.

One of several decisions may result from this review. A standard may be new and require either no changes or only editorial changes. In that case, the standard is balloted for reapproval on concurrent committee and society ballots. Parts of a standard may need to be either added or revised; in that case, only the changes are balloted concurrently on subcommittee and committee ballots. There may need to be a substantial change to the standard. In that case, the standard is written and submitted through the normal subcommittee, committee and society ballot process. A standard may no longer be used. In that case, the standard is balloted for removal on the committee ballot.

ANSI Standards Development

ANSI supports the development of a consistent set of American National Standards through its activities to establish priorities, minimize duplications, avoid conflicting standards and ensure participation by all affected interests. ANSI's board of directors assigns functions to its Executive Standards Council, which may delegate activities to boards and committees that are established as needs arise. ANSI relies on accredited standards developers for the technical content of standards..

ANSI is the U.S. member of non-treaty international standards organizations and coordinates U.S. participation in such groups as the International Organization for Standardization and the International Electrotechnical Commission. Developers of ANSI standards are required to take international standards into consideration.

Professional societies, trade associations and other organizations are approved as accredited standards developers based on the use of ANSI procedures for developing and achieving consensus and for administrative tasks. There are some 175 ASDs that have been approved to use one of ANSI's three recognized methods for developing evidence of consensus. ASTM uses the accredited organization method, which is described above. Another example of an ANSI accredited organization is the American Nuclear Society. The other two ANSI methods are the accredited standards committee method, an example of which is given below, and the accredited sponsor using the canvas method, which is described in ANSI procedures.[6]

Structure — Accredited Standard Committees

An accredited standard committee may include multiple associations or societies, with one organization acting as secretariat. The membership of an ASC includes a diverse balance of interest categories without dominance by any single category. The secretariat is responsible for interfacing with ANSI, including maintaining accreditation, and for overseeing the committee's compliance with ANSI procedures. The secretariat may also be involved in the appointment or selection of the ASC officers, as described below.

Each ASC has a different charter and some flexibility in establishing protocol. There are presently about 100 ANSI ASCs. Five of them deal with topics related to radiation science and are designated N13, N14, N15, N42, and N43. As an example of the process, this paper will focus on procedures and experiences related to the ASC N13, for which the Health Physics Society is the secretariat. For comparison, brief information will be given about some of the other ASCs.

The N13 ASC is charged with topics related to radiation protection of workers and the public. The N13 committee consists of representatives from 15 professional organizations and seven government agencies, along with eight individual members. The N13 chair, vice chair and secretary are appointed by the secretariat.

The Institute of Nuclear Materials Management is the secretariat for ASCs N14 and N15, which deal with the packaging and transport of radioactive and non-nuclear hazardous materials and the protection, control and accounting of special nuclear materials. The Institute of Electrical and Electronic Engineers is the secretariat for ASC N42, which focuses on radiation instrumentation. ASC N43 covers radiation-producing equipment in industrial and nonmedical research (excluding nuclear reactors). The HPS is also the secretariat for N43, but it follows a different protocol than N13. For example, the N43 chair and vice chair are selected by a majority vote of the N43 members, subject to approval by the board of directors of the HPS, rather than being appointed by the secretariat.

The Health Physics Society has a permanent committee to manage development of the ASC N13 standards. The HPS Standards Committee consists of nine members and makes use of technical section managers who oversee working groups. The six technical sections within the HPSSC indicate the range of standards topics being developed within the framework of N13: contamination limits, environmental, external dosimetry, internal dosimetry, instrumentation and medical health physics.

The HPSSC forms working groups that are responsible for the content of the individual N13 standards. There are presently about 42 working groups developing N13 standards.[8] These include two standards related to environmental radiation dosimetry in which one of the authors of this article participates, N13.29 and N13.37. (There are 13 N43 working groups, which follow slightly different procedures that do not involve the HPSSC.[9])

Project Initiation

An ANSI standard begins with the Project Initiation Notification System, whereby an accredited standard developer (such as ASC N13) notifies ANSI of the intent to develop a new or revised American national standard. The project is advertised in *Standards Action*, an ANSI publication. This is an important step in ANSI's role to coordinate standards and allows all affected parties the opportunity to make comments directly to the ASD.

Participation — N13 Working Groups

In general, a working group chair is nominated by the section manager to lead the development of the proposed standard. Often the section manager will suggest individuals with appropriate expertise to be recruited as working group members, and the HPSSC may then identify other organizations that have an interest and should be represented. The formation of a new working group is announced in the Health Physics Society's monthly newsletter, which is sent to the HPS membership, and specialists interested in participating are invited to submit a resume.

All proposed members' resumes as well as the chair's are evaluated and balloted for approval by the HPSSC. The working group approved for N13.37, for example, consists of eight members and includes representatives from industry, academia, the DOE, the National Institute of Standards and Technology, and the Nuclear Regulatory Commission. The N13.29 working group has some of the same members.

Writing

The specific content and the procedure used for writing the standard are the purview of the individual working group and chair. The methods used within working groups may vary and are likely to reflect the experiences and abilities of the individual members. Working Group N13.37 is developing procedures for the testing and use of thermoluminescence dosimeters in environmental applications. This standard is meant to replace an earlier ANSI standard that was published in 1975. In this working group's experience, the first step involved is working with a previous draft to identify specific topics to be covered and to develop the general outline of the new standard. Individual members were responsible for writing sections of the standard based on their expertise, with specific tasks being assigned by the chair. Typically, completed assignments have been requested in a one- to two-month timeframe.

The working group chair then coordinates the completed contributions into a new draft, which is distributed electronically. A conference call is usually scheduled for discussion of the new sections and to establish the next set of task assignments. Because travel funds are generally limited, as much work as possible is achieved through electronic correspondence and conference calls.

However, in-person meetings of the N13.29 and N13.37 working groups are important for the completion of the standards. Meetings usually include lively discussions and have proved to be the best way to resolve difficult issues. Often N13 working group meetings are scheduled to coincide with the annual Health Physics Society meetings to take advantage of the attendance of some members, but this is not a requirement. On the contrary, because of the potential for conflict with HPS activities it has sometimes been more productive for the N13.29 and N13.37 working groups to schedule meetings at other times with an individual working group member acting as host. After a meeting or conference call, minutes are distributed to the members with a particular focus on the action items. N13.37 working group members sometimes have difficulty meeting proposed deadlines because of other obligations. It is the responsibility of the chair to keep the standard progressing and to make sure that conference calls and meetings are productive. The working group chair reports on the group's progress to the HPSSC section manager, who in turn informs HPSSC.

Presenting, Reviewing and Revising

Though it is not formally required by HPSSC, the N13.29 and N13.37 working groups chose to present their work in progress at various users group meetings or scientific conferences. This proved especially valuable in getting feedback from a broad group of interested parties. Comments received were discussed by the working group and generally proved very helpful. In the case of N13.29, which describes performance tests for environmental dosimetry providers, the DOE supported a pilot test of the N13.29 draft standard. Pilot test results were presented at scientific meetings and an international conference and were the basis for further modifications.

Once a final draft standard is completed, the working group votes to submit it for approval.

Committee Ballots

The draft standard developed by the working group is then balloted by HPSSC. HPSSC may also provide a copy to the N13 committee for initial review at the same time. The results of the HPSSC ballot and any N13 comments are provided to the working group chair and the section manager.

After approval by the HPSSC, the standard is submitted to the N13 ASC for consensus balloting by all the member organizations. The ASC members may vote one of the following positions: affirmative, affirmative with comment, negative with reasons, or abstain with reasons. The reasons for a negative vote must be given and, if possible, should provide specific means to resolve the objection.

N13 (and N43) committee approval requires that a majority of the committee membership and two-thirds of those voting (excluding abstentions) approve the standard. (In the protocol followed by N43, the standards are administered and balloted by the N43 ASC directly, without going through HPSSC. There is a proposal to change the ASC N13 protocol to match this, with HPSSC being the HPS representative to the N13 and N43 ASCs.)

Once approved by an ASD, a draft standard may be published for trial use for up to three years before submittal for final ANSI approval. Such trial standards may be registered with ANSI.

Comment Period / Resolving Negatives

A proposed standard is submitted to ANSI for posting in ANSI *Standards Action,* where it is open to a 60-day public review and comment period. This may be done concurrent with the N13 ASC ballot or after the N13 ballot closes. This process solicits comments on potential conflicts or technical concerns and is intended to allow the views of all interested parties to be considered.

The N13 secretariat sends all comments and negative ballots to the N13 officers, HPSSC chair, section manager and working group chair. All comments must be acknowledged and addressed. The working group chair works with the section manager and the objector to resolve negative comments. If a substantive change is made to the draft standard it must be reballoted by the ASC. Changes related to the use of the words "should" and "shall" may be considered substantive changes that could lead to reballoting.

If a negative comment remains unresolved, a copy of the comment and the response is submitted to the ASC in order to afford all members an opportunity to respond to them or to reaffirm or change their votes within four weeks. The ASC may choose to approve a standard despite an unresolved negative. In such cases, the objector may appeal to the ASC and, if unresolved, to ANSI to determine if the consensus process has been followed.

ANSI Designation

After giving its approval, the ASC submits the proposed standard to the ANSI Board of Standards Review. If there are no unresolved objections and the developer has certified compliance with ANSI procedures for demonstrating consensus, the standard is administratively approved by the BSR.

If there are unresolved objections, the Board of Standards Review evaluates such issues as to whether due process was followed, whether an effort was made to resolve objections, if the appeals process was completed, and if notice was provided in accordance with PINS. If these and other criteria[6] are satisfied, the standard is approved and permission is given to use the official designation "An American National Standard." Approval will be denied if the BSR determines that the standard is contrary to public interest, contains unfair provisions, is unsuitable for national use, or has a conflict with an existing American national standard.

Publication

In a recent arrangement, the ANSI N13 and ANSI N43 approved standards are published by the Health Physics Society and distributed at no additional charge to all HPS members.[10] Other organizations publish ANSI standards as well, in some cases as a revenue-generating activity.

Five-Year Review

The Standards Action lists proposals for new standards as well as proposals to revise, reaffirm or withdraw existing standards. The standards developer is required to initiate action to reaffirm, revise or withdraw an American national standard within four years of its approval. If no action is taken within five years, the developer may request an extension, for up to 10 years. A standard cannot maintain the American National Standard designation beyond 10 years from the date of its approval.

Concluding Comments

The ASTM C26 and ANSI N13 working groups described here provide a window into the varied consensus standards writing processes. While their procedures differ in details, they work toward the same goal: using the principles of openness and consensus to develop state-of-the-art technical standards that are accepted among interested parties in a particular field of expertise. The U.S. government has encouraged the development and use of such standards.

Consensus standards provide a recognized mechanism to share knowledge on a variety of technical topics. These standards promote quality in industry and research, and in some cases may become the basis for regulatory policy.

Thousands of individuals from scientific, industrial and consumer organizations and government agencies voluntarily commit their expertise and substantial effort to the development of standards. The maintenance of useful standards that address technological advances and changing needs requires a continuous contribution of resources. Issues in economic and environmental globalization and international interactions magnify this challenge.

Acknowledgments

The authors acknowledge the helpful contributions of Nancy Johnson, Health Physics Society standards coordinator, and Jack J. Fix of Pacific Northwest National Laboratory, chair of Health Physics Society Standards Committee, in clarifying ANSI and HPSSC procedures. Thanks go to Ken Pearson of ASTM for providing additional information, and to Nancy Chieco, EML, for editorial assistance.

References

1. H.F. Beeghly, J.P. Cali and W.W. Meinke, Editors, Nuclear Standards for Chemistry and Technology, National Bureau of Standards Special Publication 310, U.S. Government Printing Office, Washington D.C., 1968, pp. 5–86.
2. www.astm.org, www.ansi.org, www.iso.ch
3. www.nssn.org
4. The National Technology Transfer and Advancement Act of 1995, Public Law 104-113, Plan for Implementation (March 7, 1996).
5. Memorandum for Marilyn L. Glynn, General Counsel, Office of Government Ethics, from U.S. Department of Justice, "Application of 18 U.S.C. ß 208 to Service on Boards of Standard-Setting Organizations" (August 24, 1998).
6. American National Standards Institute. "Procedures for the development and coordination of American National Standards" (March 22, 1995).
7. ASTM Technical Committee Officer Handbook, ASTM (1985).
8. J.J. Fix, H.V. Piltingsrud, "Updata: Health Physics Society Technical Standards" Health Physics Society's Newsletter (October 1997).
9. N. Johnson, private communication.
10. M. Walchuk, "How'd that Standard get in my Newsletter" Health Physics Society's Newsletter (August 1998).

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Joint DOE-PNC Research on the Use of Transparency in Support of Nuclear Nonproliferation

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Disclaimer

The views presented in this paper represent only the personal views of the authors. They do not necessarily represent the views of PNC, LANL, DOE or the University of California. All discussions were from the nuclear nonproliferation viewpoint, so information considered for release for enhancing transparency does not always mean that operators can actually release this information due to requirements to protect both nuclear materials and sensitive nuclear technology. Before any actual information is released, more consideration, discussion and input from other viewpoints are definitely needed.

Abstract

The Power Reactor and Nuclear Fuel Development Corp. of Japan and the Los Alamos National Laboratory in the United States have engaged in a joint research project to examine the uses of transparency measures in reducing concerns about proliferation. This research began with an examination of the fundamental aspects of transparency and eventually led to an examination of possible technical options. The investigators from both organizations concluded that nuclear fuel cycle transparency could play a very useful role in helping different audiences to understand a nation's commitment to nonproliferation.

Introduction

In the autumn of 1993, the U.S. Department of Energy and the Power Reactor and Nuclear Fuel Development Corp. of Japan (PNC) started a series of meetings and discussions under the DOE-PNC Agreement for Cooperation in Research and Development Concerning Nuclear Material Control and Accounting Measures for Safeguards and Nonproliferation. The goal of these particular meetings was to address technical initiatives that could support a state's commitment to nuclear nonproliferation. Out of these discussions, two projects were developed to address technical issues in nonproliferation. One of these projects, Joint Research on Transparency in Nuclear Nonproliferation, was started in early 1996 by Los Alamos National Laboratory and PNC, and the results are reported in this article. The focus of this project was a fundamental study of transparency executed through independent study and three workshops to discuss issues and results. The first workshop focused on the policy environment of transparency. The second workshop was to develop transparency options. The third workshop discussed technical options for transparency.

Results

Definitions of Transparency

The PNC felt that the definition of transparency could change depending on the audience, the timing requirements of the activities, the location of the effort (country or facility where activity takes place) and changes in the international environment. Therefore, a broad definition would be best. Culture also has an impact on the definition of transparency. Cultural characteristics and beliefs will affect how the definition is interpreted.

As a general definition, PNC submitted the following: "Transparency is the effort to promote mutual trust, improve credibility and establish working relationships between countries, international agencies, other nuclear entities and citizens through the sharing of information with respect to nuclear activities, both in the areas of nuclear disarmament and the peaceful use of nuclear energy."

The LANL representatives also felt that transparency must be flexible enough to meet the demands of a variety of situations, locations and needs. Indeed, though each transparency effort will depend upon the situation and the target audience, it

*From October 1, 1998, PNC officially changed its name to Japan Nuclear Cycle Development Institute.

will always involve documenting nuclear activities in such a way that an outside observer can form an accurate picture of those activities. This definition should be seen as flexible and as one that can be used in a variety of ways and to accomplish a variety of tasks. In addition, LANL felt that the voluntary release of information was the true measure of transparency. Transparency goes beyond required activities, such as reporting to regulatory bodies. This distinction is evident in the LANL definition of transparency: "Transparency is the voluntary release of information for the purpose of reassuring outside parties that one is engaging only in announced activities."

Reasons for Transparency

The PNC organized the reasons for transparency into three main areas: (1) the need for nuclear energy, (2) the need to address safety concerns and (3) the need for nonproliferation. The first two reasons are self-evident, but in the area of nonproliferation PNC would like to use transparency to confirm peaceful use of nuclear materials and to ease regional concerns. It is desirable to give the public and other countries additional assurances that nonproliferation obligations are being met. LANL not only believes that existing International Atomic Energy Agency safeguards are completely adequate for verification of obligations under the Nuclear Nonproliferation Treaty, but also believes that taking extra steps beyond the requirements of IAEA would promote a higher level of trust.

Detailed Goals of Transparency

As for PNC, the goal of transparency is to become as transparent as possible to a variety of audiences; however, 100-percent transparency to everyone is impossible. There are always obstacles, however reasonable and acceptable, to transparency. Because of the differences in target audiences, the details of transparency measures will vary. Therefore, the success of transparency is based on showing a satisfactory level of transparency to each target audience.

LANL takes a similar approach to the goals of transparency.

Obstacles to Transparency

For both the United States and Japan, the complications of domestic and international agreements and laws are an impediment to transparency. However, these obstacles are derived from sensitive nuclear technology and physical-protection requirements and therefore are seen as unavoidable.

Of primary concern to PNC was the lack of a Japanese equivalent to the Freedom of Information Act of the United States. At the time of the first workshop, Japan did not have a law regarding release of information, but an information-disclosure bill passed the Diet in May 1999.

The U.S. side is also affected by national security concerns. Unlike Japan, the United States is a nuclear-weapons state, and because of national security concerns the U.S. must carefully identify information that is available to the public.

Questions regarding the protection of proprietary rights are also a concern. Companies under contract to the U.S. government want to stay in control of their technology and maintain a competitive edge. LANL also discussed the additional burdens of environmental, safety and health legislation.

A major concern of both sides is the cost of transparency efforts. It seems that the more transparency that is requested, the more it costs. The challenge for both sides is to increase transparency without adding to the escalating cost of these activities. However, both realized that some transparency measures would have to be maintained even if the cost were high.

Types of Facilities Where Transparency Might Be Applied

The PNC concluded that, to receive the most benefit from transparency activities, it is important to select facilities from the nuclear fuel cycle where nonproliferation concerns exist. This means that facilities that manufacture, store or use any form of nuclear material that might be converted to weapons use should become more transparent.

As is widely known, plutonium and highly enriched uranium (defined as uranium containing more than 20 percent ^{235}U) are favorable materials from which to make nuclear weapons and explosion devices. Therefore, the facilities in which these two materials are handled or the facilities where these materials can be produced or extracted should incorporate transparency activities in order to promote nuclear nonproliferation.

In the Japanese nuclear fuel cycle, enrichment plants, mixed-oxide fuel fabrication facilities and reprocessing facilities are of the highest priority for transparency activities.

Non-nuclear weapons states such as Japan do not use HEU in their civil fuel cycle. It is possible to technically modify an enrichment plant in order to produce HEU. Therefore, transparency at enrichment plants would be used to demonstrate that all enrichment activities produce only low-enriched uranium. MOX fuel fabrication plants store large quantities of MOX powder. Reprocessing plants handle a large quantity of nuclear materials, including plutonium, and are therefore a proliferation concern.

LANL used a two-fold approach to the selection of generic nuclear facility types. First, it is assumed that the country in question has complied with all obligations under the NPT, including allowing inspections by the IAEA. Second, the country seeks to provide further assurances to others of its commitment to nonproliferation. In particular, the country wants to demonstrate that its civil nuclear program is only to be used to produce nuclear material for further peaceful civil purposes.

LANL believes that on the basis of the ready availability (or potential availability) of material that is easily used for nuclear weapons, the facility types of greatest proliferation concern are research reactors with unirradiated HEU fuel, enrichment plants, reprocessing plants, reactors with unirradiated MOX fuel, MOX fuel fabrication facilities, and storage sites for bulk HEU and MOX. Among these facilities, those that handle material in bulk form (outside of sealed containers) are of particular interest because of the greater difficulty in performing safeguards. These facilities would be reprocessing plants, enrichment plants, and MOX fuel fabrication facilities. Of somewhat less concern because of the high radiation fields are storage locations for spent fuel. This conclusion supports the IAEA emphasis on the protection of direct-use material, defined as nuclear material that is usable for nuclear-weapons purposes without further isotopic enrichment or transmutation in a reactor.

Criteria for Applying Transparency

PNC believes that for ease of use and flexibility, transparency criteria should be created that can be applied at a general level to all nuclear facilities. Of course, each facility has specific needs and concerns, but those will be addressed once an activity has passed a basic review.

Before evaluating a transparency option/activity against a set of criteria, PNC would require that all information to be released undergo an initial review for quality, quantity and ownership. As mentioned in the first workshop, transparency measures depend highly upon the target audience. Concerning quality, information should be in a format that is easy to understand and be most beneficial to the target market. To avoid releasing too much similar information, the quantity of information already available should be reviewed. If an activity is well documented, it may be more beneficial to choose another activity or facility. The most critical part of this review is determining the ownership of the information. Because of existing agreements with local, national and international governments and agencies, some information might not be released without first consulting the owner.

Upon examination, the PNC established five main criteria categories for applying transparency: confidence building, protection, disruption, time constraints and cost.

- The goal of confidence building is to release information through transparency activities that will corroborate that there are no clandestine activities taking place, bolster the validity of material accountancy, confirm that nuclear materials are adequately protected and verify that nonproliferation obligations are being met.
- Regarding protection, detailed information concerning sensitive nuclear technology, physical protection of nuclear materials and proprietary information should not be released. It is also important to review all information that has already been released. While individual pieces of information may not be a problem, the combination of all those pieces might inadvertently reveal sensitive information.
- The disruption category is primarily concerned with the setup and maintenance of a transparency activity. When transparency equipment is being set up, both facility operations and employee activities may be disrupted. Too much disruption of activities can make a transparency project infeasible.
- Every activity will be affected by several time constraints, such as time for negotiating the release of information and time for the development and installation of systems. These constraints will impact the effectiveness of the transparency activity.
- Cost is always a factor. Therefore, a balance must be sought between the effectiveness of the transparency activity, the time involved and various costs.

The discussion at LANL on criteria for applying transparency had four major themes: support for transparency objectives, release of appropriate information, confidence gained and costs.

- Looking at transparency objectives, activities should be undertaken as part of a rational, coordinated plan to achieve clear and stated objectives. For example, one government might want to convince another government that its nuclear activities are consistent with declared nonproliferation obligations. This potential objective relies heavily on the idea that each transparency activity should have a clearly defined target audience or audiences. The combination of the target audience and transparency goals will help determine and constrain acceptable transparency options. Each option must be reviewed in detail on a case-by-case basis to ensure that the transparency objectives are being achieved.
- Transparency is primarily about information: what information to release, to whom and when. All information released should be designed thoughtfully to achieve some understood goal. In considering various transparency options, it is also necessary to understand what information should or should not be released to any given target audience. There are several general guidelines that should be followed. A transparency measure should not release information that could be damaging to the very nonproliferation interests it seeks to promote. Release of proprietary or other forms of sensitive information should be avoided. In addition, the possibility of releasing trade secrets is a cause for concern in a competitive industry. Protection of materials is also a concern. Although the release of general information concerning material shipments or plant throughputs could be a useful transparency measure, one would want to avoid releasing detailed information that might threaten the physical protection and security of materials.
- Confidence gained is another criterion. It serves no purpose to release information if it does not result in increased confidence in your established transparency goals. Information of no interest to the target audience will not result in increased confidence.
- Because any facility at which transparency methods may be applied will have various operating costs associated with it, it will be important to carry out transparency measures so as to minimize the impact on facility operations. In particular, one would strive for transparency methods that minimize interference with the process line or facility personnel. Nevertheless, it should be realized that transparency is not cost-free. Transparency is best viewed as a strategy designed to provide important information to the public or to political entities while continuing operations with relatively little disruption. The value of this information and the efficacy of transparency methods in disseminating it will determine how big a price one reasonably should be willing to pay.

Applicable Transparency Options

From the PNC viewpoint, the first step in developing transparency options is to review the type of information that, if released, could result in increased trust and understanding between nuclear operators and local and foreign governments and agencies, as well as between nuclear operators and the general public. In creating this list, PNC tried to catalogue the types of information that a variety of audiences might be interested in and not necessarily information that can be released.

The three general categories of information PNC has created are facility functions, operations and IAEA activities. Table I describes, in general, the type of information sought in each of the categories. All information, including the contents and quantity to be released, will depend upon the target audience.

Table I. Types of Information of Interest

Facility Function
- General facility information (operations, operations plan/schedule)
- General safeguards information (summary of safeguards inspection efforts, safeguard technology R&D)
- General information on the physical protection of nuclear materials (summary of the physical protection systems, physical protection technology R&D)

Operations
- Accounting information (type of material used, amount used, amount stored)
- Transportation (type of material, to where, how much, purpose, who is notified)

IAEA Activities
- General information on IAEA activities

When the PNC had identified the types of information of interest, the next step was to look at devices that could be used to release this information. In general, the information release mechanisms are the following:

- Promotional materials, such as videotapes, brochures, tours and news releases. This type of information could be used to explain both the nature of the facility and its complicated processes. Sometimes, the combination of a written and visual description of an activity makes it easier to understand and perhaps more interesting. Tours can allow people to see first-hand what is going on in a facility. News releases can be used to advertise a new project or a research breakthrough.
- Remote monitoring, where a target audience can see activity in a specified area. A remote monitoring system, perhaps in a storage unit, could confirm that only declared activities are taking place in the monitored location.
- Environmental monitoring, samples taken from outside, inside or both. Environmental monitoring, perhaps at a facility under suspicion, could be used to confirm that only declared activities are taking place at the facility.
- Satellite monitoring, shipments between facilities. This type of monitoring could be used in two ways: to confirm that shipments between facilities happen as declared and to demonstrate that the shipments are adequately protected.
- Independent inspectors, target audience participants. Allowing inspections of a facility could decrease suspicions that something other than declared activities is taking place at the facility.

LANL took a facility-by-facility approach toward selecting transparency measures. The facilities were organized into two categories: (1) bulk-handling facilities and (2) reactors and storage sites with unirradiated HEU or MOX fuels. Table II lists the transparency options available in each facility category.

Table II. Potential Options at Candidate Facilities

Facility	Transparency Options
Bulk-Handling Facilities (enrichment, reprocessing plants)	• Regular facility tours to the public, visiting dignitaries, etc. • General information on facility material throughputs, radiation releases, operational characteristics, etc. • General information about material shipments to and from enrichment and reprocessing plants • Environmental monitoring of enrichment levels in or around an enrichment facility • In-stack environmental monitoring of effluents to determine burnup of spent fuel being reprocessed
Reactors and Storage Sites with Unirradiated HEU or MOX Fuels	• Regular facility tours to the public, visiting dignitaries, etc. • Regular dissemination of environmental data gathered in and around facilities • Release of general information on material shipments, quantities and locations • Remote monitoring of incoming unirradiated fuels • Remote monitoring of stored material • Independent inspection of tags and seals on stored or unirradiated materials

Technical Option for Transparency

The facilities to be discussed were narrowed to enrichment, reprocessing and fuel-fabrication plants. The target audience for this workshop was limited to foreign governments and/or international agencies.

PNC discussed technical transparency options for reprocessing, enrichment and MOX fuel-fabrication facilities.

Reprocessing Facilities

The following are types of information that may be valuable from a transparency viewpoint: (1) quantity of plutonium (inputs, outputs and waste), (2) the plutonium isotopic value in the adjustment vessel, (3) inventory of stored materials and (4) storage-monitoring activities.

The measurements taken at the start and at the end of a reprocessing campaign could be correlated to demonstrate that all the material in the campaign resulted in final products within an appropriate manufacturing range. It should be noted that the figures could only be compared at the completion of the campaign. Then comparisons will be needed from campaign to campaign. It is also valuable to confirm that the reactor supplying the spent fuel was not producing weapons-grade plutonium.

The reason for sharing information regarding storage materials is to confirm efficient materials management. In addition to accounting measures, monitoring of the facility via a camera system could also be used to confirm that materials have not been stolen. One possibility would be the use of an infrared camera in the plutonium storage vault. An image from an infrared camera can confirm whether the storage container actually contains the declared material by displaying the type of heat emitting from the container.

Enrichment Facilities

The following are types of information that may be valuable from a transparency viewpoint: (1) quantity of feed material, (2) quantity of product (low-enriched UF_6), (3) quantity of tail (depleted UF_6) and (4) enrichment range.

It would be useful from a transparency standpoint to compare the amount of feed materials presented for enrichment with the amount of product and tail produced after the enrichment procedure is completed. These measurements would be correlated to confirm that the nuclear material flows and inventories are in accordance with the facilities' declaration. Of primary importance is measuring of the enrichment range of the fuel to confirm that no HEU is being produced. Such an enrichment pipe monitor could prove that the enrichment range stays consistently within the LEU level. This monitor might be a useful technology for transparency purposes.

MOX Fuel Fabrication Facilities

The following are types of information that may be valuable from a transparency viewpoint: (1) MOX powder located in feed material and scrap material and in the fuel assemblies, (2) inventory of stored materials and (3) storage-monitoring activities.

It would be valuable to compare the amount of plutonium within the feed, scrap material, and the assemblies produced. As for the feed storage, it would also be valuable to allow a target audience to independently monitor the storage facilities via a camera system. This would provide independent confirmation that materials have not been stolen.

LANL discussed several available technologies for transparency activities.

On-stack Stable Noble-gas Monitoring at Reprocessing Plants

The burnup of fuel being reprocessed is a key indicator of compliance with nonproliferation obligations. Spent fuel from light water reactors typically has a burnup of 35,000 MWd/tU or greater. Fuel that is to be reprocessed for potential military applications has a nominal burnup on the order of 1,000 MWd/tU or less. Therefore, an independent, nonintrusive measure of burnup to confirm that the fuel being reprocessed has a burnup consistent with its declared value would be very valuable within the context of transparency.

The heavier stable isotopes of the noble gas xenon (^{131}Xe, ^{132}Xe, ^{134}Xe and ^{136}Xe) are produced in substantial quantities as byproducts of the thermal fission of ^{235}U and ^{239}Pu during reactor operations. These fission gases are retained within the cladded fuel rods while the fuel is in the reactor and in cooling ponds. However, they are volatilized when the fuel is dissolved before separation of actinides from fission products. The dissolver off-gases are then routed through the plant stack and emitted into the atmosphere.

Because the natural atmospheric isotopic abundance of each heavy xenon isotope is well known and does not appear to vary significantly over the globe, it is a relatively simple matter to isolate the component because of fission-gas production. Using this approach in experiments conducted within the United States, Los Alamos National Laboratory has demonstrated that analysis of the relative abundance of stable xenon isotopes in whole-air stack samples is valuable for making fuel-burnup determinations. Air samples are taken from the stack of the reprocessing facility, and the xenon isotopic abundance in the samples is analyzed using mass spectrometry. After subtracting out the background component, the burnup can be estimated using a variety of statistical techniques. On the basis of this experience, it is expected that we could confirm declared burnups to an accuracy of roughly 10 percent, sufficient to distinguish between high- and low-burnup fuels.

Environmental Sampling

Environmental sampling can be applied to transparency goals and measures. The basic process is to take a sample from the environment (e.g., soil, water, vegetation, or dust and debris from a surface) and, through very careful sample preparation and analysis, determine the types, elemental concentration and isotopic composition of actinides in the sample. The sample is prepared and the analysis performed in a clean chemistry laboratory. This ES capability is part of the IAEA Strengthened Safeguards System. Such a laboratory will be built by the Japan Atomic Energy Research Institute at Tokai and will give Japan an intrinsic ES capability. The results of the ES sampling and analysis would show that all activities were consistent with the country's declared activities and nonproliferation commitments under the NPT.

NTvision

NTvision is a state-of-the-art video monitoring system to observe changes as they occur in real time using Internet technologies. NTvision is low-cost, easy to use and simple to maintain. It can also be used in a secure mode and can interface with other sensor technologies. The resulting video display from an NTvision event is a set of images showing a beginning reference image, the event image, the post-event reference image, and the difference, indicating what changes have been made in the field of view. These event images can show items that are added or taken away, or simply show a change of the configuration in the scene. For transparency applications, NTvision can be used in much the same way. The uniqueness of the system includes the use of embedded HTTP server technology that creates an event table that can be accessed using basic Internet browser technology, such as Netscape. Restricting access to authorized users is easy and intuitive because NTvision uses the Netscape FastTrack Server with a browser interface. This can provide secure, worldwide access to event data within seconds of an occurrence, using Internet technologies. A summary of the key features of NTvision include:

- It acquires and provides scene analysis in real time;
- It can provide secure intranet/Internet camera access using a wide range of media, including telephone and secured or unsecured Internet;
- Raw data are processed, filtered and stored for user review;
- The user scans and selects data of interest with a commercial Web browser easily available from Microsoft or Netscape;
- NTvision uses almost entirely commercial hardware and software building blocks.

LANL pointed out that, with the Internet technology approach using Web browsers, the data from an event are available within seconds. In addition, the user only needs to access the data necessary to resolve a given event rather than having to download all data from the event.

Summary

This work allowed a thorough analysis of the role of transparency in nuclear nonproliferation. A clear conclusion of the project was that, when properly done, transparency has a valuable role in providing assurance to many different audiences that a country's nuclear program is not being used to develop nuclear weapons. However, transparency initiatives must be implemented in an intelligent manner to be effective. This means providing information that is not only correct but is both qualitatively and quantitatively appropriate for the audience. If this is done, transparency measures can make a significant contribution. In the absence of proper planning, however, they can be expensive, intrusive and counterproductive. Many technologies currently exist that can be of use in transparency programs, and this seems a rich area for future research.

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Charles W. Nakhleh is a staff member in the Applied Theoretical and Computational Physics Division at the Los Alamos National Laboratory. His current interests are large-scale numerical simulations of high-temperature fluids. Before taking his current position, he was a staff member in the Nonproliferation and International Security Division at Los Alamos, where he studied applications of Bayesian statistics to a wide range of data analysis and integration problems, including the use of noble-gas measurements to verify declared production activities at reprocessing plants. He received a doctoral degree in physics from Cornell University in 1996.

Toshiro Mochiji graduated from the Nagoya University in 1978 and received a master's degree in nuclear engineering in 1980. He has been with Japan Nuclear Cycle Development Institute (formerly PNC) since 1980.

Makiko Tazaki graduated from Gakusyu-in University with a bachelor's degree in law. She has been working with JNC since 1988 and now is a member of the Nuclear Nonproliferation Group at JNC.

Robin E. Keeney worked in the field of technology transfer at the U.S. Air Force Phillips Laboratory prior to taking a fellowship position at the Power Reactor and Nuclear Fuel Development Corp. in Tokyo, Japan. In the year and a half she worked for PNC's Office of Nuclear Nonproliferation, she conducted research on transparency in the nuclear field from a Japanese viewpoint and studied international trends in nonproliferation. Currently, she is working at Los Alamos National Laboratory in the Nonproliferation and International Security Division, where she is continuing research in the nonproliferation field.

NRC Names New Member to Reactor Safeguards Committee

The Nuclear Regulatory Commission has appointed John D. Sieber of Wexford, Pennsylvania, to the Advisory Committee on Reactor Safeguards. Sieber received a bachelor's degree in mechanical engineering from Carnegie Mellon University in 1961. He also attended Purdue University and the Massachusetts Institute of Technology. His 30-year career includes line and management positions at Duquesne Light Co. He has also served as a member or director of many organizations, including the Electric Power Research Institute, Nuclear Electric Insurance Ltd., the Nuclear Energy Institute, the Institute of Electrical and Electronics Engineers and the Westinghouse Owners Group. As a consultant to RWE Energie in Essen, Germany, Sieber was active in the use of simulators for nuclear operator training. Since 1994, Sieber has been the president of Northmont Consulting Inc., involved in nuclear plant assessments, management oversight and mentoring, event analysis, oversight of root cause determinations, and operational and human performance analysis. The Advisory Committee on Reactor Safeguards advises the commission on the safety aspects of nuclear facilities and the adequacy of safety standards.

Raytheon Team Gets Contract for Pu Pit Conversion Facility Design

The U.S. Department of Energy signed a $44 million contract with Raytheon Engineers & Constructors Inc. in August to design a pit disassembly and conversion facility. The Raytheon team includes Battelle and Siemens Power Corp.

The Englewood, Colorado, company and its subcontractors will design a facility to remove the plutonium metal from pits taken out of nuclear weapons and convert it to an oxide powder suitable for disposition. The resulting plutonium oxide is unclassified, according to an Aug. 18 DOE statement, and can therefore be placed under International Atomic Energy Agency safeguards. It will feed into the immobilization and MOX fuel fabrication facilities to be built to accomplish DOE's plutonium disposition mission. The Savannah River Site near Aiken, South Carolina, is currently the preferred location for the facility.

Facility construction is scheduled to begin in 2001 and be completed by mid-2005, according to DOE. After 10 years of operation, the facility will be decontaminated and decommissioned. The facility will consist of one main building designed to process special nuclear materials in accordance with Nuclear Regulatory Commission standards, plus support buildings and structures.

The contract contains provisions for both preliminary and detailed design of the PDCF and an unpriced option for supervision and inspection of construction. The contract is expected to last for five and one-half years, including the option period.

World Nuclear Transport Institute Recognized by IMO, IAEA

The World Nuclear Transport Institute was granted consultative status June 18 by the Council of the London-based International Maritime Organization. It was also conferred observer status June 11 by the Vienna-based International Atomic Energy Agency. Consultative status will allow WNTI, a nuclear industry membership organization founded in April 1998, to participate in IMO meetings. Observer status will permit it to attend the IAEA General Conference in September.

According to WNTI Secretary General Sten Bjurstrom, the institute "represents the collective interests of its members through participation as a non-governmental organization in the IMO and the IAEA," both of which are United Nations groups. With headquarters in London and offices in Tokyo and Washington, D.C., WNTI was created by the nuclear industry to promote safe, efficient and reliable transport of radioactive materials.

WNTI represents both the front end and back end of the fuel cycle industry and covers issues relating to all modes of nuclear materials transport. Its international membership includes ABB Atom, British Nuclear Fuels plc, Cameco Corp., Cogema, ConverDyn, Edlow International, the Federation of Electric Power Companies of Japan, Japan Nuclear Fuels Ltd., Japan Nuclear Security Systems, Marubeni Corp., Mitsubishi Corp., Mitsui Co. Ltd., Nissho Iwai Corp., Nuclear Cargo + Services GmbH, Nuclear Fuel Transport Co. Ltd., Studsvik AB, Sumitomo Corp., SKB, Swiss Nuclear Fuel Commission, Transnucléaire, Transnucléaire of Japan, Transport Logistics International and Urenco Ltd. WNTI membership information is available from the headquarters office at 171 408 1944 (fax, 171 495 1964) or from the Washington office at 301/652-5105 (fax, 301/654-1200).

U.S., Russian Fuel to Be Used in Canadian Test Reactor

The Department of Energy has reached agreement with the government of Canada to ship a small quantity of mixed oxide nuclear fuel to Canada for a one-time test called Project Parallex. This effort is part of a DOE nonproliferation project to obtain, with the cooperation of the Canadian government, the technical information that would become part of potential international agreements that use the Canadian Deuterium Uranium (CANDU) reactors to help dispose of Russian weapons-grade plutonium.

The agreement involves the shipment of nine fuel rods containing less than 120 grams of plutonium from DOE's Los Alamos National Laboratory in New Mexico to the Atomic Energy of Canada

Ltd. test reactor in Chalk River, Ontario. The material will cross into Canada at Sault Saint Marie, Michigan. The shipment of U.S. and Russian fuel is expected to take place this fall.

The fuel rods to be tested at Chalk River were made at the Bochvar Institute in the Russian Federation and at the Los Alamos National Laboratory. The tests will provide information on the performance of these fuel rods in CANDU reactors.

Link-up Creates New Force in Nuclear Support

Two major United Kingdom nuclear companies are to join forces in a new operation that is expected to become a leader in the market for nuclear support technology. The British Nuclear Fuels Co. says it has reached agreement in principle with the technology arm of the U.K. Atomic Energy Authority to create a joint-venture operation that will have an annual turnover of 150 million pounds sterling by providing support for nuclear reactor operators worldwide.

BNFL and AEA Technology will combine their expertise to provide help in the safe running of nuclear plants and in developing ways of extending their working life. Negotiations between the two organizations has reached the detailed contract stage and is expected to lead to the formation of a joint services company.

The creation of the joint services company will not only allow BNFL to continue providing technical support for the U.K. Magnox stations but will provide further strength and depth to the technical resources. BNFL mainstream activity is as a primary provider of nuclear fuel cycle services for both U.K. and international customers. Recently, it has been involved in a merger with the publicly owned Magnox Electric Co., which operates the country's eight Magnox stations together with a further three stations that are being decommissioned.

AEA Technology, with 4,500 employees and a turnover of 300 million pounds sterling a year, focuses on technology-based products, specialized science, environmental management, improving the efficiency of industrial plants, and risk assessment and safety management.

Scientists Successfully Demonstrate Plutonium Immobilization Technology

In August, a team of scientists and engineers from Clemson University and the Department of Energy's Savannah River Site, with support from DOE's Lawrence Livermore National Laboratory, successfully demonstrated an important aspect of the can-in-canister technology for disposing of surplus plutonium. The demonstration took place at Clemson Environmental Technologies Laboratory.

The can-in-canister technology involves immobilizing surplus plutonium into ceramic disks that are placed in small stainless steel cans. These cans are secured inside large stainless canisters that are subsequently filled with high-level waste glass. This glass will be generated by the Defense Waste Processing Facility at the Savannah River Site, the preferred site for the immobilization facility.

The department also announced that it has moved the start of the design of the plutonium disposition immobilization facility to 2001. The design had been planned to proceed concurrently with engineering development in an effort to have the immobilization facility available for operation in 2007, the earliest practical date. The schedule adjustment will support operation of an immobilization facility in 2008 and is supported by new schedules for providing radioactive waste as a radioactive barrier at the Defense Waste Processing Facility.

Results confirm the overall feasibility and practicality of the can-in-canister technology. The tests at Clemson University involved three pours of simulated high-level waste glass into actual canisters containing cans of simulated ceramic disks to show that glass would fill all the spaces around the cans and their supports. Filling the spaces around the cans is important because the high-level waste glass provides the radiation barrier needed to resist theft or diversion. No radioactive materials were used in these tests.

Microbial Janitors Tackle Nuclear Cleanup Problems

The Department of Energy's Idaho National Engineering and Environmental Laboratory is launching a yearlong test of a microbial decontamination technology called the microbial janitors to tackle nuclear cleanup problems at a nuclear reactor reprocessing plant in the United Kingdom. The technology will be used to remove surface contamination on a concrete wall at the reactor in a proof-of-concept test run. The depth of contamination on the wall at the reactor is anticipated to be around 2-3 mm - about the thickness of three dimes stack on top of each other. The INEEL has been collaborating on this technology since 1995 and hopes ultimately to use it to clean up radioactively contaminated concrete at nuclear facilities worldwide. This technology will reduce the risk to workers and significantly lower cleanup cost.

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January 19, 2000
Nuclear Fuel Supply Forum, Willard Inter-Continental Hotel, Washington, D.C., U.S.A. Sponsor: Nuclear Energy Institute. Contact: Conference Office; phone, 202/739-8000; fax, 202/872-0560; e-mail, fae@nei.org.

February 28–March 2, 2000
2000 National Space and Missile Materials Symposium, San Diego, California, U.S.A. Sponsors: U.S. Department of Defense, U.S. Department of Energy, NASA. Contact: NSMMS; phone, 937/254-7950; Web site, http://www.usasymposium.com.

March 13–17, 2000
Safety of Radioactive Waste Repositories Conference, Cordoba, Spain. Sponsor: IAEA. Contact: IAEA; phone, +43-1-2600-0, ext. 21310; e-mail, official.mail@iaea.org.

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8th International Conference on Nuclear Engineering, Baltimore, Maryland. Sponsor: American Society of Mechanical Engineers, French Society of Nuclear Engineers, Japan Society of Mechanical Engineers. Contact: George Bockhold; phone, 352/392-9722; e-mail, icone8@icone-conf.org; Web site, http://www.icone-conf.org/icone8/.

April 2–5, 2000
NEI Fuel Cycle 2000, The Peabody Memphis, Memphis, Tennessee, U.S.A. Sponsor: Nuclear Energy Institute. Contact: Conference Office; phone, 202/739-8000; fax, 202/872-0560.

April 30–May 4, 2000
IEST 46th Annual Technical Meeting and Exposition, Rhode Island Convention Center and Westin Hotel, Providence, Rhode Island, U.S.A. Sponsor: Institute of Environmental Sciences and Technology. Contact: Joan Harpham; phone, 847/255-1561; fax, 847/255-1561; e-mail, iest@iest.org; Web site, http://www.iest.org.

May 22–26, 2000
2nd International Conference on Nuclear Materials Protection, Control and Accounting, Obninsk, Russia. Sponsor: Minatom and U.S. Department of Energy. Contact: Gennady Pshakin; phone, 7-08439-98128; fax, 7-095-8833112; e-mail, pshakin@ippe.obninsk.ru; or Peggy York; phone, 505/665-9785; fax, 505/667-0978; e-mail, pyork@lanl.gov.

May 9, 2000
Nuclear Operations Seminar, London, U.K. Sponsor: British Nuclear Energy Society. Contact: BNES; phone, 0171 665 2241; e-mail, tillbrook_a@ice.org.uk.

May 23–25, 2000
Nuclear Technology 2000 Annual Meeting, Bonn, Germany. Sponsor: INFORUM GmbH. Contact: INFORUM GmbH; phone, 0049 228 507 223; e-mail, 100672,1424@compuserve.com.

May 30–June 2, 2000
9th Annual International Conference on Controlling Arms, Waterside Marriott Hotel, Norfolk, Virginia. Sponsor: Defense Threat Reduction Agency. Contact: Jerry Stockton; phone, 703/715-4414; or Scott Evans; phone, 703/461-2260.

June 4–8, 2000
ANS Annual Meeting, San Diego, California. Sponsor: ANS. Contact: ANS; phone, 708/579-8287; e-mail, meetings@ans.org.

July 16–20, 2000
41st INMM Annual Meeting, The Hilton Riverside New Orleans, New Orleans, Louisiana. Sponsor: Institute of Nuclear Materials Management. Contact: INMM; phone, 847/480-9573; fax, 847/480-9282; e-mail, inmm@ inmm.org; Web site, http//www.inmm.org.

INMM Spent Fuel Management Seminar XVII
January 12–14, 2000
Loews L'Enfant Plaza Hotel

Washington, D.C., U.S.A.

For registration information, contact:
Rachel Airth
Institute of Nuclear Materials Management
60 Revere Dr., Suite 500
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847/480-9573
Fax: 847/480-9282
E-mail: inmm@inmm.com

International Safeguards

The INMM International Safeguards Division met July 25 in Phoenix, Ariz., U.S.A., the site of the 40th INMM Annual Meeting. Forty-eight members of the international safeguards community — from the IAEA, ABACC, Argentina, Australia, Belgium, Canada, France, Germany, Japan, Republic of Korea, Sweden, United Kingdom and the United States — participated in this meeting.

The principal topics of discussion were:

1. The IAEA Integrated Safeguards System and associated Additional Protocol (INFCIRC 540), with emphasis on the wide variety of implementation aspects.
2. Issues surrounding a potential fissile material cutoff treaty, and the expected role of the IAEA in such a treaty.

The majority of discussion time was devoted to the Integrated Safeguards System, with the expression of a wide variety of opinions regarding the status, future, impact, etc.

As in past meetings of the ISD, it was recognized that many factors must be considered in the introduction of the changes currently under consideration as part of the IAEA's new system, as well as the vast array of new technology that may support these changes.

The next meeting of the ISD will be Nov. 5 in Tokyo, Japan. It will be held from 4:30 to 6:30 p.m. at the Gakushi-Kaikan, where the INMM Japan Chapter meeting will be held. The principal topic will again be the IAEA Integrated Safeguards System and Additional Protocol. Your participation in this meeting would be most welcomed and appreciated.

It is anticipated that in the next 12 months, the ISD will also meet once in Europe and once in the United States. Specifics regarding the dates, times and places for these meetings will be announced as soon as is practical.

Cecil Sonnier
Chair, INMM International Safeguards Division
Jupiter Corp.
Albuquerque, New Mexico, U.S.A.

Author Submission Guidelines

The *Journal of Nuclear Materials Management* is the official journal of the Institute of Nuclear Materials Management. It is a peer-reviewed, multidisciplinary journal that publishes articles on new developments, innovations, and trends in safeguards and management of nuclear materials. Specific areas of interest include physical protection, material control and accounting, waste management, transportation, nuclear nonproliferation/international safeguards, and arms control and verification. *JNMM* also publishes book reviews, letters to the editor, and editorials.

Submission of Manuscripts: *JNMM* reviews papers for publication with the understanding that the work was not previously published and is not being reviewed for publication elsewhere. Papers may be of any length.

Papers should be submitted in *triplicate*, **including a copy on computer diskette**. All popular Macintosh and IBM word processing formats are acceptable. Submissions should be directed to:

Dennis Mangan
Technical Editor
Journal of Nuclear Materials Management
60 Revere Drive, Suite 500
Northbrook, IL 60062 USA

Papers are acknowledged upon receipt and are submitted promptly for review and evaluation. Generally, the author(s) is notified within 60 days of submission of the original paper whether the paper is accepted, rejected, or subject to revision.

Format: All papers must include:

- Author(s)' complete name and telephone number
- Name and address of the organization where the work was performed
- Abstract
- Camera-ready tables, figures, and photographs
- Numbered references in the following format:
  1. F.T. Jones and L.K. Chang. "Article Title," *Journal* 47(No. 2):112–118 (1980).
  2. F.T. Jones, *Title of Book*, New York: McMillan Publishing, 1976, pp. 112–118.
- Author(s) biography

Peer Review: Each paper is reviewed by two or more associate editors. Papers are evaluated according to their relevance and significance to nuclear materials safeguards, degree to which they advance knowledge, quality of presentation, soundness of methodology, and appropriateness of conclusions.

Author Review: Accepted manuscripts become the permanent property of INMM and may not be published elsewhere without permission from the managing editor. Authors are responsible for all statements made in their work.

Reprints: Reprints may be ordered at the request and expense of the author. Order forms are available from the Institute's office, 847/480-9573.