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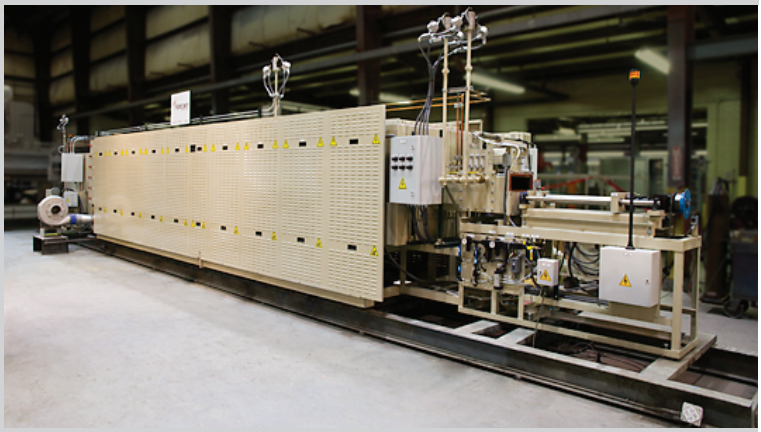

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Changing of the Guard and a Preview of 2015

By Larry Satkowiak
INMM President

It is that time of the INMM lifecycle: the changing of the guard. I begin my two-year term as President of the INMM after serving two years as Vice President. I am quite fortunate having had Ken Sorenson as a mentor and Scott Vance as a "grand-mentor." In their former roles as President and Immediate Past President, respectively, they were not only outstanding in leading and guiding the Institute in a measured and thoughtful manner but also served as nearly ideal role models for me. Thank you, Scott, for bearing the six-year burden of the presidency and sharing your vision of what the institute could be and guiding us in that direction. Thank you, Ken, for leading us through some our recent turbulent times and I look forward to your continued mentorship as Immediate Past President.

Congratulations to Cary Crawford and Steve Wyrick, our newly elected Executive Committee (EC) Members-at-Large. Their two-year terms began October 1. Thank you to Mark Schanfein for serving as Member-at-Large to the Institute for the last two years. A special thanks to Steve Wyrick for finishing out Ruth Duggan's term after she stepped down. We all miss Ruth. Finally, congratulations to Corey Hinderstein on her election as Vice President. Corey has been active in the INMM for many years in a variety of capacities and will serve the Institute well. I look forward to working with Corey.

Other recent changes in leadership include:

- Morris Hassler is the new chair of the Facility Operations Technical Division. Thank you, Shirley Cox, for all of your service to the Institute in this and all the other positions you've held over the years.
- Michelle Romano is the new chair of the Membership Committee. Thank you to Al Garrett who filled this position for several years. Good luck, Al, in your new position at the IAEA in Vienna. I am sure the Vienna Chapter will appreciate your support and wisdom.
- Markhu Koskelo is the new chair of the Exhibits Committee. He did a terrific job this year identifying and soliciting exhibitors for the Annual Meeting.
- George Baldwin is the new chair of the Communications Committee.
- Steve Ward is the new chair of the Education and Training Committee.

The Institute is fortunate to have such dedicated volunteers, people who are willing to give their time and talents to support the Institute and believe in its mission. Our dedicated members are our true strength.

The 55th Annual Meeting held in July was very satisfying. Atlanta proved to be a gracious host and the Marriott Marquis an excellent venue. We had more than 700 attendees and representatives from more than thirty-six countries. The final technical program had 449 papers in sixty-eight concurrent sessions. We had a strong international participation; more than one-third of the attendees were from outside the United States. The meeting was kicked off with an excellent Opening Plenary. Senator Sam Nunn was fantastic with his talk "Nuclear Risk: The Race Between Cooperation and Catastrophe." We closed the meeting with a screening of *Pandora's Promise* and had more than 150 attendees. From the beginning to the very end there seemed to be an air of excitement in the hallways as professionals from all over the world engaged each other, exchanged information, renewed friendships and made new ones.

Also encouraging was that 139 students registered; they presented more than 115 papers during the meeting. We recognized three new chapters: South African Chapter, India Pandit-Deendayal-Petroleum University Student Chapter, and Morocco University of IBN Tofail Student Chapter, bringing our total to thirty-two worldwide.

We were very pleased with the number of attendees and the quality and number of papers presented. Last year we struggled with the impact of the U.S. government travel policy on conference travel and attendance. I think the worst is over and the future looks brighter.

Preview of 2015

The 30th Spent Fuel Seminar will be held January 12-14, 2015, Crystal City, Virginia, USA. This workshop continues to be relevant as the nuclear industry continues to struggle with issues surrounding the disposition of commercial spent nuclear fuel.

The Reducing the Risk Workshop will be held March 17-18, 2015, at the George Washington University Elliot School of International Affairs in Washington, DC, USA. Topics range from addressing the insider threat, cybersecurity, and the changing relationship with Russia.

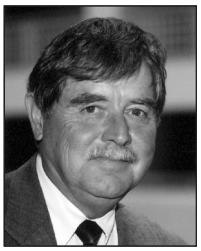
On April 26, 2015, we present an INMM/ANS Joint Workshop on Safety-Security Risk-Informed Decision-Making in Sun Valley, Idaho, USA. The INMM has a long-term partnership with the American Nuclear Society and periodically holds joint workshops when a topic overlaps both of our missions.

The INMM Nuclear Security and Physical Protection Technical Division will hold a Vulnerability Assessment (VA) Tools Workshop in Boston, Massachusetts, USA, September 14-16, 2015.

Working within the framework of our MOU with the European Safeguards Research & Development Association (ESARDA), a joint workshop focusing on Building International Capacity will be held on October 4-7, 2015, at the Jackson Lake Lodge (Grand Teton National Park), Moran, Wyoming, USA. This is the eighth in a series of joint workshops with ESARDA held every three to four years. Locations rotate between Europe, United States, and Asia.

And of course, the 56th Annual Meeting, July 12-16, 2015 in Indian Wells, California, USA. These events provide an opportunity to engage other nuclear material management professionals from around the world, to exchange information and best practices and make lasting friendships. What an exciting year we will have!

What an Excellent 55th INMM Annual Meeting



By Dennis Mangan
INMM Technical Editor

This issue of the *Journal* is dedicated entirely to the 55th Annual Meeting held in Atlanta, Georgia, USA, July 20-24, 2014. This is the first time I can recall that an Issue of the *Journal* has been solely dedicated to the meeting. I trust as you read the articles in this issue you will surmise, if you weren't there (or if you were), that it was an excellent meeting.

Larry Satkowiak, our new INMM president, opens the issue with a warm "Changing of the Guard" column where he reflects on those people who have, over the past years, provided him with input that prepared him for the office of president. He also identifies the new members of our Executive Committee plus new cairs of various committees. He also provides a good preview of some of the upcoming activities in 2015.

Teressa McKinney, chair of the INMM Technical Program Committee, and in effect the chair of the annual meeting, provides an excellent summary of the event. As you will note, the meeting included two plenary addresses and three panel discussions, which is something that seldom occurs at our meeting.

Former U.S. Senator Sam Nunn, co-chair and chief executive officer of the Nuclear Threat Initiative, was the opening plenary speaker on Monday morning and had an interesting overview of the status of international nuclear materials management. Although he praised the efforts of the past, he adeptly added the phrase: "While great progress has been made, I think that we can all agree we have miles to go before we sleep". Senator Nunn's speech and thoughts were superb.

The INMM Opening Plenary Session Panel Discussion, "Nuclear Security Summits—Advancing the Nuclear Security Agenda," moderated by Larry Satkowiak, and including Matt Bunn, Laura Holgate, and Hubb Rakhorst as panelists. This panel discussion was likewise extremely interesting and well done.

On Tuesday, Tero Varjoranta, Deputy Director General and Head of the Department of Safeguards at the International Atomic Energy Agency, presented a second plenary address. He did an excellent job in discussing the difficulties the IAEA is facing to accomplish their safeguard goals, and likewise addressed his thoughts for the future. It was a well-done speech.

Following Varjoranta's speech, the usual *JNMM* Roundtable discussion was held. The panelists were a mixture of Associate *JNMM* Technical Division Editors, officers of the Institute, and several committee chairs. The two guests interviewed were Tero Varjoranta and Laura Holgate. This roundtable session was more involved than most past roundtables. The interviewees were fairly active, and plenty of questions were asked. It was a worthwhile discussion.

A Tuesday Plenary Session Panel Discussion was held. Michael Whitaker was moderator, and seven panelists were interviewed and held discussions on "How the Evolving Domestic, Regional, and IAEA Safeguard Requirements and Practices are Influencing Safeguards Implementation and Culture." The seven panelists were Tero Varjoranta, Steve Adams, Sonia Fernandez-Moreno, Olli Heinonen, Tomonori Iwamoto, Laura Rockwell, and Piotr Szymanski. This panel discussion was likewise exceptionally informative.

In addition to the above speeches and panel discussions, this issue also has the award-winning first and second place student papers. First place went to *Simulated Response of Electrochemical Sensors for Monitoring Molten-Salt Fueled Reactors* by Devin Rappleye, Milan Stika, and Michael Simpson of the University of Utah, USA. Second place was *Status of the Implementation of Safeguards by Design in the International Regime* by Luis A. Ocampo-Giraldo of Pennsylvania State University, USA. Congratulations to these winning students.

Finally, this issue concludes with two of our regular features: a typically well-reviewed and documented book review by Mark Maiello, Book Review Editor, *A History of U.S. Nuclear Testing and Its Influence on Nuclear Thoughts, 1945-1963* by David Blades and Joseph Siracusa; and a very interesting article *Taking the Long View in a Time of Great Uncertainty—Turning the Corner*, by Jack Jekowski, editor of "Taking the Long View" and chair of the INMM Strategic Planning Committee. Both of these two closing articles fit in quite well with the rest of the articles in this issue.

JNMM *Technical Editor may be reached at dennismangan@comcast.net.*

Report of the 55th INMM Annual Meeting

Teressa McKinney, Chair
Technical Program Committee

I hope you had the opportunity to join us at the 2014 Annual Meeting that was held at the Marriott Marquis in downtown Atlanta, Georgia USA. The weather was a lot more cooperative than most of us had anticipated for mid-July temperatures and we only hope that we can have great weather when we return in two years. Once again I would like to give a great big thanks to Anne Czeropski and Jodi Metzger for their excellent guidance on every detail for the planning of the annual meeting. I also want to thank all the INMM Headquarters staff at the Sherwood Group for their excellent support at the Annual Meeting: Lyn Maddox, Kim Santos, and Patricia Sullivan. As I stated previously, there is so much more that goes on behind the scenes and they all make it look so easy!

Several events that took place prior to the Annual Meeting. You can find meeting highlights from the Executive Committee in an article by Larry Satkowiak, in the September 2014 issue of the Communicator.

Sunday, several events took place: the Annual Meeting of the New Brunswick Laboratory Measurement Evaluation Program sponsored by New Brunswick Laboratory, and the Advanced Particle Transport Methodologies/Tools for Nuclear Safeguards and Nonproliferation Workshop were conducted by Georgia Tech and Virginia Tech. D. L. Whaley and his registration team opened the registration and were available throughout the remainder of the week. Once again, the NDA Users Group, organized by Stephen Croft, DA Users Group, organized by Jon Schwantes, and ANSI/INMM 5.1 Analytical Chemistry Laboratory Measurement Control Committee organized by Peter Mason and Melanie May held meetings, as did all of the technical divisions. Also, the ANSI N15 5.1 Subcommittee Meeting met during this time. The President's Reception was held in the Exhibit Hall and gave everyone a chance to preview the exhibits. A student mixer and career fair was held in the same venue immediately following. This provided students the opportunity to meet with industry partners and INMM leaders for one-on-one Q&A, and to discuss potential career opportunities.

Monday morning began with INMM awards being presented before the opening plenary speakers. Awardees for 2014 were:

- 2014 Vincent J. DeVito Distinguished Service Award: Joseph Pilat, Los Alamos National Laboratory
- 2014 Edway R. Johnson Meritorious Service Award: Susan Pepper, Brookhaven National Laboratory
- 2014 Early Career Award: Karen Miller, Los Alamos National Laboratory

Former U.S. Senator Sam Nunn served as our opening plenary speaker. He gave an intriguing talk, Nuclear Risk: The Race Between Cooperation and Catastrophe. We followed the opening plenary with a plenary panel that focused on Nuclear Security summits—Advancing the Nuclear Security Agenda with representatives from the three Summits that occurred in The Netherlands March 2014: Laura Holgate (Nuclear Security), Matthew Bunn (Nuclear Knowledge), and Huub Rakhorst (Nuclear Industry). Many thanks to the Opening Plenary Subcommittee (Joyce Connery, Steve Mladineo, Larry Satkowiak, and Corey Hinderstein) for your great suggestions! The panel discussion was followed by many good questions from the audience.

Immediately following the opening plenary the technical sessions began. We noticed an increase in attendance this year as compared to the past several years—more than 700 attendees and representatives from over thirty-six countries. The final technical program had 408 abstracts presented in sixty-eight concurrent sessions with four panel discussions throughout the week. The Technical Program Committee worked very hard to pull together another stellar program for the annual meeting. We experienced growing pains with more abstracts than we had available space, but in the long run everything came together nicely. Thank you technical division chairs for your hard work on the technical program:

- Morris Hassler, Facility Operations
- Michael Whitaker, International Safeguards
- Cary Crawford, Materials Control and Accountability
- Mona Dreicer, Nonproliferation and Arms Control
- Tom Bonner, Nuclear Security and Physical Protection
- Steve Bellamy, Packaging, Transportation, and Disposition

Typically, Tuesday proves to be one of the longer days for the annual meeting. Although INMM did not organize a 3K run due to budget constraints, the "Keep it Alive" run was organized to keep up the tradition. We thank Markku Koskelo and Larry Satkowiak for motivating those that took part in the early morning run.

This annual meeting we tried something a little differen; we opened Tuesday with a second plenary session. Tero Varjoranta, IAEA deputy director general for Safeguards, introduced the topic, How the Evolving Domestic, Regional, and IAEA Safeguards Requirements and Practices are Influencing Safeguards Implementation and Culture. This topic was followed by a panel discussion that was coordinated through Michael Whitaker, International Safeguards Division. The panel consisted of Tomonori Iwamoto, Stephen Adams, Laura Rockwood, Olli Heinonen, Tero Varjoranta, Sonia Fernandez-Moreno, Piotr Syzmanski. This proved to be another great start to the day.

Amidst the numerous concurrent sessions, the technical posters featured in the poster session were organized by Taner Uckan. Georgia Tech organized a tour of their laboratory for INMM participants during the lunch break. All the slots were filled quickly; hopefully, we can offer this again in 2016 to those that were not able to attend this year. The U.S. Nuclear Regulatory Commission also opened its doors to interested INMM participants for a tour of their Incident Response Center.

Tuesday evening the Annual Business Meeting took place. The results of the annual election of officers were announced. The results are Larry Satkowiak, President; Corey Hinderstein, Vice President; Chris Pickett, Secretary; Bob Curl, Treasurer; Cary Crawford, Member-at-Large, and Steve Wyrick, Member-at-Large. The outgoing Executive Committee Members-at-Large Mark Schanfein and Steve Wyrick were recognized as well.

Figure 1. Left to right: INMM President Ken Sorenson, Technical Program Committee Chair Teressa McKinney, Senator Sam Nunn, Laura Holgate, Huub Rakhorst, Matt Bunn, and INMM Vice President Larry Satkowiak

Figure 2. Left to right Michael Whitaker, Tomonori Iwamoto, Stephen Adams, Laura Rockwood, Olli Heinonen, Tero Varjoranta, Sonia Fernandez-Moreno, and Piotr Syzmanski

Two resolutions of respect were read during the meeting: Edward Kruyuchkov and Michael Lineberry. Ken and Larry also recognized the newest INMM Fellows: Charlie Harmon and Steve Ortiz.

Although Tuesday evening did not close with an official banquet, the International Safeguards and Nonproliferation Arms Control Divisions organized a

gathering at a local restaurant. The event was very well-attended and many positive comments were received regarding the no-host gathering (a special thanks to Katie Snow).

Wednesday was another filled day with papers and lunch meetings. The ANSI N15 Technical Standards Meeting, organized by Melanie May, Lynne Preston, and Steven Ward met during lunchtime.

Thursday technical sessions continued through most of the day. However, in lieu of a closing plenary speaker a viewing of the movie *Pandora's Promise* was featured. More than 150 people attended the movie sponsored by the Southeast Chapter, Savannah River National Laboratory, Tetra Tech HEI, and the Central Region Chapter.

After the movie, Ken Sorenson and Larry Satkowiak made the announcement of student paper winners:

Robert J. Sorenson Scholarship

$1,000 — Domestic Student: Alexis Kaplan, University of Michigan

$1,000 — International Student: Vivek Maradia, Pandit Deendayal Petroleum University

For details on the Sorenson Scholarships, see teh INMM website at www.inmm.org/sorenson

J. D. Williams Student Paper Award

1st Place — $1,000

Devin Rappleye, *University of Utah*

Paper #412: Simulated Response of Electrochemical Sensors for Monitoring Molten-salt Fueled Reactors (International Safeguards)

2nd Place — $500

Luis Ocampo Giraldo, *Pennsylvania State University*

Paper #350: Status of the Implementation of Safeguards by Design in the International Safeguards Regime (Facility Operations)

In addition, for the first time, the best paper presented in each division (not including the first and second prize winners) were each awarded $50. Those papers are:

Education and Training

Sheila Amalia, *Universitas Gadjah Mada*

Paper #222: The Role of Teachers on Forming Perception on Nuclear Safety in Indonesia

Materials Control and Accountability

Alexis Kaplan, *University of Michigan*

Paper #275: Total Plutonium Content Determination with the Differential Die-Away Self-Interrogation Instrument

Nonproliferation and Arms Control

Manit Shah, *Texas A&M University*

Paper #190: Simulation Analysis of Scintillation in a NaI Detector

Nuclear Security and Physical Protection

Marc Paff, *University of Michigan*

Paper #122: Performance of a EJ309 Organic Liquid Scintillation Detector Pedestrian Radiation Portal Monitor Prototype at the 2nd SCINTILLA Benchmark Campaign

Packaging, Transportation and Disposition

Paul Rose, *Georgia Institute of Technology*

Paper #271: Detection of Shielded Special Nuclear Material Using High Energy Gamma Ray Transmission Imaging and Cherenkov Detectors

As I mentioned in the morning speaker's meetings, we are always interested in your feedback regarding ways to improve our annual meeting. I encourage you to complete the on-line survey after each annual meeting or please let us know your thoughts.

Our 56th Annual Meeting will take place July 12-16, 2015, at the Renaissance Esmeralda, Indian Wells, California USA. Mark your calendars now because you don't want to miss it. I look forward to seeing you there!

55th INMM Annual Meeting Opening Plenary Address
July 21, 2015

Former U.S. Senator Sam Nunn
Co-Chair and Chief Executive Officer
Nuclear Threat Initiative

Thank you, President Ken Sorenson, for your introduction and for your outstanding record. Thank you, Teressa McKinney, for organizing this conference, and I thank all gathered here today for the outstanding work of the Institute of Nuclear Materials Management. I am delighted to welcome you to Atlanta and to my home state of Georgia.

All Americans should be grateful for this Institute and for your fifty-six years of remarkable work to advance effective nuclear materials management around the globe. While great progress has been made, I think that we can all agree we have "miles to go before we sleep."

Our Nuclear Threat Initiative has worked closely with your Institute since our founding in 2001. We have partnered on several key projects, including the development and launch of the World Institute for Nuclear Security, an organization that has grown to more than 2,000 members from 108 countries and that provides a forum to share and promote best security practices among those responsible for nuclear material all over the world. In addition, two members of our NTI team, Corey Hinderstein, who is about to begin a two-year stint at the U.S. Department of Defense, and Kelsey Hartigan, have held leadership posts with your Institute.

I also want to praise two people in today's audience whom we have worked closely with over the years—Laura Holgate of the National Security Council staff and Matthew Bunn of the Belfer Center. Laura and Matt have both dedicated their careers to reducing nuclear risk and have had enormous roles in reducing nuclear dangers. They will be speaking on a panel this morning, and I look forward to hearing their valuable insights on the Nuclear Security Summit process and the global nuclear security agenda.

Today, the elements of a perfect storm are in place around the world: an ample supply of weapons-usable nuclear materials, an expansion of the technical know-how to build a crude nuclear bomb and the determination of terrorists to do it.

This should be a grave concern for all of us. As this crowd knows, terrorists don't need to go where there is the most material; they are likely to go where the material is most vulnerable. That means the future of the nuclear enterprise requires that every link of the nuclear chain be secure. The catastrophic use of atoms for terrorism will jeopardize the future of atoms for peace.

Perspective is crucial. The enemy of nuclear security is not only complacency; it's also paralyzing pessimism. The message must go out that on nuclear material security, we must—and we are—moving forward. Because of the cooperation between the United States, Russia, and other nations, including the Nunn-Lugar Cooperative Threat Reduction Program in the early 1990s, the world has made real progress in securing weapons-usable nuclear materials.

Since 2012, seven states, including Ukraine, have completely eliminated these materials from their territories. Imagine the Ukraine crisis today if there were still nuclear weapons and weapons-usable nuclear materials spread around the country.

While twenty-five countries still possess weapons-usable materials to-

day, that's half the number of states that had them in 1992. Also, more than a dozen states have recently taken important steps to improve the security of their nuclear materials by reducing their quantities.

Today, I also want to praise the Global Threat Reduction Initiative (GTRI) team, who are celebrating their tenth anniversary this year, and everyone who has been a part of this crucial work. The U.S. Department of Energy launched GTRI in 2004 to focus on and accelerate the United States' efforts to secure vulnerable nuclear and radiological material located at civilian sites around the globe. This work has been supported and funded by both the Bush and Obama administrations, and many in this room have been critical to its success.

Many of the removals of weapons-usable nuclear material have been accomplished in partnership with Russia. Despite the serious tension between the United States and Russia over the ongoing crisis in Ukraine, we must not lose sight of how essential cooperation between our two countries is to global security and to preventing catastrophic terrorism and nuclear proliferation. It is critically important that the United States and Russia, as the two nations with the largest amounts of nuclear material, continue to work to reduce nuclear dangers. There will be a huge cost in diminished global security if the Ukrainian crisis continues unabated and poisons the atmosphere for essential cooperation in these areas.

The tragic downing of the Malaysian plane in Ukraine last week makes the situation even more urgent. It also highlights how risks escalate when dangerous technologies like surface-to-air missiles fall into dangerous hands. We are in a high-risk new era. Two immediate questions and one long-term one:

1. Will President Putin use his power to force the Russian rebels to assure a humane recovery effort and a full, objective investigation?
2. Will President Putin begin working vigorously and responsibly to end the civil war in Ukraine? As NTI Board member and former Russian Foreign Minister Igor Ivanov stated recently, "Only international cooperation can prevent Ukraine from becoming a failed state."
3. Will the Malaysian Air tragedy shock Russia, indeed shock all of us, into thinking anew about the essential accountability of sovereign states for dangerous weapons and materials to our neighbors and the world?

In a recent Washington Post op-ed titled "Strategic Terrorism," former Chief Technology Officer of Microsoft Nathan Myhrvold warned the world that the economics and availability of weapons of mass destruction have radically changed and that today we face a different cost equation and a different world. With today's technologies, a small number of people can obtain incredible destructive power with crude nuclear, biological, chemical, or cyber weapons, as well as high-tech conventional weapons, as we have just seen in Ukraine.

The Ukraine tragedy and the terrible loss of innocent lives increases the distrust and makes cooperation even more difficult. Paradoxically, it also makes the rebuilding of trust and cooperation more essential.

There are still nearly 2,000 metric tons of weapons-usable nuclear materials spread across the world in hundreds of sites, some of them still poorly secured and vulnerable to theft or sale on the black market. As you know, a small amount is sufficient to build a terrorist nuclear weapon. Though not my subject today, we have "miles to go" to improve the security of radiological material which could be used in a "dirty bomb," and the world is fortunate that this has not already occurred.

We must secure all materials to the highest possible standard. Yet, stunningly, even though the destructive power of these materials in dangerous hands has the capacity to shatter world confidence, kill hundreds of thousands, and change society as we know it, there is no effective global system for how it should be secured. Let me repeat that. There is no effective global system for how weapons-usable nuclear materials should be secured. Let me tell you what I mean.

In spite of the global threat posed by these materials, security practices of countries vary widely, as many in this room know. Some states require strong nuclear security practices, including the threats from inside; others don't. Some states require strong measures to counter the risk of insider threat; others don't. Some facilities have armed guards on site; others have to call the police or military to respond and hope that they get there in time.

Several important elements for guiding states with their nuclear security responsibilities do currently exist, but they fall short of forming standards or reflecting best practices. For example, the International Atomic Energy Agency (IAEA) develops very useful guidance on various nuclear security topics. In order for them to constitute international standards, states must treat them as requirements and not suggestions. At the Hague Nuclear Security Summit in

March, thirty-five countries did just that and committed to "to realize or exceed" the intent of key guidelines. In addition, security guidance should reflect the strongest security approaches—true best practices—not the lowest common denominator. WINS' best practices are one area where this is happening, and I urge your continued support for WINS' efforts.

Another serious gap in international efforts is that they cover only approximately 15 percent of weapons-usable nuclear materials—those used in civilian programs. The remaining 85 percent of materials are categorized as military or non-civilian and are not subject even to limited guidelines.

This lack of an effective global system for nuclear materials security stands in stark contrast to other high-risk global enterprises. For example, in aviation, countries set standards for airline safety and security through the International Civil Aviation Organization, which then audits state implementation of the standards and shares security concerns with member states. If your practices don't meet these standards, your plane isn't going to land in the United States, the European Union, China, Russia, Japan, India, Brazil, or most other places around the world.

Obviously, in an age of terrorism, the airline industry depends on this safety and security system for its economic viability, and countries depend on it to protect their citizens. Shouldn't the security of potentially the most dangerous material on the planet have an equally effective approach?

We also need to think broadly about nuclear security as it is affected by nonproliferation, arms reductions and nuclear energy. For example, let's think about these questions and challenges:

- What are the security implications of continuing to increase nuclear material stockpiles without limits?
- What are we doing about the spread of technology for peaceful nuclear power programs that can also be used for nuclear weapons, and can we close gaps by building consensus around new approaches to the nuclear fuel cycle?
- Can we think and act boldly by beginning to bring the production of all enrichment and reprocessing under strict international monitoring?

The intersection of all of these areas is the nuclear material and whether it is managed responsibly. Nuclear security is not a stand-alone issue; it is a continuing and perpetual mission, one that can be made easier or harder depending on the policy decisions made in these related areas.

My bottom line: the world needs a nuclear materials security system in which:

1. All nuclear weapons-usable materials are covered—civilian and military.
2. All states adhere to internationally recognized standards and best practices.
3. States demonstrate to each other that they have effective security in place by taking reassuring actions, such as inviting peer reviews of their facilities using outside experts; and
4. States reduce risks by decreasing their materials stocks and the number of facilities that house them.

The Issue of Sovereignty

The global discussion about nuclear security is changing for the better, and the Nuclear Security Summits have been very productive. I give President Obama high marks for his initiation and leadership of this effort. The toughest roadblock to more effective nuclear materials security remains a concept of national sovereignty that is not consistent with today's dangers. States opposed to global rules on nuclear security contend that the responsibility for nuclear security within a state resides entirely with that state.

This dubious argument implies that the world must accept a very high degree of catastrophic nuclear risk to protect a very broad definition of nuclear sovereignty. Is that really the case? As I see it, this definition of sovereignty will not survive after the first act of nuclear terrorism. If a nuclear disaster occurs, what would we wish we had done to stop it? What keeps us from doing it now?

The stakes for both global commerce and stability are extremely high. Let me give a vivid example. A couple of years ago, *Scientific American* magazine reported on a study that investigated the likely impact of a hypothetical regional nuclear war between India and Pakistan using 100 weapons. According to the computer models, more than 20 million people in the two countries could die from the blasts, fires, and radioactivity. Smoke from the fires would cover all the continents, diminish sunlight, and shorten growing seasons. Agricultural yields would decline around the world, and one billion people with marginal food supplies could die of starvation within ten years.

It goes on, but suffice to say that even if you give this scenario a substantial discount—or even if you change it radically downward by assuming a limited terrorist nuclear attack rather than a regional nuclear war—one truth should be clear. The right to do whatever you

wish with nuclear technology in your own country is no more compatible with global nuclear security than "do-whatever-you-want" aviation rules would be compatible with safe and secure international air travel. We have no trouble applying this logic to countries like Iran and North Korea, but doesn't nuclear security accountability apply to all?

Fortunately, many countries support the idea of shared and effective responsibility. They understand that this call is not an abdication of sovereignty; it's an assertion of the prime obligation of a sovereign state—to protect its citizens from disaster. A concern for the fate of citizens in our own countries entitles, even obligates, leaders to insist on global standards for nuclear materials security and a more secure nuclear fuel cycle.

The Tasks and Call to Action

While much of the work in nuclear security is in the hands of governments, it is clear that they need more effective partners outside government. Before closing, let me briefly tell you the parts of the apple that NTI is biting off in terms of promoting global nuclear security:

- We are engaged in a global dialogue that brings experts together from inside and outside of government and across the nuclear industry to determine how to design and build a global system for nuclear materials security. We believe that our work made a positive impact at the recent Netherlands Summit.
- In 2012 and 2014, we evaluated and benchmarked nuclear security conditions in 176 countries through the NTI Nuclear Materials Security Index, with particular emphasis on those with weapons-usable material.
- As I mentioned, working with many in this room, we helped create the World Institute for Nuclear Security. WINS needs sustained support from government and industry to continue this critical work.
- We recently launched a "Pilot Project" on verification, the results of which will be shared in a special session at this meeting by Kelsey Hartigan and Andrew Newman.

Finally, I want to update you on an initiative we launched in 2006, when NTI, through the generosity of Warren Buffett, pledged $50 million to help create a low-enriched uranium stockpile to be owned and managed by the IAEA. It was matched two-to-one by a number of nations, including the United States, the European Union, the United Arab Emirates, Norway, and Kuwait.

As the United States and its negotiating partners engage in nuclear talks with Iran in Vienna, success hinges on Iran agreeing to verifiable commitments to prove to the world on a continued basis that its nuclear program is exclusively peaceful.

Iran has vigorously asserted it needs national enrichment capability to protect against an interruption in its nuclear fuel supply, despite Russia's commitment to supply all the necessary fuel for Iran's only nuclear power reactor at Bushehr. So, in theory, if Iran's concerns about security of supply are addressed, it should have no need for a large domestic enrichment program. The point of the fuel bank is to empower countries to confidently purchase nuclear fuel on the market rather than build their own enrichment facilities, so the fuel bank could help meet Iran's energy security concerns as a back-up to the market.

Unfortunately, at a time when the fuel bank could be a valuable asset, progress on its establishment is stalled. In the last three years, the IAEA and Kazakhstan, which has volunteered to host the bank, have not been able to finalize plans. They must intensify these efforts to quickly resolve the remaining issues.

The fuel bank is not just a good idea; it could be an urgently needed piece of the puzzle to reduce nuclear threats, including playing a role in the resolution of the Iran crisis, or at least avoiding other Irans in the future.

We believe we are making a contribution.

Closing

We are the first to admit that NTI is a small organization with a limited budget dealing with global threats and global opportunities. The world looks to members of the INMM to lead in the field of security as you have led in safeguards and so many other areas. Your wisdom and experience are vital to the future of the nuclear enterprise and our security.

Yes, governments do have the primary responsibility, but this organization plays a very big role. Your Institute recognized this when you broadened your Physical Protection Technical Division to include, and indeed highlight, nuclear security. You have recognized that our new era requires new approaches.

The world has changed. We must think anew.

We are in a race between cooperation and catastrophe. Together, we must run faster. With your vigorous help and strong leadership, I am confident that we will. Thank you.

INMM Opening Plenary Session Panel Discussion
Nuclear Security Summits—Advancing the Nuclear Security Agenda

July 21, 2014
Panelists:
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Special Assistant to the President
Senior Director for Weapons of Mass Destruction Terrorism and Threat Reduction
National Security Council

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Moderator:
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The following is a transcript of the Opening Plenary Panel Discussion, Nuclear Security Summits—Advancing the Nuclear Security Agenda, presented during the Opening Plenary Session of the INMM 55th Annual Meeting.

Larry Satkowiak: The Nuclear Security Summit consists of three summits, the Nuclear Security Summit, the Nuclear Industry Summit, and the Nuclear Knowledge Summit. We have three panelists today who will make opening remarks about their individual nuclear summits and then we'll open it up to questions and hopefully discussions because we really want to hear people's ideas, people's thought as well as their questions.

Matthew Bunn is a professor at the Harvard Kennedy School. His research interests include nuclear theft and terrorism, nuclear proliferation and measures to control it, the future of nuclear energy and its fuel cycle, and innovation and energy technologies. Before coming to Harvard, Dr. Bunn served as an advisor to the White House Office of Science and Technology Policy, as a study director at the National Academy of Sciences, and as the editor of *Arms Control Today*. He is the author or co-author of more than twenty books or major technical reports, and more than 100 articles and publications ranging from *Science* to the *Washington Post*.

Matthew Bunn: Good morning everyone. I would say I'm here more as a representative of a coalition called the Fissile Materials Working Group than as an expert from Harvard University. I'm proud to be on the steering committee of the Fissile Materials Working Group, which is a coalition of nongovernment organizations that took the lead role in organizing the nongovernment summit in 2010, has helped with the nongovernment meetings in 2012 and 2014, and is taking the lead on planning for the 2016 event.

As we heard from Senator (Sam) Nunn, there has been already tremendous progress in nuclear security in the last two decades with something like half of the countries that once had weapons usable nuclear material on their soil, eliminating it. Most of the remaining countries are taking major steps to improve nuclear security. The four year effort and the summit process have driven a substantial amount of additional progress.

But there is much more to be done, as we also heard from Senator Nunn. There are many countries in the world where the security measures in place are not yet sufficient to cope with the full spectrum of plausible adversaries, whether outsiders or insiders. And we still have a serious problem in many countries with security culture as highlighted in our own country by the amazing incident at Y-12 in 2012. As Senator Nunn pointed out, we still have no global rules that say how secure a nuclear weapon or the materials to make one should be. We have no agreed way of showing countries that you really do have effective nuclear security in place. And we have no agreed forum for continuing a high-level dialog and deciding on next steps after the Nuclear Security Summit process comes to an end.

So, we believe that there's an immense need for the 2016 official summit, the government summit that you'll hear about from Laura Holgate, to really make a major step forward. They have to establish a sustainable framework to build effective security and continuous improvement in the face of evolving threats and evolving technologies for the long haul. They have to leave a suitable

nuclear security legacy for President Obama. And if not, if there isn't major progress, there's really a risk that the whole effort could sort of peter out and nuclear security could begin sliding back in the direction that it was before the Nuclear Security Summit process began.

They face really an extraordinary challenge in this respect because there have been three summits already that have mined this vein as much as they could and found as much agreement as they participating states were able to find so far. So there really is, I think, a very, very difficult challenge facing Laura and her colleagues preparing the official summit.

So what is the nongovernment community doing about it? Our role really is to raise ideas, to exert pressure, to keep score, to educate the media, to educate policymakers, and to educate the public. And we're working actively on all of these fronts. You heard already from Senator Nunn about some of the excellent work that the Nuclear Threat Initiative is doing. We are planning another nongovernment summit in 2016. We're raising money for it now. Of course, whether it will happen will depend on the success of that effort. The effort is being led by the Fissile Materials Working Group and its international partners in other countries around the world and other groups may get involved over time, though that's not yet settled. It will be in our current thinking, nothing is set in stone yet, so what I'm offering are preliminary ideas, a little bit different from the previous meetings with more of an emphasis on discussion of ideas and paths forward and less of an emphasis on a presentation, another presentation, another presentation, and so on.

We're taking a page from the industry's playbook at their most recent summit with the notion of working groups on particular subtopics. Our current thinking is to have three working groups. The first would focus on the issue of comprehensiveness. Senator Nunn pointed out a huge fraction of what we're doing so far is really focused only on the civilian material so that working group would be asked several questions, but in particular, they'll be asked what kinds of things could states plausibly agree to that would help ensure effective security for the non-civilian material.

The second working group would be on implementation of best practices and requirements and in particular what steps could really provide convincing evidence that effective nuclear security was in place without compromising classified information. Or identify where additional work was needed.

A third working group would be on consolidating and eliminating stockpiles and, in particular, how can we build toward agreement on eliminating the civil use of highly enriched uranium and beginning to reduce the stockpiles of civilian separated plutonium that many people may not realize are now bigger than all the world's weapons stockpiles of plutonium combined.

The idea is to try to get the working groups started early so that some preliminary ideas from the working groups—with maybe a little more legitimacy behind them having come from a group of organizations rather than just an idea from one group—could be plugged into the official process, which realistically makes its decisions fairly early on in the process.

We are discussing collaboration with the industry summit. Those discussions are still in somewhat early stages. It's possible we will have both of those meetings in the same venue and it's possible we might have some joint sessions and some independent sessions since we have some overlapping interests and some different interests. We're discussing whether there's a role for the national labs and similar technical institutions that haven't really had a major role in any of the three types of meetings so far. So that's obviously a subject of interest to this group here and I'd be happy if you have particular ideas about what role would be appropriate for such institutions, by all means drop me an email or take a look at the Fissile Materials Working Group page and you can find an email for the whole group.

While the working groups have not yet begun, a set of the major NGOs working on this subject has already gotten together and worked out a number of broad areas that we will individually and collectively be pressing on over the next couple of years.

We believe the world needs, first of all, a comprehensive nuclear security regime, as Senator Nunn said, with all countries with relevant materials participating in the major agreements and both civil and non-civil material having effective and lasting security in place.

Secondly, we need some mechanism to build confidence that effective security really is in place rather than just state saying, "trust me."

Thirdly, we need some kind of sustainable framework to continue high-level attention after the submit process comes to an end and to push for a continuous improvement.

Fourthly, we need effective implementation of best practices and stringent requirements with strong security cultures in place.

And fifthly, we need some kind of plan for eliminating the civil use of HEU and drawing down the stocks of civilian plutonium.

So, that's our preliminary thinking. It's our view the risks remain unacceptably high. We look around the world today and while a couple of years ago you could have said "Well, al Qaeda is mostly crushed and the risk may be dramatically lower," now we see the Islamic State having seized power in a large chunk of Iraq and Syria, possibly having more power and more violent intent even than al Qaeda ever did. We see determined and, in some cases, successful attacks on heavily guarded targets in Pakistan. We see in Russia just as an example, the director and two of the deputy directors of one of the largest plutonium and highly enriched uranium processing facilities being arrested for corruption. We have a lot of challenges to the nuclear security system today and we've got a lot of work still to do to ensure that that system is up to the challenges.

So I will stop there and an apologize for going on too long.

Larry Satkowiak: Thank you very much. It's now my turn to apologize because Laura was supposed to go first. But we are a room full of very smart people and we'll just juxtapose everything you heard.

Laura Holgate joined the Office of Weapons of Mass Destruction Coordinator at the National Security Council in 2009 as the senior director for weapons of mass destruction terrorism and threat reduction. In this role she oversees and coordinates the development of national policies and programs to reduce global threats from nuclear, biological, and chemical weapons, detect, identify, secure, and eliminate nuclear materials, prevent malicious use of biotechnology, and secure the civil nuclear fuel cycle.

From 2001 to 2009, Ms. Holgate was the vice president for the Russia new independent states program at the Nuclear Threat Initiative. Ms. Holgate led NTI's activities to secure and eliminate fissile materials, develop new employment for former weapons workers, reduce risks of the nuclear fuel cycle, and enhance national threat reduction programs.

Laura Holgate: Thanks so much, Larry and Ken, and to the leadership of the Institute for Nuclear Materials Management, for being patient and forgiving me enough to invite me back after I had to excuse myself from a couple of previous keynote addresses at previous events. I also want to thank the absent Joyce Connery who organized and conceived this panel and is missing out on it. But it's also great to see so many friends and colleagues and it's particularly daunting to give a speech not only after my former boss, Senator Nunn, but in front of him in terms of having him in the audience. It's an honor to have a chance to share some ideas with you from the podium, sir. And it's great to be back with my INMM friends.

The Obama administration's focus on nuclear security is part of comprehensive nuclear security policy presented by the President in Prague in 2009. In that speech he described a four-pronged agenda to pursue a world without nuclear weapons. He laid out new U.S. policies and initiatives towards nuclear disarmament, nuclear nonproliferation, nuclear security and nuclear energy. In that speech President Obama identified the risk of nuclear terrorism as the most immediate and extreme threat to global security, and he called for a global effort to secure all vulnerable nuclear materials in four years. He also highlighted the need to break up black markets, detect and intercept materials in transit, and to use financial tools to disrupt elicit trade in nuclear materials.

Now it's almost impossible to quantify the likelihood of a nuclear attack by extremist groups. But we know, as we've heard this morning, that we have 2,000 metric tons of nuclear weapons usable materials in both civilian and military programs around the world. We know that terrorists have the intent and the capability to turn these raw materials into a nuclear device if they were to gain access to them. And a terrorist attack with an improvised nuclear device would create political, economic, social, and environmental havoc around the world no matter where that attack occurs. The threat is global, the impact of a nuclear terrorist attack would be global, and the solutions must, therefore, also be global.

It's become a cliché to observe that our societies, our economies, and our security are all interconnected, but it's never been more true. We have seen how catastrophic destruction in any one place, whether natural or manmade, flows around the world in the form of refugees, disruption of markets, political instability, and, if the response is not sufficient to the challenge, it can result in diminished faith in governments as a whole. Even with all too frequent reminders of this reality, we have not yet done all we can or all we need to do to protect ourselves against a nuclear threat. And while we've made strides in dismantling core al Qaeda leadership, we should expect its adherence and offshoots as well as other violent extrem-

ists with a variety of agendas to continue to try to achieve their nuclear ambitions. In short, the threat of nuclear terrorism is real and serious and it will endure into the foreseeable future.

The President's call in Prague was intended to reinvigorate existing bilateral and multilateral efforts and to challenge nations to reexamine their own commitment to nuclear security. Given the global repercussions of an attack, all nations have a common interest in establishing the highest levels of security and protection over nuclear material and strengthening national and international efforts to prevent nuclear smuggling, and detect and intercept nuclear materials in transit. World leaders have no greater responsibility to their people and their neighbors than to secure nuclear materials and prevent nuclear terrorism.

The Nuclear Security Summit process has been at the centerpiece of U.S. efforts to secure nuclear materials and prevent nuclear terrorism. Since the first summit in April 2010 in Washington, D.C., President Obama and more than fifty world leaders have been working together through the Summit process. The Summit community has built an impressive track record and meaningful progress towards nuclear security and on actions to back up the words. Of the national commitments made in Washington in 2010 more than 90 percent had been completed by the second summit in Seoul. That's a very impressive statistic for summit follow-through if you look across the types of summits that have been held internationally.

These outcomes, whether in the form of material removed or eliminated, treaties ratified and implemented, reactors converted, regulations strengthened, centers of excellence launched, technologies upgraded, capabilities enhanced, these outcomes are tangible, concrete evidence of increased and improved nuclear security. The international community has made it harder than ever for terrorists to acquire nuclear weapons and that's made us all safer.

In Seoul, fifty-three countries made more than 100 commitments contained in national progress reports and thirteen different so-called gift baskets. These gift baskets gave opportunities for countries to step beyond the limitations of consensus in a communique to highlight steps they're actually taking as a group to reduce nuclear threats. And while it would be an overstatement to suggest that these 100 commitments came about exclusively as a result of Nuclear Security Summits, it's fair to say that almost certainly not all of them would have transpired in the absence of the kind of high-level forcing event that summits can have.

The Hague Summit this March maintained the momentum of tangible actions to reduce the threat of nuclear terrorism and to make progress toward strengthened international norms and standards for nuclear security. First of all, the number of facilities and nuclear materials continues to decline and additional commitments were made. We successfully completed removals of highly enriched uranium and plutonium from Belgium and Italy. In total enough material for a couple of nuclear weapons. Importantly, Japan committed to remove more than 500 kilograms of highly enriched uranium and separated plutonium, this is dozens of bombs worth, from its vast critical assembly. This is the largest ever pledge by a country to remove nuclear material from its territory and we look forward to continued work with Japan on this initiative. In addition to these accomplishments twelve countries highlighted the elimination of all nuclear materials from their territory.

Secondly, security at sites and on borders is increasing. All summit countries reported progress in enhancing nuclear security practices in their own country, including twenty countries committing to increased cooperation to counter nuclear smuggling efforts and thirteen countries pledging to improve nuclear detection practices at ports.

Thirdly, the global nuclear security architecture continues to be strengthened. Additional countries are adopting binding legal commitments such as the Convention on the Physical Protection of Nuclear Material. The contribution of multilateral institutions such as the IAEA to nuclear security continues to grow. And voluntary collectives like the Global Initiative to Combat Nuclear Terrorism are prioritizing the nuclear security agenda and national regulatory bodies are updating provisions for nuclear security.

Radioactive source security is also being enhanced and twenty-three countries agreed to work together to secure their most dangerous radioactive sources to levels established in international guidelines by 2016.

A majority of summit states will implement stronger security practices. In a real breakthrough, thirty-five countries pledged to implement stronger nuclear security practices in their countries by bringing international guidelines into national laws, inviting international peer reviews, and committing to continuous review and improvement of their nuclear security system. And as has been hinted, we also opened the door a crack on military materials at least in terms of the discussion and in terms of the U.S.

statements on these issues, and also on the notion that there's a concept of sufficiency in how much plutonium a country has. These are small but modest steps towards some of the areas of the Nuclear Security Summit agenda that has not been as strongly addressed.

The other interesting thing that happened in 2014—a unique event—was that the leaders participated in an unprecedented nuclear terrorism exercise that was well received in the end despite some initial skepticism on the part of some leaders. This scenario helped illustrate the kind of decision leaders may face and prompted a constructive discussion on the kinds of steps decision-makers in countries should take before such an event arises. President Obama participated in the scenario and highlighted lessons the United States has learned from extensive U.S. nuclear security exercises. Several participants suggested we continue and further develop this dimension of our work for the 2016 summit.

Once again, groups of countries joined together and targeted joint statements or gift baskets, the celebrated collective actions to implement specific aspects of the summit agenda. In total there were thirteen such joint statements, three of which had more than thirty commitment signatures from different countries.

So as was announced last summer in Berlin, President Obama will host the next Nuclear Security Summit in the United States in 2016. We have not yet picked a city, but at this point we can say that we envision 2016 to be a transitional summit in which we will seek to establish how we can maintain the momentum of the summit process and build a global nuclear security architecture in a way that is enduring. We will continue to seek additional tangible results in nuclear material reductions and better overall nuclear and radiological security practices. But we will also be looking for ways to enhance the global nuclear security architecture so that it can stand on its own in a post-summit context. We will continue to promote an architecture that over time is comprehensive in scope including both civilian and military material, that is based on international standards, that incorporates measures to build confidence, that states are applying the security responsibly in their countries, and that promotes declining stocks of directly usable fissile material.

We need to do more together to enhance nuclear security performance, to dissuade and apprehend nuclear traffickers, to eliminate excess weapons and material, to avoid production of materials we cannot use, to make sure our facilities can repel the full range of threats we've already seen in our neighborhoods, to share experience and best practices, and to do so in ways that are visible to friends, neighbors, and rivals and therefore provide assurance that we are effectively executing our sovereign responsibility. We also need to reflect the principle of continuous improvement because nuclear security is never done. As long as materials exist they require our utmost commitment to their protection.

Key aspects of the summit success have included the personal attention of national leaders, a focus on tangible meaningful outcomes, a regular event that elicits deliverables and announcements, and a forum that builds relationships that can help advance joint efforts. We need to find ways to capture some of these attributes in more lasting vehicles that continue to exist after the summit process is complete in order to promote nuclear security progress. The IAEA's first ever nuclear security ministerial held last year is an important step toward strengthening the Agency's role in promoting nuclear security. And the 2012 special session at the U.N. on nuclear terrorism reflects the importance of the United Nations in this arena.

Other fora for collective action such as the Global Partnership, the Global Initiative, the World Institute for Nuclear Security, and the Nuclear Suppliers Group have all been invigorated in recent years. And INMM and other professional societies are key components of this architecture and must continue to contribute to this mission as we move beyond summits to nurture new concepts, build professional skills, and develop global connections. The summits were designed to enhance, elevate, expand, and empower this architecture of treaties, institutions, norms, and practices to effectively address the threats we face today.

We were at the early stages of planning for the concepts of the 2016 Summit including by intensive outreach to a number of summit countries. One idea that has surfaced is the creation of a core group of countries that have played leadership roles in the summit process and which going forward could be embedded in international institutions to provide focus and initiative. We're also looking at ways to link the official Summit more directly to the civil society summit and the industry summits. But whatever shape it ultimately takes, it will be an involving process over the next two years taking into account input and ideas from countries that have and will continue to make the summit process a success thereby making the world a safer place. Many thanks and I look forward to the discussion.

Satkowiak: Our final panelist is Huub Rakhorst. Huub graduated from the University of Groningen in physics and from Delft University with an MBA. After ten years with the Dutch Ministry of Economic Affairs in The Hague and Washington, D.C., he joined URENCO in 1985. He held various positions at URENCO including finance director and since 2006 he is the managing director of URENCO Nederland in Almelo, the Netherlands. He chairs the steering committee for the Nuclear Industry Summit in 2014 and we'll hear more about that summit now.

Huub Rakhorst: Thank you very much and thank you for the invitation to speak at this important conference. Let me start off by reiterating the importance of the nuclear industry in the world. The nuclear industry is important for generating electricity. Something like 12 percent of the world's production comes from nuclear power plants. Many industrial applications depend on nuclear technology. And of course, tens of millions of people are treated every year with nuclear medicine products. I think it's very important that the nuclear industry constantly reiterates this kind of importance to the world.

Nuclear security is, of course, very important to our industry. If it's not okay then the nuclear industry has no future. An incident anywhere means a big blow to our industry globally. That's why the nuclear industry pays lots of attention to nuclear security and pays, by the way, also a lot of money to make that happen.

Traditionally, and that's one of the drawbacks of nuclear security I think, traditionally there's always a loss of secrecy around nuclear security. You don't talk about nuclear security because it's secret. And that's a big difference from talking about safety in the nuclear field. We know already for many, many years that organizations like WANO talk extensively about nuclear safety and have all kinds of discussions with their memberships in order to share best practices and see what can be done to further nuclear safety in the world. That's different than the area of nuclear security. It's also to a certain extent to many industries kind of an excuse not to discuss nuclear security. That's something we have to change. We are really in the process of changing that. I think our nuclear energy summit this year has made a big contribution to that.

In the Nuclear Industry Summit (NIS) of 2014 in Amsterdam at the end of March, we not only talked about issues like weapons usable nuclear materials but also about technology around that. As you can imagine, the technology issue is very important for our industry. We focused, for example, very much on the issue of cyber security. It's relatively new, it wasn't so much highlighted in the previous summit but as you can imagine the issue of cyber security is very much on the agenda of our industry and it is something that will stay on the agenda, I'm pretty sure, in the 2016 NIS that is being held in the United States.

What can I talk a little bit about the industry summit of this year? First of all, I have to mention that we have excellent cooperation between the Dutch chair, the Dutch government, and our organization finding ways to talk to each other, to keep each other informed about the progress towards the NIS 2014 in conjunction with the Nuclear Security Summit. And that is important because I think, generally speaking, it is very important that industry has a good relationship with their national authorities on this subject. I hear stories, indeed, I think Senator Nunn mentioned it as well, the issue of national sovereignty where governments would say we know best what is necessary in terms of nuclear security and you, industry, you have to listen.

Well, listen we do. But we also like to talk and we also like to discuss issues relating to nuclear security. Because we think as industry we have a lot to share with governments in terms of best practices, in terms of cooperation between companies that have the same goals and the same ideas about this topic.

So what did we do in preparation of the Nuclear Industry Summit? We had three international working groups addressing different topics. First of all, strengthening self-control, which means a lot of ideas and which means to improve your safety culture at the company level. The second working group was specifically mentioning the issues of managing cyber security and information security. And the third working group was on managing materials of concern, in particular HEU (highly enriched uranium) and radioactive sources.

We had an international group of people in each of these working groups present. They did an excellent job to prepare their reports. These reports are all on our website and in the end we have put together the recommendations out of these working groups in a joint statement that contains thirteen concrete recommendations and I'll highlight a few.

One of them is on good practices shared and incorporated. I refer back to what I said earlier. Talk to each other and share your best practices in that respect. Another one is on promoting a strong security culture in your industries. Strong culture means from the top down to the lowest level of your personnel. And

then, of course, you need well-trained personnel. That's where organizations like WINS and IAEA come into play. We very much favor these kinds of international organizations helping in training your staff to be good security people.

Another one is one I've already mentioned is to collaborate with your governments, with the states. For example, on what kind of regulations you as industry would promote in terms of performance-based regulation, which is also mentioned in the Nuclear Security Summit. A statement that is something that we as industry very much would like to see further explored.

Specific recommendation is on cyber security, again calling upon collaboration with states on the threats in that respect because we think the cyber issue is only going to grow over time and it's not only weapons material that you're concerned about, you're also concerned about the technology to make that kind of material.

One of the other recommendations is to incorporate national and international guidances. For example, from IAEA, Laura Holgate already mentioned that a lot of countries want to incorporate the IAEA recommendations on these kinds of issues into national law and we are okay with that.

The final one is on HEU minimization. In industry we had warned that can only be done if it is technically and economically feasible. HEU is an important aspect in, for example, the treatment of cancer patients so we really have to weigh certain minimization issues versus the availability of this material.

Looking at the 2016 event that's going to be here in the United States and to be organized by industry, we know that there is already quite some work ongoing in this respect. I think the American organizers learned from the Dutch in starting this process early, 2016 seems to be a long way off but it's very close. I know that NEI is taking the lead in this respect. They have set up already the working groups so I have full confidence that this is going to be a very good next NIS 2016. And I really look forward to work together with the organizers of NIS 2016 to make that a success.

Looking further down the road I think that there is a big role to be played by the organization like IAEA and WINS, but also the World Nuclear Association, WNA. I know they have taken up the issue of nuclear security in one of their working groups, which means that, broadly speaking, the nuclear industry in the world is taking up this issue even more vigorously. Thank you very much and I look forward to your questions.

Questions:

Satkowiak: I'm going to take the chair's prerogative and ask my own question.

My question goes back to something Senator Nunn said about threats and it also ties into some of the things Laura Holgate mentioned. We as a nuclear community realize that the threat is out there. We perceive the threat. We think it's real. How broadly is that perception accepted in the international community? Is this something that is universal or is that half the battle, just convincing people that the threat is real?

Holgate: I think while we've been able to get a lot of countries to work with us on the Nuclear Security Summit, I think it's fair to say that we don't have a common perspective on the threat. Some nations are defensive about their own nuclear security practices and are in a little bit of denial about that. Some are skeptical about the intent or capabilities of terrorists, whether or not six guys in a cave can really build an IND when it took U.S. and Russia Manhattan Project equivalence to create nuclear weapons. And some believe the U.S. is the main target and so it's not really their problem.

I think these are all patently false beliefs. I don't want to give them any credence by repeating them, but I think those are the kinds of attitudes that we have to struggle with in our conversations with other countries and try to get past that. We know that every country can improve nuclear security, our own included. We know that the crude design of the first U.S. bomb was considered so reliable it wasn't even tested. The Manhattan Project level activity had to do with generating the material not building the bomb. So if you've got the material you're really not a Manhattan Project away from a useful device.

This has really been a struggle across some of the countries. So they're willing to go along to a certain degree but when it comes time to making hard judgments, expensive judgments, changing policies, changing practices, that has been a challenge. I appeal to all of you because this is an international community but also because there are a lot of large brains and creative people here to help think about how we dramatize the issue without scaring people to death. That was one of the reasons we did this exercise for the leaders, to help bring home to them the kinds of questions that would be asked, the kinds of issues that will be brought up if there is an incident anywhere and it affects all leaders.

But I know Matt Bunn has done a lot of thinking about this threat perception issue. I suspect he might have a thought.

Bunn: As Laura knows, I tend to be long-winded on almost every subject and particularly this one. I think this is very important and I think that there are many states that are perfectly happy to sign a statement that says this is a threat without actually thinking that it really is. And in particular there are many countries who, in the famous language about securing all vulnerable nuclear material around the world, said "Oh, well, vulnerable nuclear material, that's obviously somebody else's. It has nothing to do with me."

I think that's wrong for every country including the one we're sitting in. All countries have more work to do to make sure that their material is secure.

There are a couple of things that I think would be helpful. One is I've been arguing for some time that the U.S. government should put together a detailed report on what it knows about what terrorists have done, how easy or difficult it is to make a bomb, what the state of nuclear security is, what the real thefts of HEU and plutonium have been and so on in several versions. A very, very classified version that would just be for educating ourselves within our government, a somewhat less classified version we could share with countries like the UK and France that we have restricted data agreements with, an even more watered down version we could share with other countries, and then a very watered down version that could be made public for these kinds of purposes.

I think also that the practice of actually carrying out realistic tasks of the security at nuclear facilities is something the United States has been doing for a long time. A few other countries do it, not very many. And it has proved, I think, very effective in revealing vulnerabilities and convincing policymakers that they're real as opposed to just nuclear security managers whining that they need more money.

The Netherlands has a very interesting approach because they don't have the problem that we have of having lots of guys with guns around the facility. They do these exercises with no notice. People don't know it's an exercise when it's happening, which obviously in the United States if you did that, people would get killed.

I think it helps the security culture, it helps with understanding the threat, it helps with convincing people that even though there is a security system there that looks reasonable, that maybe it really could be overcome by intelligent adversaries looking for the weak points.

So I think both of those would be quite helpful. We did a survey of nuclear security experts in most of the countries that have highly enriched uranium or plutonium recently and the number one driver of improvements that they identified in their country's own nuclear security systems were incidents. But a very important other driver was results of inspections and tests and things like that.

Rakhorst: Just to reiterate what was just said. Indeed in the Netherlands we don't have armed guards as all the facilities are very close by cities and military force and police force, etc. So we do the force-on-force exercises we call it within the Dutch nuclear industry, which is not very big. We have five or six big entities. And that proves to be very successful because it is very realistic and it helps you to sharpen your security force.

There are different approaches across countries but as long as they are comparable in terms of result, I would be fine with it because there is no standard which fits all.

Audience Questions

Ed Lyman: I have two questions. First, for Mr. Rakhorst, do you flag cyber security as one of the main concerns that was discussed at the industry summit? One issue that's come up here in the United States with licensing of the MOX fuel plant and at fuel cycle facilities there is increased reliance on automated systems for inventory control and also for material accounting. The vulnerability of safeguards in material accounting is increased due to cyber security threats because you're relying more on automated systems and less on direct physical verification. I was wondering if that issue had been discussed at all in the industry summit?

Rakhorst: Not particularly, but the driver behind a lot of these discussions on cyber security is the vulnerability of your process systems for outside interference. In particular nuclear power plants or enrichment plants need to be protected against intruders as was shown in the example in Iran where an enrichment plant was targeted by cyber attacks. That is very much on the agenda of the nuclear industry to protect against that. Not just because of the implications for the nuclear issues per se but also because of the implications of losing secrets that you don't want to lose, which might have nothing to do with nuclear issues but more of economic and commercial issues.

There's a natural drive in the nuclear industry to protect against cyber security like in any industry it should be, but in particular in the nuclear industry because of also the nuclear aspect of it.

Ed Lyman: Then a question for Ms. Holgate. You've highlighted the thirty-five state agreement as a breakthrough and I just want to understand that better. Because it seems many of those countries have bilateral agreements with the U.S. on nuclear cooperation, so they're already bound to comply with INFCIRC225 and the current revision at least for U.S.-origin material already. I'd just like to understand more what value-add is there for those countries in signing this agreement.

Holgate: In terms of the application of the U.S. bilateral agreements for cooperation, that coverage affects only the sites that happen to receive U.S.-origin material so it does not cover their entire nuclear complex. Well certainly there are countries in that thirty-five who are not within the U.S. relationship in a bilateral way. But it's more important to be signaling that these guidelines that have been previously understood to be simply advice from the IAEA are now making their way into international law at the voluntary decision of these countries and through their normal regulatory and legal processes. The benefit there is showing the progress from soft law to hard law, which I think is a very important concept as we look at how we expand and enhance the nuclear security architecture.

It's also the case that there's more than just the 225 application, it's all three nuclear security documents from the IAEA. It also includes commitments to do peer reviews and to do certification of nuclear workers, which are also above and beyond what is the case in many countries. We do really look at the willingness of countries to state in a collective way that they plan to make the serious changes in their own nuclear regulatory processes as meaningful and one that we hope to find ways to add other countries to that over time.

Mark Schanfein: This is kind of directed towards Laura. Fukushima kind of shook the foundations of safety for nuclear reactors and the incident at Y-12 that occurred I think shook the foundations of security in terms of the U.S. I spent ten years with the Los Alamos plutonium facility and I thought the security was excellent. I'm sure you've already had to address this, but how do you, with what the U.S. is promoting, recover from something like that? What do you say to the foreign partners of why that's an anomaly?

Holgate: To my view and the position I took immediately when I heard about what had happened at Y-12 is that transparency is the only antidote to hypocrisy. And we immediately had a policy that we would share what we could about the root causes of that problem, about the steps we'd taken to cure it and about the lessons learned that went from it. And it's the nature of our democracy that these things do get very broad public exposition. There was testimony on the Hill, there were IG reports, there were internal reports. Now some of these by definition have classified components but the bulk of what happened there is not a classified situation. And it points to a whole range of common problems that exist whether it's lackadaisical equipment management or whether it's a culture of how the guards work and interact with false alarms and other kinds of challenges. There was a number of common points that frankly come out not unique to that situation but almost every time you have a security failure, even if not as visible and catastrophic as that, these are constant things.

This is why it's so interesting that the WINS community has taken up these particular challenges of how do you deal with a sleepy guard problem and really tried to dig in on best practices to manage these common and replicating challenges.

Right now as many of you know, my writ expands beyond nuclear to include chemical and biological. We're dealing with a very similar situation in terms of a couple of our biological labs in the United States. I'm going to be hosting a meeting tomorrow from CDC just down the street to address that challenge. But it's the same point. We need to be clear and transparent with the world about the nature of the problem and the steps we've taken to solve it, and the other pieces that people might learn from it. And I was really surprised when I was talking with my Dutch counterparts in the context of the Nuclear Security Summit, and you've heard many references to this concept of assurances. How do we help others which is what your question is really tugging at. How do we do our security in a way that gives others confidence that we're doing it right. I asked my Dutch counterpart, I said what's the most assuring thing you see from the U.S. in terms of our nuclear security behavior? He said frankly it was the briefing that you gave to the other Sherpas on the Y-12 incident. The fact that you were prepared to be that forthcoming about it and to share that kind of information. So I think we may have actually succeeded in turning around the international perception because of our approach to sharing what we knew about that.

Bunn: If I could just suggest, I think beyond the testimony and the IG report, at the early days we've now learned a

lot that would be worth putting together into some kind of report, maybe a report based on the briefing because the briefing as far as I know hasn't been made public. I think there's more of a story that we can tell.

From the very beginning of nuclear security cooperation, I've been advocating that we as the United States shouldn't be saying we do everything right and do it like we do it. But rather, we've made a lot of mistakes ourselves, here's some things we've learned from those mistakes, maybe that will help you avoid making similar mistakes yourself. I think that's a more compelling message than we're terrific and we have no flaws, which is not true. I think this is a great teaching moment.

Tom Gray: I'm curious about the transitional nature of the 2016 security summit. In the event that the next U.S. administration doesn't place the same importance on nuclear security as this one does, is there enough support internationally to maintain the momentum for this movement? Who would be the next big players for leadership in that role and what roles could industry and a nongovernmental sector play in that transition?

Holgate: The reason we call it a transitional summit is because it's pretty sure there will not be a 2018 summit in the same spirit. And that has nothing to do with prejudging any future U.S. administration, it's simply that there is kind of an exhaustion, frankly, among leaders, and when the leaders discuss this privately among themselves in the summit at The Hague, there was a sense of these have been incredibly powerful up to this point, but it's not clear that every two years needs to be the right movement.

What's also clear, though, is that nobody wants to really shut it down and say this is the final one forever. So that's one of the challenges we have in 2016, to be clear that we don't expect to build the future in a way that does not rely on the continued every two-year meetings of leaders, and this is where really empowering the international institutions occurs. Those were there before the summit started, they will be there when the summits are over or when they are in a pause or whatever, more stretched out. And how do we spend both the next two years defining what a more reliable and effective architecture that is based on the effective capabilities of these institutions. How do we uplift these institutions so that they can continue to carryforward the momentum even if leaders aren't meeting every two years?

For example in the IAEA the movement of the office of nuclear security to a division of nuclear security is a piece of that progress. The budget issue that was raised earlier has got to be part of that. And so how do we similarly in the UN, how do we empower the 1540 committee to be more active? How do we inspire more visible behavior by governments in the 1540 committee process? One of the great things is the annual reports or the regular reporting that countries are required to do. Every country on the planet required to do under 1540. That's a great source of the kind of assurance behavior that we've been talking about. How do you tell the world what you're doing in these realms?

So we need to look very carefully about what is it that has made the summits a success, what are the components of state behavior that summits have provoked or invoked, and how do we park those effectively in the institutions that we have in a way that is more enduring and more capable. So that's what we're really going to be focusing on in 2016 is getting leader buy-in to institutional uplift in a very specific and concrete way.

Rakhorst: I think the nuclear industry post-2016 will continue on its path forward. And that means that there's increased direction between industries on this issue. There's also increased interaction with regulators with countries. In my view, it will be a sign of competence and a sign of quality for clients and the people at large if the nuclear industry shows that they have made further progress in the area of nuclear security, like they did in nuclear safety as well.

For example by being certified with ISO 27001, which is the certification for information and security. And for example by showing that they have done all the training necessary for a good security force. For example, with people certified by WINS and other organizations. So in that respect it will be necessary and normal for the nuclear industry to continue in this field also because of the activities like, for example, WANO and WNA, organizations working together to further nuclear security within the nuclear industry.

Bunn: Well, I do think we have a real challenge. All of what has just been said is true, that we've built up the international organizations, the industry organizations, the relationships. But I fear that if we're not continuing in some intensive forum like we've had, that those may decay again. And I look back at the history of U.S. nuclear security in the United States and you often see a big ramp up in response to some incident or inves-

tigation or something and then a falling off. So I worry and I think we have a lot of work to do between now and 2016.

Laura mentioned the budget for the IAEA. I would be remiss if I didn't mention the budget of the U.S. government, which obviously has been a large amount of huge controversy over the last several years. But the budgets for nuclear security work in foreign countries have been going down and down. Some of that is the result of work getting completed, but some of it is not. The budgets are now hundreds of millions of dollars a year less than the same programs we're planning that they would need just a few years ago. We'll be putting out a fairly comprehensive report on that subject in the next few days from our center at Harvard. But I think we have work to do to figure out a vision for nuclear security that is compelling enough to sustain the support needed from both the administration and the Congress for a program that is constrained only by its opportunity and not by its funding.

Holgate: Can I just add one more thing to the point on the architecture point and I was remiss in not having mentioned it earlier. There are two critical treaties that were raised earlier during Senator Nunn's presentation, the Convention on Physical Protection of Nuclear Materials and the International Convention on Suppression of Acts of Nuclear Terror. These are held up by a dispute between two senators in the United States Senate. It's the legislation that is needed to bring these into force for the U.S., is required to update our criminal code. So it's actual legislation, it's not just advice and consent. The advice and consent stage was achieved in 2008.

But we need to pass new laws to criminalize certain acts of nuclear terrorism in order to be in line with these treaties. And so the draft legislation is in the Judiciary Committee, which is not used to thinking about nuclear security as part of its jurisdiction. And it's gotten stuck there on a debate for years having to do with the death penalty, and whether or not that should be applied to nuclear terrorism acts.

There are many sides to that question. The administration actually takes no position on that issue. We just wish the senators would figure it out, vote on it, get it into conference, and have a bill. The President will sign this bill. But right now we're on the sidelines and one of the key things that these updates of these treaties do is it creates review conferences for implementation of these treaties. That is a classic kind of platform for the regular check-in of implementation and if we are actually in that treaty process we can participate in a way that hopefully inspires senior level participation and concrete progress. And turn that into a piece of what it is that summits do. If we're not into treaties, we can't do that. And that is not where the United States wants to be as the founder, in fact, of some of these treaties.

Bunn: This is by the way, this House of Representatives, which isn't founded by partisan cooperation, twice managed to put together bipartisan bills with overwhelming majorities and these two senators have been unable to follow along with what the House has done.

Satkowiak: I want to personally thank all of the speakers. Thank you.

55th INMM Annual Meeting Tuesday Plenary Address
July 21, 2015

Tero Varjoranta
Deputy Director General and Head of the Department of Safeguards
International Atomic Energy Agency (IAEA)

Further Optimization of IAEA Safeguards is Essential

It is my privilege today to talk to you about international safeguards—in particular: why the further optimization of IAEA safeguards is essential and how we intend to do it.

Let me start by discussing the changing nuclear world.

Today—right across the world—we see more nuclear facilities and material coming under IAEA safeguards. Nuclear power is expanding—in those countries already using it, as well as in new countries. Over the past five years alone, the number of nuclear facilities under safeguards has risen by 12 percent and the quantity of nuclear material under safeguards by some 14 percent. With many more nuclear facilities being built, this global trend looks set to continue.

International nuclear cooperation between states is intensifying with an expansion of trade and services in nuclear and related equipment, items and materials. Also, technologies are changing. Many older nuclear plants are being modernized and becoming more technologically sophisticated. The geographical focus of these expanding programs also continues to change. And this is not only a macro-level phenomenon; it is an everyday reality for us in the IAEA. For example, by the time this year's INMM meeting is over, there will be more nuclear material under safeguards than when the meeting began.

In the reasonably near future, the IAEA may have to take on a large additional workload verifying a possible comprehensive deal struck between the E3+3 (France , Germany, the UK, China, Russia, and the United States) and Iran. We have already doubled our verification effort in Iran over the past six months under the Joint Plan of Action. This has had significant resource implications, not just in financial terms—which have been covered by additional extra-budgetary resources—but also in terms of staff time and competence. Many of our best and most experienced inspectors and analysts are now working on the Iran file full-time, which means they are not available to work on other files. Any comprehensive deal will almost certainly expand that work much further again.

Speaking of Iran; let me take this opportunity to briefly inform you of a few very recent developments.

On July 20, the Agency was able to confirm to the E3+3 that Iran had implemented all of the voluntary measures to which it had agreed under the Joint Plan of Action—the JPA. It has now been agreed to extend the deadline to November 24, 2014, in order to try to reach a comprehensive solution.

We all very much hope that a deal will be reached. If and when it is, the Agency can expect to be requested to conduct the necessary verification activities. As I said earlier, this is likely to involve considerable additional effort by us. We stand ready to play our part.

In a parallel process, last November the Agency and Iran signed a Framework for Cooperation, by which both parties are cooperating to "resolve all present and past issues" on a step-by-step basis. During the first two stages of this process, Iran has implemented a total of thirteen practical measures over the first six months and is now in the process of implementing a further five practical measures, to be completed by August 25 this year. These "transparency measures" involve Iran providing the Agency with more information about planned nuclear facilities and activities in Iran, and—for the first time since 2008—information relating to possible military dimensions to its nuclear program—issues we set out in the annex to the Director General's November 2011 report. The Agency's assessment of this information is ongoing.

If we were to be invited back into the DPRK under whichever scenario, this would also require a substantial additional verification effort by the Agency, especially given that we have not been in that country for over five years. In the meantime, we maintain readiness to return if and when the time comes. This in itself carries resource implications.

Also in Syria: if the Syrian government were to allow the Agency to address all outstanding issues this would also add to the Agency's workload.

In the present economic climate, I cannot expect our member states to increase their funding of the Agency's regular budget to match this increase in demand upon our services.

To sum up: we all want safeguards to be credible and of high quality. In today's challenging economic climate, the demands on Agency safeguards are growing and becoming more complex. Therefore, to cope with the changing nuclear world, the Agency needs to increase its productivity. In other words—the *Further Optimization of IAEA Safeguards is Essential*.

We can increase our productivity in three basic ways;

- Firstly, the Agency needs to optimize its internal processes;
- Secondly, member states themselves can address the difficulties some of them have in executing their part of safeguards implementation; and
- Thirdly, we need to make better use of modern technology in our work.

I'll discuss each of these later.

To give you an idea of the scale of our current activities—we are implementing safeguards in 181 states, with about 180,000 significant quantities (SQs) of nuclear material (as you will recall, 1 SQ equals the amount of nuclear material needed for one nuclear explosive device). All this is held in some 1,300 facilities in those 181 states.

We receive more than 700,000 nuclear material accounting reports annually and carry out about 2,000 inspections on the ground. We are applying more than 20,000 seals and deploying over 1,000 attended and unattended monitoring and measuring systems in the field. Last year we analysed more than 900 samples and over 400 satellite images, and prepared about 3,000 analysis and evaluation reports.

And we are a department of about 800 people with an annual regular budget of about 130 million Euros (at today's conversion rate that is about 175 million U.S. dollars).

As you recall, the IAEA's budget is subject to zero real growth, and despite the growing number of facilities and amounts of nuclear material under safeguards, there has actually been a slight *reduction* in the number of staff in the Department of Safeguards over recent years.

What kind of safeguards we implement in each individual country depends on the safeguards agreement and possible protocols we have in force with that country. Activities, safeguards conclusions and our costs are different, based on these legal frameworks.

For comparison, at present, fifty-three states have state-level approaches based on integrated safeguards. These states contain around 75 percent of nuclear material under safeguards. Interestingly, the Agency expends about 50 percent of its verification effort in these States. A roughly equal number of states, fifty-four, have both a Comprehensive Safeguards Agreement and an Additional Protocol (AP)—but have yet to be provided with the Broader Conclusion. These states contain only 2 percent of the nuclear material under Agency safeguards, but account for about 8 percent of the Agency's verification expenditure. The fifty-five states that have a Comprehensive Safeguards Agreement only, contain just 2 percent of the nuclear material, yet they account for over 20 percent of the cost of verification.

These simple statistics clearly indicate that state-level approaches (SLAs) based on integrated safeguards provide promising opportunities to achieve "more with less."

This leads me back to the heart of what I want to say today, namely, that further optimization of safeguards implementation is essential.

We all want credible safeguards. As long as the nuclear world continues to change, we have to adapt and change with it. For me it is clear that without further improvements and optimization, we will find it increasingly difficult to guarantee an effective, reliable and credible safeguards system.

It is important to note that even though the nuclear world constantly changes, the Agency's obligations and those of member states in their safeguards agreements remain unchanged. In this context, it is essential that the department improve its productivity by striving for greater efficiency without compromising the credibility or quality of our conclusions.

We have developed safeguards implementation over many years. We are aware that our explanation of how we are evolving the way we implement safeguards—and also of what is staying the same—has not been entirely clear in recent times. We have used a lot of different terminology over the years that has not always assisted understanding amongst our member states and the wider safeguards community. That is why during the last six months we have conducted a major engagement with our member states where we have explained in more detail what we are doing and, in response to certain concerns, have clarified—and in some instances, modified—our approach.

Conceptually, the Agency will continue to implement safeguards through consideration of a state's nuclear activities and related technical capabilities as a whole, rather than on a facility basis. We refer to this as the State-Level Concept.

The gains in effectiveness and effi-

ciency of this approach have been demonstrated through the implementation of integrated safeguards—as I indicated earlier.

The Agency now wants to pursue the further optimization of safeguards implementation in those states where integrated safeguards are already being applied and also do so in relation to *all* states with a Safeguards Agreement in force. This will require modifications to some of the Agency's ways of working, particularly the processes supporting safeguards implementation.

It is important to recognize that while the overall State-Level Concept and its processes sound new, many of its constituent parts are not new.

For instance: "State-specific factors" are drawn from what used to be called 'State-specific features and characteristics', dating back many years; and the objectives stay the same, although now we pursue them through better use of the "safeguards criteria."

What is new is the integration of these elements into a more coherent process for planning, conducting and evaluating safeguards activities.

A number of member states have voiced concern that, in our efforts to achieve greater optimization in our working processes, we ensure that safeguards are implemented consistently, objectively and without discrimination. That is why the Agency will continue to corroborate, assess and evaluate all safeguards-relevant information using teams of Agency experts through a stringent internal review process. Our purpose is to ensure that our findings are unbiased.

The Agency also recognizes the need to apply state-specific factors objectively, consistently and in accordance with clear and established guidelines, based on technical considerations. The Agency's unique ability and mandate to conduct in-field verification activity is its real added value and will continue to form the bedrock of the Agency's verification effort. Last year, the number of complementary accesses conducted by the Agency went up—and it is my intention that it stays up.

Nonetheless, further to the need to improve its productivity and in line with the requirements of safeguards agreements, the Agency will keep the frequency and intensity of routine inspections for states to the minimum level necessary to produce credible conclusions. As a result of the *further* optimization of the processes supporting safeguards implementation it is hoped that the Agency may be able to achieve an overall reduction of routine in-field verification activity.

The scope for any such reductions will be greatest for those states with the Broader Conclusion, and especially those with integrated safeguards (applied through SLAs), in which over 75 percent of the nuclear material and facilities under safeguards exist.

In states without a Broader Conclusion and in those with only a CSA in force, the Secretariat, in consultation with the state involved, will constantly strive to assess whether the frequency and intensity of routine safeguards activity can be reduced, consistent with being able to draw soundly-based conclusions. However, as in-field verification activity in these states will continue to be driven largely by the safeguards criteria, such activity is unlikely to be reduced significantly.

The further optimization of safeguards implementation will have little impact on the frequency and intensity of in-field verification activity when applied to states with VOA and Item-specific safeguards agreement(s), as verification effort in these states is already confined to certain facilities and/or items.

Taken together, the Agency's further optimization of internal processes will allow verification activities to better focus on areas of greatest safeguards significance. This will increase confidence in the effectiveness of safeguards implementation.

The practical, day-to-day implementation of safeguards works best when it is conducted as a common effort between the Agency and member states to achieve a successful outcome. To ensure transparency about the new processes supporting this implementation, the Agency intends to maintain an ongoing dialogue with member states to keep them informed about how safeguards are implemented. In this way, the Secretariat will seek to maintain and nourish the necessary trust and confidence of member states into the future.

Turning next to what member states themselves can do to improve the effectiveness and efficiency of IAEA safeguards implementation, as called on by the Board of Governors back in September 2005, states should either amend or rescind their small quantities protocols as soon as possible. At the end of 2013, forty-four states had yet to do so.

Some states have yet to establish their state authority and system of accounting for and controlling nuclear material. Moreover, of those that have been established not all state authorities have the necessary authority, independence from operators, resources or technical capabilities to implement the requirements of safeguards agreements and

additional protocols. In particular, some state authorities do not provide sufficient oversight of nuclear material accounting and control systems at nuclear facilities and LOFs to ensure the required accuracy and precision of the data transmitted to the Agency.

Improvements are also needed from member states in a variety of other areas, ranging from their provision of visas for Agency inspectors, to the timeliness and accuracy of their reporting, to the provision of access to facilities.

To take the last of these points: For Agency inspectors to conduct their verification activities effectively, they must be able to access installations and perform the verification activities within agreed timeframes. Yet, in several states access by Agency inspectors to a facility has been subject to delay. There have been cases where access was limited or where environmental sampling was not permitted. Others, where access for the Agency to verify design information was denied. In addition, some states have delayed shipment of destructive analysis samples, thus preventing their timely analysis for drawing safeguards conclusions. The Agency's ability to resolve questions, inconsistencies, discrepancies and anomalies depends on states' cooperation in responding to Agency requests for additional information or for access to resolve such issues.

Delays in resolving issues can result in the Agency being unable to attain the safeguards objectives and the effort to resolve them takes up valuable staff time and resource. All this has a clear implication to the productivity issue.

On a more positive note, some States *are* seeking to improve matters though a variety of different means. For example, by hosting regional workshops to raise awareness of Agency safeguards; or by providing the use of facilities for training of Agency inspectors thus supporting development and qualification of those inspectors; or by providing the Agency with early design concepts to assist in developing safeguards measures for emerging new nuclear fuel cycle technologies.

Another important way in which several states have helped to improve the effectiveness and efficiency of IAEA safeguards, is to agree to the installation of remote monitoring systems which permit a reduction in the number of times inspectors must travel to a facility.

The level and quality of cooperation between the state and the Agency also plays a part in helping to improve productivity. In trying to optimize safeguards implementation for a state, the relationship between the Agency and the national or regional safeguards authority can be a critical factor. Building cooperative and trusting relationships often brings tangible mutual benefits: for example, it can result in lower levels of in-field inspection activity. We are making a conscious effort at the Agency to foster more cooperative partnerships with national and regional safeguards authorities. Real progress is being made, but there is further to go.

Let me then turn to the importance of technology development in our efforts to improve our productivity. Through our R&D program, backed by our member states and the European Union, we need to continue to invest in the best available scientific safeguards equipment and techniques. In this way we can improve our cost-effectiveness. Member state support programs continue to make substantial contributions (in cash and in kind) to Agency safeguards. There are now twenty states and the European Union with formal support programs with the Agency.

Within the Department of Safeguards, we are currently embarked on a major overhaul and modernization of our information technology system. Once fully implemented, this will enable us to work more effectively and efficiently in house. We are already modernizing our laboratory facilities and the supporting infrastructure at Seibersdorf in Austria. What we call the ECAS project—*Enhancing Capabilities of the Safeguards Analytical Services*—involves, amongst other things, the construction of a new Nuclear Material Laboratory building that will provide a secure, flexible, fit-for-purpose facility in which to conduct analysis of nuclear material samples.

The Future

So, what of the future?

I believe that only if safeguards are implemented in a manner that Agency's conclusions are credible can we sustain the confidence of our member states.

As the Director General has emphasized on many occasions, states' adherence to their safeguards agreements with the Agency should remain the benchmark. We must continue with efforts to encourage states that have yet to do so, to become parties to the additional protocol.

As the nuclear world continues to change, further optimization of safeguards implementation by the Agency is vital. Central to these efforts is the further evolution—not revolution—of safeguards implementation, particularly in those states with the broader conclusion. This evolution is continuing to take place in a structured, objective and coordinated manner, consistent with well-

established principles. It is critical that member states understand what the Agency is doing. That is why the Agency intends to maintain an ongoing dialogue with member states to keep them informed about how safeguards are implemented.

To ensure transparency about the new processes supporting this implementation, the Agency will keep member states informed through regular consultation. In this way, the Secretariat will seek to maintain the necessary trust and confidence of member states into the future.

My vision for safeguards in the future is one in which the member states and nuclear industry see us as value added—important partners, not as adversaries; in which we continue to draw independent, robust and soundly-based conclusions; and in which any non-compliance is firmly dealt with.

Therefore, it is vital that we get it right:

- The international community needs it
- future generations depend on it—and
- it is our joint responsibility to deliver it.

JNMM Roundtable

Tuesday Plenary Speaker:
Tero Varjoranta, *International Atomic Energy Agency Deputy Director General, Safeguards Department*

Opening Plenary Panelist:
Laura Holgate, *Senior Director for WMD Terrorism and Threat Reduction U.S. National Security Council*

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Dennis Mangan: Tero, I thought your presentation this morning was really outstanding. You painted a picture that there's a lot of work to be done with regards to the international safeguards around the world. As you were talking, you made comments like "fifty-four of the member states have accomplished this," or "twenty-eight of the member states have accomplished that," and different descriptions like that. I think it would be nice to have a list of member states with an update on their status in international safeguards. I don't think there is such a list. Would it be politically acceptable to have such a list of all the nations that stated "this one has complete international safeguards, this one is undergoing safeguards, this one doesn't need safeguards," kind of a thing? Is it possible to have something like that?

Tero Varjoranta: I think it would be valuable to have something like that in many different respects. Whether it's possible from a political standpoint is another matter. But if we look, for example, at the nuclear safety community, they have done something similar. They have the World Nuclear Association, WNA. If you go to the web pages of WNA you can look at any country in a standardized format and see what they have in the nuclear safety area. It's the "point of contacts" in each state that is keeping those pages up to date. It's not something that is mandated or required, but it's still an excellent information resource.

I think the safeguards community is lagging behind the safety and security communities in terms of transparency. For some reason, safeguards is still a very closed community.

At the Agency, we have recently experienced some challenges with the state-level concept—the SLC. Because some member states haven't fully understood what we are doing and that was reflected in last September's meeting of

the Board of Governors. And it has taken a lot of effort on our part to recover from that. So having more information available about what we do and how is important.

Gotthard Stein: In your excellent presentation you made a reference to the importance of research and development for international safeguards and in this context you mentioned the need to optimize the available support structures. Can you elaborate more on this issue and ideas?

Varjoranta: It's part of my agenda that we have to revisit our strategies for meeting our longer-term goals, including in relation to R&D.

This is my third time in the Agency. The first time was 1991-93, right after the First Gulf War. I was in the support program office. We had 300-400 Member state support program (MSSP) tasks being carried out all over the world and nobody really knew very well exactly what was going on. So we had to put a certain structure in place.

Ever since then, MSSPs have played a very important role in supporting us. However, as I mentioned this morning, we also face a challenge here. When MSSPs develop "high tech" solutions for us, not all of our member states will allow us to use that technology. So it's not just enough to have it, it also needs to be deployed.

One such example relates to remote monitoring. This is a very promising technology for us resource-wise. Yet, there are still countries, even in Europe, that will not accept this type of technology. The reliability of our equipment has improved markedly over the past fifteen years or so. So things are going in the right direction overall.

Obie Amacker: This goes back to yesterday's topic and, Laura (Holgate), your group's discussion on the security issues. I don't know who exactly mentioned it, but there was reference to the cyber/computer side as well as physical security. The context of their cyber security discussion was mainly related to plant/facility systems operation and proprietary information. My question is, is there a recognition that cybersecurity and physical security go hand in hand, that they are integral to each other by relying on each other for their efficiency, and are they being looked at in that context or just as separate elements?

Laura Holgate: I think that recognition is more clear at the technical and operator level than it is at the policy and leader level. I think it's harder for the leaders who have steps net on one part of their brain and guns, gates, and guards on the other part of their brain to kind of bring those together in a sophisticated way.

But I do think there's progress. There's recognition in the Communique, which had a little bit more of an expert tone to it about the interconnection of cyber in the broader challenges of physical protection.

And then there's also a related issue that the British have been very clear about raising both in the Seoul Summit and in the Hague Summit about information security as a component of physical security. That has more to do with floor plans and guard schedules and things like information having to do with sensitivity of information, but obviously the thing that makes those most challenging is their availability on computer systems and public access in that context. So there's another cyber angle to that piece of the puzzle.

Clearly the IAEA and the expert communities recognize this. They're doing several new components of the security series that relate to the cybersecurity and how to integrate it into the broader piece and that data point was brought in a few times during the Sherpin negotiations. But I'm confident and just speaking for myself, I accept it and I understand it at a very broad level, but I don't actually have a good set of examples near at hand to explain how the interaction really takes place.

It's interesting you should say so because tomorrow I leave to go to a different conference where we're having a WMD (weapons of mass destruction) panel that at the last minute had a cyber person added to it. So we're all trying to figure out how nuke, chem, bio, cyber, what is the connectivity? What is the spectrum? Does it really belong there? Does it belong above or below in some way because it does connect. On the other hand, the solution sets in cyber land seem quite different from the solution sets that we think about in terms of solving the nuclear, biological, and chemical challenges. But cyber as an intensifier of those challenges, I think is more and more visible to the community.

Chris Pickett: During your plenary talk this morning, Mr. Varjoranta, you were talking about technology and the need for new technology at the Agency. One thing from the U.S. side that we've experienced is there seem to be long delays in getting acceptance for new technology. The process of accepting and approving it for use for safeguards has been rather lengthy, almost to the point that some systems become obsolete before they can get certified for safeguards use.

We recently had an Agency workshop on measurement codes, the nondestructive assay codes that are used for materials accounting measurements. Attendees indicated that hardware changes faster than software and that in trying to support the new hardware changes, the IAEA is running into a lot of technology obsolescence in terms of maintaining and sustaining these systems. Could you speak a bit on what could be done to improve the infusion of new technology into the Agency and what options are being considered for sustaining some of the current systems?

Varjoranta: We are facing the challenges to which you refer and it's not beneficial for us or anyone else. Development takes time and effort and money and then, sometimes, we are not able to deploy that technology because member states won't agree. I think there is no simple, quick fix for how to deal with that.

Due to concerns over cybersecurity and physical protection, many plant operators are getting increasingly careful about what kind of equipment we are allowed to take into nuclear plants. We cannot show the plant operators all the details of all of our equipment, so we have to find ways of dealing with this. And of course it means good synergetic communication and cooperation between developers, the end users and us as to where the equipment is going to be deployed.

There are also examples where particular technologies being developed for us are no longer appropriate or have become obsolete before they reach the production stage. In which case, we might need to stop or modify a particular R&D project.

Markku Koskelo: Building on that very same topic, there has been some discussion or perhaps rumor, not sure if it's true, that the Agency would do some of its own R&D for systems, instruments, or perhaps computer programs. Would you care to comment on whether that rumor is true and whether there is some discussion that would mean that some of the research that was previously done outside through the support programs is now being brought in-house?

Varjoranta: It's always been the policy and still is the policy that the Department of Safeguards is not a place where R&D takes place. Instead, we build on the R&D carried out in our member states. We don't have the human or financial resources, or the facilities, to do the work ourselves. Certain activities may need to be carried out in the future on a small scale, but nothing major.

Glenn Abramczyk: It's sort of become a joke, but I'm going to come back to the last question from this morning about the budget. Surely you must have some of kind of estimate, based on the continuing number of states you're going to have to look at, the number of facilities you need to look at, cybersecurity versus physical security. Do you have just any kind of projection of what your budget should be to get you, if not ahead of the curve, at least back on the curve to meet your mandate?

Varjoranta: We are actually starting that exercise in a couple of weeks' time. It's not easy. You need to look at the Agency's budget as a whole, and not just at the safeguards budget in isolation, because the Agency's budget is put together in a complex way.

As I mentioned, we are dependent on extra-budgetary funding in the safeguards department and it's highly appreciated because without it we couldn't get by. It's not only money but it's also the experts that member states have provided to us. So the purpose is not to try to get rid of extra-budgetary funding; we need it. The discussion is where the balance lies.

We have certain policies in place for using member states' extrabudgetary funds. For example, we don't use cost-free experts for inspection activities; we use them for supporting our technical services. Indeed, in a few areas, for example, related to safeguards equipment, we have a section where most of the staff are cost-free experts. You could argue that this is not sustainable in the long term. But it's necessary at the moment.

So the whole budget issue is broader than how much money we need. My purpose today was not to show that we need X number of dollars. My purpose was to show that as far as I can see into the future, this is not going to get easier. The World is getting more complicated and more people in countries all over the world will get to understand the physics related to nuclear materials. Such knowledge will keep spreading, aided by the internet. This is challenging. If we are going to meet that challenge, we need to be thinking "outside the box".

The other important element is that it's always easier to ask for extra-budgetary funding for activities than to get long-term increases in the regular budget. Let me take Iran as an example. It was reasonably easy to raise 6 million Euros for activity related to the Joint Plan of Action. But where do I get more than a dozen additional, extremely experienced inspectors to designate to Iran? Recruiting inspectors usually takes about a year, with another year for basic training. And then it is seven years before they are really capable. I can only send good, experienced people on an important inspection where they cannot afford to make a mistake. At present, we are coping by taking experienced people from the service divisions. But this leaves gaps in the "back office." So it's not only money, it's also human resources. I don't want to be in a situation whereby a comprehensive deal between the E3+3 and Iran is struck and then I suddenly need a large number of inspectors and have to start recruiting.

Scott Vance: That's an interesting answer, because it pertains directly to what struck me this morning. I really enjoyed your talk very much. In it, you mentioned that one of your goals was to get inspectors to, I'm putting words in your mouth so you can correct me, work smarter, not harder. In other words, to take advantage of experience and become less rigid and more flexible. What struck me as you mentioned that was the relationship of that goal to the concern that the nuclear industry has had for some time with the aging of our workforce and the inability to replace that workforce. So, it's interesting you just answered that question that way, because I'm curious how big of a concern is losing expertise and making sure that you retain as much as you can?

Varjoranta: It is a concern. It's also about the competitiveness of the Agency as a workplace. When I came to the Agency the first time in 1991, I had a new family. I had three small kids and a wife. When we came to Vienna, my salary in Vienna was slightly more than our salary together in Finland. Today, the situation is more likely to be that the single salary in Vienna is lower than the combined salaries from elsewhere in Europe. That's another reason why we have difficulties recruiting competent young people.

Ken Sorenson: Tero, I apologize upfront, but this is another budget related question. In your remarks this morning, the reality you deal with, you recognize it and I think your perspective that you mentioned in one respect is to work smarter, be more productive, and more efficient and that goes to my question. How do you and how can you take advantage of the work of other safeguards organizations like EURATOM and ABACC to help meet the IAEA safeguards objectives?

Varjoranta: EURATOM and ABACC are quite different organizations in their nature, their legal setup and the way they operate. So there is no one-approach-fits-all. We are trying, of course, to make as many synergies as possible with these regional safeguards organizations. However, at the end of the day, we are responsible for our conclusions. We have to be accountable for that.

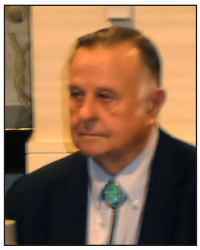
We provide safeguards conclusions once a year. So if you get the okay from the Agency, it's valid for a maximum of twelve months.

Sam Savani: Your talk was very interesting and very informative. I enjoyed it very much. I gather that one of the challenges that you are facing is communication—asking "what are you going to do, what are your intentions?" Another challenge is resources, and we talked a lot about the budget and the experts and resources who can do all the work on time, and their retention. The other challenge is the pressure on conclusions, once you come up with an observation or conclusion, they have serious consequences so you have to be under a lot of pressure to get it right so the decisions that are made are good. Are there any other ma-

jor challenges that you or your organization and what are major steps are you taking to address these challenges?

Varjoranta: One of the major challenges for us is communication. Naturally, we cooperate all the time with member state experts and their state system of accounting and control (SSACs). Somehow we took it for granted that if the states' experts know, then the missions and capitals also know, and the governors on the Board also know. But, this is not always the case. The state-level concept (SLC) is a very good example. While several member state delegations did not appear to fully understand the SLC, at the working level we were having good technical cooperation with their facility operators and experts in national laboratories. We have to improve our communications at all levels.

Our other communication challenge is that because diplomats usually only stay three years and then rotate, it's not enough for us to inform and educate people once, we need to keep repeating the exercise. So we have decided to engage in ongoing dialog with the member states to ensure that they know what we are doing. Essentially, the root cause for all our problems over the SLC is a lack of understanding. And it's not the member states' fault. We have to make sure the member states understand what we are doing because I can't ask anyone to trust me and what I'm doing if they don't know me and if they don't know the basis of what I'm doing.



Robert Curl: When you were talking about the Agency's resources, you talked about where you are applying your resources and how much of the inspectorate effort goes to various applications. You mentioned that you have large member states that are nuclear weapons states, and you apply safeguards to their commercial non-weapons programs. A large portion of the Agency's inspectorate effort goes to applying safeguards in these nuclear weapons states, and there are reasons for that. I thought I heard that you might be considering the possibility of pulling back from that a little and redirecting some of those inspectorate resources where they may be more needed. Can you comment on that?

Varjoranta: It's a policy of the Director General that we continue to implement safeguards in nuclear weapons states and more than we have done before. Carrying out safeguards in some of the different types of facilities in nuclear weapon states—developing approaches and developing techniques—is very useful for us. It's true that safeguards in nuclear weapons states are expensive. And on the horizon there are possibilities that major plans and major costs are coming up so we do need to do some serious thinking about how we conduct safeguards in a smarter way.

Clemens Listner: I also have a question on the state-level concept and I really appreciated that you gave in the morning such a clear picture of what you're doing in the Agency on the state-level concept. If your supplementary document is as clear, I don't foresee any further problems coming up. But while you're going a step forward on the communication's side, I have the impression that the IAEA is going a step back on the aspect of universal applicability of the state-level concept. Because you said in the morning that you are applying these state-level approaches only to the Broader Conclusion states at the moment. But I don't see actually why it shouldn't be applied to all the other types of commitments, especially when you look into the future to probably upcoming further commitments like FMCT (Fissile Material Cut-off Treaty), which could also be verified in a state-level concept way.

Varjoranta: At present, we are only implementing state-level approaches for countries with integrated safeguards. What we are saying in the supplementary document is that we are planning eventually to implement state-level approaches for all states. What I was referring to in my talk was that the possibility to streamline and have flexibility in safeguards implementation is greatest when you have the broader conclusion in place. It's the smallest when you have an INFCIRC66 type of agreement.

Stein: This is a follow-up question to Laura in connection with Clemens' remarks about the future role and potential of the State-Level Concept. Since in other verification fields, like in chemistry and biology we also have to deal with the detection of declared and undeclared scenarios, one might argue that the state-level concept could be used and applied also as a model for those applica-

tions. We just start to study this issue in the frame of INMM and ESARDA. What do you think about this idea?

Holgate: What I think is probably not useful because I'm only just since sitting down here with Tero understanding the state-level concept. But I have to say I'm sitting here thinking about the Syria CW (chemical weapons) problem as we talk about this and where I'm more familiar with the verification concepts. Although it's a brand new problem for the OPCW (Organization for the Prohibition of Chemical Weapons) where safeguards are a well understood challenge. I think the difference between what the OPCW does normally in verification and the Syria challenge is much bigger than say even what the IAEA safeguards world does normally about the Iran challenge. This is where we're not talking about quite the delta in impact and in confusion.

Clearly the challenges are there and I was glad to hear that Olli Heinonen this morning, mentioned that he and Ralf Ocais had been invited by the OPCW Director General (Ahmet) Üzümcü to come talk to that just a couple of years ago before the Syria crisis about lessons learned in the safeguards space that might be available to the OPCW. So in the general principle I think there's a lot of value there.

I think the challenge in some ways in the chemical space is so much bigger because of the much more diverse dual use piece. There are only so many kinds of buildings that can be a nuclear kind of building and you can find out pretty quickly walking in the door whether it is or it isn't. The chemical business, and particularly the type that we're now worried about from the Syrian point of view, is small scale tactical, perhaps malicious use of residual capacity, is going to be much less visible than either their state production facility which was secret. I mean their large scale production capability. So the next two phases of the Syria CW problem are going to be really challenging and I think you do have to take into account past behavior in terms of hiding and truth-telling and other challenges like that. It's my perception that that's some of what is trying to be got at in the state-level concept is the history of performance and not just the specific checklist of today's reality. But I bet you have an idea.

Stein: I agree completely about the complexity of this issue. But it might be possible that the state-level philosophy can be used as a tool for system analysis to structure the problem and identify sensitivities and priorities.

Holgate: Sounds like a good PhD thesis.

Pickett: Your predecessor, (Former IAEA Deputy Director General) Herman Nackaerts, when he spoke to this roundtable a few years ago, mentioned he wanted to see inspectors become more like investigators to help them do a better job of detecting undeclared materials, activities, and such. Is that still a desire or goal at the Agency?

Varjoranta: We stick very strictly within the legal framework that we have. To be able to implement safeguards well requires good cooperation with member states. We have seen what it means when we don't have good cooperation.

There was a major push a few years ago for safeguards to become "information driven." I think there was some misunderstanding here. As I mentioned in my speech, in nuclear material accountancy we get every year over 700,000 reports from our member states on nuclear material. Today, we are looking at about 20,000 open sources of safeguards-relevant information. We are looking at about 400 satellite images. And we may also receive a few dozen pieces of information from third parties.

So you see that nuclear material accountancy is the basis of our work along with that of the inspectors—checking that reports are accurate, that they reflect the situation: monitoring the flows of nuclear material is the key thing we do. As we have 180,000 significant quantities under safeguards, we have to make sure that those significant quantities are where they are supposed to be. That's still the core of our business. That isn't changing.

Different interpretations of language and terminology can also cause problems. There are a lot of examples where words have different meanings when translated into different languages. So, another reason why referring to our inspectors as "investigators" is not in my vocabulary is that it may translate in ways that give the wrong impression.

Abramczyk: Perhaps a question for both of you. It's been mentioned several times but never brought up further than the Democratic People's Republic of Korea. Do you have plans, desires, or contingencies if you were allowed to go in and do some kind of inspections?

Holgate: Yes.

Varjoranta: Yes, also from my side.

Abramczyk: Care to elaborate?
Holgate: No.

Varjoranta: No.

(laughter from the room)

Abramczyk: I get credit for the shortest answer.

Varjoranta: In my speech this morning I said that we are maintaining readiness to go back into the DPRK. If the request were to come now, we could fire up our system reasonably quickly. But, to be able to maintain that readiness, we need to devote quite significant resources.

Holgate: I'll be a little less flippant in suggesting that if we get to a point where it's beyond simply a safeguards issue or compliance issue and we're actually into a threat reduction phase of a North Korea problem where they've decided to abandon a program and there's a need for international support in helping deal with the residue facilities, materials, people. That has been one of the impacts of the major squeeze on our budget for nonproliferation programs, is there used to be kind of a floating bogey out into the future years for that contingency. And that doesn't exist.

I'm confident should we have that opportunity, resources will be found. But in the absence of the luxury of being able to say well, maybe in 2017 or 2020 we'll need to take apart facilities, dispose of material, redirect human personnel, we don't have that now in the future year budgets. Should we find ourselves in that opportunity without a lot of prior visibility and sometimes these things do happen in a shock. Again, to turn to the Syria chemical thing, who would have guessed a year ago we would have had a thousand tons of chemical moving around the Mediterranean on a ship invented by our army in six months. And then transformed the destruction technology from something that took up two football fields and was mainly in two dimensions to one that is now on five decks of a ship and has to function in three dimensions. Those were completely unpredictable things. We found the resources. We found the technology. We found the expertise and we made it work. So, I'm sure that we will do that and that's a day I think we can hope for, is to find ourselves with those kinds of problems in North Korea as opposed to the much more dangerous kinds of problems we face right now.

Amacker: This is for Laura. Yesterday when you were discussing the last summit and you talked about an exercise, I like the fact that you went back to it. Dealing with scenarios is most likely new to the policy types and is an educational process. The approach taken goes back to an old educational adage relative to "tell me, show me, involve me," and how powerful the involvement aspect can be. Your description of the exercise you threw out initially being viewed with skepticism but in the end was valuable demonstrates the value of involvement. Are there plans to develop something similar for the next summit in 2016?

Holgate: Yes definitely and in fact we're looking at ramping it up in a couple different ways. First of all, hopefully we can get a little bit more complex with the leaders themselves. It may be we'll have a few different leaders in a couple of years from the ones that were in The Hague but it won't be a complete turnover.

And I think the antipathy toward the scenario concept that was at the Sherpa level in the plans will have dissipated significantly. We haven't tested that proposition yet but the Sherpas were frightened of this. They were so concerned that their leaders were going to be made to look stupid, that they were going to be put on the spot to read a spectrum and know whether it was plutonium or HEU, that they were going to be asked questions that they wouldn't know answers to. And much of this was just people who had never been through an exercise process before. We exercise all the time. The President exercises all the time. He is very familiar with these things. So we knew our leader was going to be fine with it, but there were a lot of Sherpas who were very skeptical. But when the leaders themselves got in the room, they loved it. They had a great time. They engaged. It was a very lightweight scenario and we just had to pop a few things in and then they went on and then the Dutch prime minister who was actually facilitating himself, there was no exercise facilitator, had to jump in and close things off prematurely so they could get to the next move. I think we've proven this isn't scary and that maybe we can be a little more complicated at the leaders level.

But the other thing that we're trying to build into it is, is there something useful to do at a minister's level. For example, (U.S.) Secretary (of Energy Ernest) Moniz who is part of the U.S. team, came back and said maybe we should do a minister's, whatever ministers are responsible for nuclear security, because it's not energy ministers in every country. Maybe we should do a thing with them, maybe the day before, maybe it's better to do it six months before. Certainly the Sherpas will need to have some visibility into what we prepare for the leaders so we need to think about a Sherpa-level exercise and then there was some talk

among some other countries about how to take an exercise that has one level of being an international interaction maybe at the Sherpa level. But then that each country has some internal action that's being triggered in an internal exercise at the same time so they are exercising their own coordination mechanisms or their own emergency capabilities. So there's a lot of action out here. In fact, I just last week sat down with the people at FEMA who run our national exercise program to ask them can we piggyback on some of their exercises—they do 75 exercises a year and they're certainly not all WMD, much less nuclear. But can we piggyback on some of their existing exercise planning and budgets and capabilities to build a common arc perhaps of a story that we work at the working level with more expertise and then as we elevate it, it gets a little more sophisticated but maybe also more aimed at the senior leaders. I brought someone onto my team who is an expert on exercises—and who helped the Dutch design the exercise—explicitly to be more involved in the exercise process. We really see a lot of value and it also helps drive the interactive nature of the summit which every host says they want. And then every other attendee wants to come and read a speech. So how do we break that cycle and it seems like the exercise discussion is a way to allow people to work in little tidbits about their own national capabilities or national approach to things without having to be like a series of rote speeches.

Vance: This question is really not fair to either of you, because it is based on comments from Ms. (Laura) Rockwood. However, I would be interested in your insights. She mentioned that she had a personal goal during her time at the Agency to get industry to realize the value of safeguards to them. As an attorney working with the U.S. nuclear industry, I have attempted for the past several years to get my legal colleagues interested in the concept of nuclear safeguards, and their answer is always, "That's not what we do. It's not our issue." My question is, is there anything you've seen successful in convincing industry to realize the value of safeguards?

Varjoranta: The basic need for most countries is to have their nuclear services—whether it's maintenance, spare parts, fuel etc.—flowing as smoothly as possible. So, for these countries it is clear there is added value in ensuring that safeguards are in order.

Michael Whitaker: This is more of a comment than a question. Back to inspectors and the expectations for them. More time in the office analyzing relevant information from the wide variety of sources in the field. More instruments for specific applications. It becomes challenging for any of the inspectors to have extensive experience in the use of all of them. Nuclear facilities becoming larger, more complex, more automated, which may make it more difficult to do onsite inspections. You mentioned earlier the conclusions are becoming more transparent. And then on top of this, the large pool of experienced inspectors are reaching retirement age and have to be replaced. I'm at a loss, without more funding for more inspectors, about what can really be done to balance these responsibilities. We've seen randomization to maybe reduce the number of inspections or trying to send one inspector, then two, but that limits still experience and it also limits the opportunity of less experienced inspectors to learn from the older ones. What are some ways we can help without increasing the burden and getting in the way?

Varjoranta: As I said before, it's extremely important whatever support we get, whether it's through members state support programs (MSSPs), through these types of meetings or other interactions. The other thing I didn't mention in my speech which is also important, is for us also to recruit inspectors from countries that have very little or no knowledge of safeguards. We can then train them in what it means to be an inspector and when they eventually return to their country of origin they can take that knowledge back with them.

We should have the flexibility within our budget to make this type of investment, because at the end of the day it helps every one of us.

Pickett: If you both could have a couple of wishes of what you'd like to see happen to improve global nuclear security and safeguards, what would they be?

Holgate: I think for me the thing that would probably make the most difference gets to this thing that Matt Bunn and I spoke about yesterday of threat perception. If I could really change, it would be great to change all leaders' minds. But there's about five to six leaders or elite communities in five to six countries, that if they really could see the threat closer to the way we see the threat, would be the beginning of being

able to make hard decisions and I think we really have to be respectful of the fact that the things that are going to be the most impactful in nuclear security now, as opposed to where we were ten, twelve, fifty years ago, are going to be big muscle movements. It's going to be changes in fuel cycle behavior. It's going to be D&D on research reactors or really a whole new way of looking at the low-enriched uranium replacement fuel for research. We've done the easy stuff and we've done a little bit of hard stuff too, but the things that are left are really hard.

How does Russia shut down eighty HEU-using research reactors in a timeframe that's relevant to the threat? It's impossible. And it's really impossible if the threat perception doesn't even support that that's the smart thing to do. So I think if you don't start with the threat perception, you're not going to get those big muscle movements.

But then my second wish would be for a capability of the IAEA that was also closer to being commensurate with the risks involved. You have every right to be sad about $170 million budget but your friend Khammar Mrabit sits over there with a $10 million in the (IAEA) nuclear security office from the regular budget and he also depends heavily on voluntary offer. So I think a broader sense of threat perception, I think that would enhance the political acceptability of increasing the capabilities and resources available to the Agency in the context of security.

Varjoranta: Perhaps from a safeguards viewpoint, to have all the Member States understand how safeguards actually benefit each and every one of us.

Mangan: I'd like to make an observation. This roundtable has been one of the more aggressive and active roundtables that I've been at and I've been at all of them. I think it's because Tero's presentation this morning woke up a lot of people with regard to asking questions and getting more information. I think that reflects on the comment that I made earlier that you, Tero, did a great job this morning and you did a very good job here. And Laura, you did too.

INMM Tuesday Plenary Session Panel Discussion

How the Evolving Domestic, Regional, and IAEA Safeguards Requirements and Practices are Influencing Safeguards Implementation and Culture

Panelists:

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The following is a transcript of the Tuesday Plenary Panel Discussion, How the Evolving Domestic, Regional, and IAEA Safeguards Requirements and Practices are Influencing Safeguards Implementation and Culture, presented during the INMM 55th Annual Meeting.

Michael Whitaker: Good morning, everyone. I'm Michael Whitaker, chair of the INMM International Safeguards Technical Division. It is a great honor and a privilege to be able to introduce our distinguished panelists this morning.

The theme for this morning's panel discussion is how the evolving domestic regional and IAEA safeguards requirements and practices are influencing safeguards implementation and culture. We've invited our panelists each to give a brief opening statement or set of comments and then we will open the floor for questions and comments from you. I'm looking forward to a very lively discussion.

With that, let me introduce our first opening statement by Dr. Piotr Szymanski. He is the Director of Nuclear Safeguards at the European Commission in Luxembourg. He studied physics at Warsaw University and went on to complete a PhD in experimental particle physics and is the author or co-author of more than 200 scientific papers in various fields of particle physics. He was also the head of the department for interdisciplinary applications of physics. As EURATOM director he is currently responsible for the verification and inspection of the non-diversion of nuclear materials at all civil nuclear installations within the European Union. Please join me in welcoming Piotr Syzmanski.

Piotr Syzmanski: Thank you very much. Yesterday I described to the audience the extraordinary powers that were given by the EURATOM treaty to the European Commission as a key executive body of that European Union (EU) and the EURATOM community, the number of words which are put together to understand a bit of a structure of European institutions.

But the European Commission is the guardian of the treaties and as such has put in place an original system of safeguards across EU territory. For over half of a century we cover all civil material in the EU. Occasionally, former military material is also taken into safeguards, which may be of interest of some of you dealing with similar topics potentially in the future.

EURATOM safeguards is a comprehensive system covering the whole fuel cycle from ore mining to spent fuel disposal and waste disposal. It covers all users from the smallest to the biggest reprocessing plants in the world.

How did it evolve? The general evolution was that we moved from practically permanent presence in the facility to an inspection-based approach. Already at that time we've been under serious pressure for resource's sake. What we tried to maintain, and I hope we maintained during this evolution, was to keep

a few principles that allowed us to make the European safeguards a success story for more than fifty years.

One of the sentiments is verification across the whole line starting from the declaration down to physical verification, in field, in the facilities. Second, was to stay at the forefront of technology with the help of our regional capacity in the European Commission, Joint Research Centers, with the help of ESARDA, and, last but not least, the INMM.

An important element which we keep constant despite the evolution of a service is transparency and communication of our stakeholders.

What will be the future? I think the future would look like, first, more and more online monitoring of equipment starting from the state of held data through transfer of measuring information down to transfer of surveillance measures. This is very important to be able to react to or prevent equipment failures and then to reduce unnecessary activities related to it.

Second, we will always be present in the facilities. This will not be replaced by the technology. Technology will help us to better use the time in the facility, to better prepare for the inspections. But this and knowledge of the facility, we want our inspectors to know inside out the complex facility they are dealing with. And I hope despite the pressure on resources with the help of all international community we will be able to maintain the credibility of EURATOM safeguards in Europe. Thank you very much.

Whitaker: Next I want to introduce Sonia Fernandez-Moreno. She is a senior expert in nonproliferation in nuclear security issues and is currently serving at ABACC, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Material, as the Argentine planning and evaluation officer. She has served in the federal government of Argentina in the Atomic Energy Commission and at the Nuclear Regulatory Authority for more than thirty years. She has also served in the IAEA director general's standing advisory group for implementing safeguards, SAGSI, until 2009. As former head of the institutional affairs and nonproliferation of Nuclear Regulatory Authority, she was responsible for international cooperation in nonproliferation matters. And she was one of the key officials involved in negotiating and implementing the agreements between Brazil and Argentina for the peaceful use of nuclear energy and particularly the establishment and consolidation of ABACC and in the safeguards agreements with IAEA. Please welcome Sonia.

Sonia Fernandez-Moreno: Thank you, Michael. Thank you, everybody. Good morning. My presentation yesterday was more related to the history pre-ABACC and the history of the two countries building a confidence mechanism to open up the nuclear programs to each other in a kind of reciprocal inspection mechanism.

But today I think that I will talk more about ABACC working together hand-in-hand with the IAEA in implementing full scope safeguards both in Argentina and Brazil, in all nuclear materials, and in all nuclear activities. ABACC has the obligation and the mission to implement its safeguards, it's an bi-national or bilateral safeguards agency. And this is the unique and only mission that ABACC has. Of course, ABACC does this job in a way to optimize as much as possible the implementation of safeguards in partnership with the Agency. We have joint use of equipment guidelines. We share the contaminant surveillance equipment, the NDA (non-destructive assay) technologies as much as we can keeping in mind that both organizations should be able to draw independent safeguards conclusions and this is a very key point to our system. We also prepare and implement joint inspection procedures in the field.

But this is why I think this session is very pertinent, because when you think how the evolving domestic, regional, and international safeguards may influence safeguards practices and requirements, I would say well, they really influence the implementation of safeguards a lot and that's why I think that the data covers very well this point. That is why we need to have a high degree of coordination, a high degree of cooperation to ensure that we can implement safeguards in an efficient and effective manner. Trying to avoid hampering the nuclear industry as much as possible. And in cooperation with the state regulatory bodies.

In terms of the safeguards implementation, I may say that any evolution of safeguards should bear in mind that our end partner is the operator of the facility that has to run and to fulfill an objective, which is to produce something for the industry. And any change in the safeguards may have a great impact on this process. So I would say that as much as possible what comes to my mind is we need to be predictable. We need to be able to plan ahead and to be able to communicate to the operators and the state authorities what are our objectives, what are the changes, how these changes can impact on the safeguards in that plan.

And, of course, we need to be ahead of the implementation on the new technologies because technology as it

was one of the last key points that Tero made, continues to evolve. Technology and safeguards is a very dynamic area that normally needs to be implemented early in the process of a facility. And you know that many of us are evolving in something like safeguards-by-design concepts, there are some issues that we can talk with the operators early in the process when they communicate to the agencies that they will build a new facility. So there is a lot of opportunity to fulfill this impact on the safeguards at the facility level.

And the interface there between the IAEA, ABACC, EURATOM, and the state authorities and the operator is very important.

Culture is something totally different for me. The safeguards culture implies that you share values, that you're talking about policies and common grounds, and a common understanding on the system you are operating. So it's very important that all the stakeholders have a good understanding of what you are doing and why you are doing this. And if possible ideally to really share the same objectives, the same use, and the same goals because I think that at the end of the day we are all in the same vein, just trying to help, to contribute to the total elimination of weapons mass destruction of nuclear weapons and then if we're working the environment of the culture in a multicultural environment, we need to be able to be flexible and open enough to understand others' perceptions, other views, and see how we can address these views in order to gain this confidence system that safeguards basically is. Thank you.

Whitaker: Our next statement will be made by Steve Adams. He is the deputy director of the U.S. State Department Office of Multilateral Nuclear and Security Affairs. Steve joined the Arms Control and Disarmament Agency, ACDA, to work on matters related to strategic nuclear arms control including the ABM, INF, and START I treaties. In the years following ACDA's merger with the Department of State, Steve took over the chairmanship of the U.S. government's interagency policy formulation committee on international safeguards and monitoring. He is currently responsible for policy formulation related to IAEA safeguards and technical cooperation, the implementation of the nuclear nonproliferation treaty and various nuclear weapon free zone treaties as well as nonproliferation matters associated with the G7 summit process. Please welcome Steve Adams.

Steve Adams: Thank you. In the time I have this morning, I wanted to make two main points. One is what the U.S. has done both policy-wise and practically to evolve safeguards basically since the beginning of time.

Shortly after World War II was over the U.S., Canada, and the United Kingdom issued a trilateral statement that seems to be the first instance where the word safeguards was used in the nuclear context. It initiated an international process that started in the United Nations. Indeed, the first resolution at UNGA (United Nations General Assembly) was related to nuclear energy. And that resolution formed a United Nations Atomic Energy Commission. That commission faltered after a period of time but during that time, and remember this was a time when the U.S. still had a monopoly on nuclear weapons in the world, we introduced into that commission what was called the Baruch Plan, which was a plan by which the U.S. proposed to eliminate its nuclear weapons in exchange for strong international controls and these included an inspection regime.

The climate at the time was not amenable to such detailed inspections, particularly on Soviet territory. The commission was dissolved in 1952 and coincidentally the following year was when President Eisenhower made his proposal that led to the development of the International Atomic Energy Agency.

These are some of the matters of policy that we started in the very beginning of the nuclear age. Later in the age we began to contribute to the technical development of safeguards and as some of the talks yesterday pointed to some of the early safeguards experiments at research reactors, at BWR, LWRs, as well as in reprocessing, by the time the Nuclear Nonproliferation Treaty came along, the U.S. agreed to accept safeguards on its commercial nuclear fuel cycle insomuch as the IAEA was willing to request them.

And in the 1980s that meant research reactors, BWRs, LWRs, and fuel fabrication facilities in the U.S. to a limited extent were subject to safeguards. By the mid-'90s maintaining that was not possible largely in part due to the budget of the Agency and the U.S. made a proposal to submit the material that came out of our defense programs to IAEA safeguards and also reimburse the Agency for that. This continued the cooperative development that we had with the Agency and the technical evolution of safeguards.

On a financial note, Tero mentioned the budget of the IAEA safeguards department is about $170 million. The U.S. made a decision more than a decade

ago when we renegotiated our rate in UN organizations, which was at the time about 25 percent, so 25 percent of the regular budget at the UN was paid by the United States. We renegotiated down to 22 percent but we made a conscious decision in the IAEA not to reduce it because of the value we placed on this institution. We continue to pay 25 percent of the budget and as well as this past year our extra-budgetary contribution to safeguards is over $42 million most of it, with the exception of about $13 million, is a cash contribution. The rest is in-kind. This has gone through to support the IAEA in doing the E-test project, its work in IT technology and development of other technologies related to safeguards implementation as well as to much needed training.

And just to point the direction into the future, it's our intention to continue this cooperation into the future. President Obama made a famous speech in Prague, part of which addressed eventual nuclear disarmament. In that atmosphere the IAEA will have to be very well prepared in its budget to take care of disarmament in that probably more distant future as we have more than 300 facilities that are eligible for safeguards right now. There would also be locations outside of facilities that would need to be involved. Thank you very much.

Whitaker: Our next panelist is Tomonori Iwamoto. He is the director of the nuclear safeguards and security division at JNFL (Japan Nuclear Fuel Limited). He's had a long and interesting career that has involved uranium enrichment, plutonium reprocessing and the production of mix oxide fuel. He joined the Power Reactor and Nuclear Fuel Development Corporation (PNC) in 1972 in the R&D division for uranium enrichment. While employed at the Ningyo enrichment plant in 1981 he was involved in the Hexapartite Safeguards Project that established the technical basis for IAEA inspections at enrichment plants. In the late '80s, he was assigned as a national safeguards inspector in the Nuclear Safety Bureau and was involved in the large scale reprocessing plant safeguards forum. He returned to PNC in the '90s and was responsible for developing safeguards for the Tokai reprocessing plant, MOX fuel fabrication plant, and the fast breeder reactor. Since 2002 he has managed safeguards for the Rokkasho Reprocessing Plant including nuclear safety as well. And was responsible for safeguards and nuclear security for J-MOX which is currently under construction. Please join me in welcoming Tomonori.

Tomonori Iwamoto: Thank you. Good morning everybody. In order to obtain a secure energy condition in Japan, the government of Japan actively proceed nuclear fuel cycle activity. Because Japan has almost no energy sources, therefore the only choice is nuclear energy, particularly the utilization of plutonium. So in this sense, credible safeguards measures should be needed to ensure the peaceful use of nuclear material and nuclear facilities.

The safeguards evaluation in Japan based on facility scale up manner. For instance, in the case of the enrichment plant, first we have at the small scale pilot plant at Ningyo, fifty tonnes SWU. That time we are developing a safeguards approach and safeguards tools. That time we have created a picture of the more effective safeguards for the future. Next step is the demonstration of future commercial plants. So that time we understand what kind of activities we need.

In case of a reprocessing plant, we have the Tokai reprocessing consequently commercial reprocessing. MOX fabrication plant as well. So we conducted safeguards with material accounting at a small scale stage, then we learn what kind of safeguards would be needed for future scale of plant. For the large plutonium handling facility, we have learned necessity of hold up measurement system and accurate waste measurement system for future large scale plant.

Efforts from the safeguards culture, first is inspection use of the operator equipment. In case of the large reprocessing plant exists tremendous of measurement points, in order to provide independent verification effective and minimization of the operation hamper for the safeguards implementation, we identified an appropriate way that is the inspection use of operator equipment by the signal splitting. However, the signal slitting is the authentication. However, appropriate authentication arrangements are complicated, which will require cooperation efforts by the operator.

Second is performed special test. We conducted special test for the establishment process inventory estimation equation. Rokkasho Reprocessing Plant (RRP) has so much process inventory and some processes are un-measureable at time of interim inventory verification due to it performs in operation mode.

The nuclear material in the pulse column, mixer-settler and the evaporators are difficult determine the amount. Therefore we conducted several times special tests to establish the estimation equations. We stop the plant operation at the time of normal operation condition and perform flash out operation to move

the nuclear material to the measurable vessels. Then determine how much nuclear material in the process and concentration of the nuclear material. Through the tests we obtained vessel equivalent volume in the extraction cycle and the inventory estimation equation.

Other point is onsite analytical capability. The government of Japan and IAEA jointly set up onsite laboratory in the RRP. Those are connected automatic sampling pneumatic transfer line. Inspection sample taking for the verification will be performed automatically and analysis can be done immediately. So those provide effective and credible safeguards with the timely manner. In addition, the inspectorates introduced automatic data collection evaluation system so-called I3S (Integrated Inspection Information system), which is provide timely evaluation and review of the inspection equipment data including diagnosis inspection equipment.

Currently the Agency develops data transmit form the I3S to the headquarters.

But I'm not sure current status of the development. Anyway those are to provide high confidence of the safeguards.

And now, we are performing design of the safeguards system for the J-MOX. In order to provide high assurance of the safeguards, we realize that the design information evaluation and detail operation scheme are essential, especially safeguards-by-design viewpoint.

Those are cooperation among the IAEA, the government of Japan, and the facility operator. Up to now we believed that the safeguards evolution in Japan has made under the extend cooperation manner among three parties. Thank you very much.

Whitaker: Our sixth panelist is Laura Rockwood. She joined the Harvard University's Kennedy School Belfer Center managing the atom project as a senior research fellow in February 2014. Prior to this position Laura was at the IAEA and was the section head for nonproliferation and policymaking in the office of legal affairs. During her twenty-eight years of service at the IAEA she was involved in all aspects of negotiation, interpretation, and implementation of IAEA safeguards and was the principle author of the document that became the Model Additional Protocol. She participated in negotiations of the Trilateral Initiative and the Plutonium Management and Disposition Agreement as well as the director general's expert group on multilateral approaches to the nuclear fuel cycle and three NPT review conferences. Please welcome Laura.

Laura Rockwood: It's great to be back here in such an august crowd. As I mentioned in my presentation yesterday on the evolution of the legal framework for the nonproliferation regime, my view is that the nuclear nonproliferation regime came about as a function of states' need for individual and collective security and the threat posed to that security by nuclear weapons. I believe it has evolved as a function of shifting perceptions of the nature and the source of that threat. Changes in those perceptions have produced changes in national security policy and as a consequence in the nuclear nonproliferation policy and the legal framework for that policy.

In the early days the efforts were focused on ensuring that nuclear trade didn't contribute to the proliferation of nuclear weapons. It was addressed initially through bilateral national safeguards. But very quickly evolved into the creation of the International Atomic Energy Agency and an international safeguards system designed to ensure that there would be no misuse of supplied items.

But with the increase in the number of nuclear weapons states and the development of states indigenous as opposed to supplied, their own indigenous nuclear programs, it became clear that what needed to be addressed is the risk that states could produce their own nuclear material and perhaps use that for weapons purposes. And this resulted in the development of the nuclear weapon free zone treaty in Latin America, the Tlatelolco Treaty, and the NPT and the need for a safeguards system to verify compliance with those obligations. So we created INFCIRC153 and the system of full scope or comprehensive safeguards agreements.

Now there were certain assumptions built into that and most fundamentally it was without nuclear material you can't have a nuclear weapon. And it takes an awful lot of material to make a nuclear weapon. And for the first twenty years in implementing comprehensive safeguards agreements as a matter of practice, we tended to focus on declared nuclear material. Why? The assumption was if a state was going to bother to conclude a treaty, why would they bother cheating? Well, these assumptions and that practice were stood on their head with the discovery in Iraq of an undeclared nuclear weapons program in which using very small quantities of nuclear material Iraq was able to develop much that was needed for a nuclear weaponization program. And some of those activities, I remind you, didn't even involve nuclear material.

What happened then? This triggered a massive reassessment of the focus of safeguards, efforts by member states in the IAEA to improve the Agency's ability to verify not just correctness but completeness. And eventually the approval of the Model Additional Protocol, which was designed to help us do that job better.

In 2001 and 2003 with 9/11, Iran, Libya, we were quickly forced to reassess our focus on states as the perpetrators of nuclear weapons and start looking at non-state actors and black markets. And we've done a lot in that regard but I don't think we're out of the woods yet. I think strengthening safeguards today is more about evolution than revolution. And the biggest challenges by far today in my view are not technical. They are perhaps a lack of knowledge about the history of safeguards and revisionist historians motivated by reasons perhaps unrelated to safeguards who capitalize on that lack of knowledge.

While the latter problem is difficult to address, the former is not. It is incumbent on all of us in the nonproliferation community to understand what is already been achieved in strengthening safeguards so that we don't have to reinvent those achievements. This is why institutions like the INMM, the educational and training programs that many of the educational institutions, the U.S. Department of Energy, countries around the world are supporting. That's why those efforts are so important.

And I take this opportunity to recall George Santayana's famous quotation, which I find more than apt in this situation. "Progress, far from consisting of change depends on retentiveness. When change is absolute there remains no being to improve and no direction is set for possible improvement. And when experience is not retained as among savages, infancy is perpetual. Those who cannot remember the past are condemned to repeat it."

Whitaker: Our final panelist this morning is Ollie Heinonen. He is a senior fellow at Harvard's Belfer Center for Science and International Affairs. His research and teachings include nuclear nonproliferation and disarmament, verification of treaty compliance, enhancement of verification work of international organizations, and transfer and control of peaceful uses of nuclear energy. He is more widely recognized for his work at the IAEA. He served twenty-seven years at the Agency in a variety of positions ranging from inspector to director of several of the operational divisions until ultimately achieving the position of deputy director general for the department of safeguards. Please welcome Olli.

Olli Heinonen: Good morning, it's so nice to see so many smiling faces at eight o'clock in the morning. I would like to continue what Tero said this morning. Actually I think the IAEA budget that he discussed was not good news in my view. I think that people are challenging the authority of the IAEA. This is what this state-level approach discussion is actually. It's about returning to the same discussions that took place maybe twenty years ago, as Laura mentioned, in '91, '92, '93.

But before going there, Tero mentioned this IAEA budget of hundreds of million U.S. dollars, the regular budget. I live now in Boston, Massachusetts. Boston has 640,000 people. The annual budget of the Boston fire brigade is $185 million. So this gives us a kind of idea of the operational budget of the IAEA. What people are now asking as Tero mentioned, they ask him to do more with less. If you look ten years ahead for example here, the number of nuclear installations where IAEA will have safeguards in quite a few additional facilities in India, perhaps not so much in China but all Middle Eastern countries, United Arab Emirates, Saudi Arabia plans sixteen reactors in the next twenty years. Jordan, Bangladesh, Vietnam. Just go there, many of them are newcomers so this will require much more help and assistance from the IAEA in order to create this safeguards counsel for those countries.

I think one of the things the IAEA board of member states really need to think about is how far you can go with squeezing the budget so you don't compromise the conclusions. Because that's the ultimate result. And I remember when Mohamed ElBaradei became director general in 1997 and one of his opening statements he said, IAEA has now been quite some time with zero growth budget. He's a person who can say when the emperor is naked. But this needs attention.

At the state-level approach, why I think it's an important thing to talk and this is where the challenge is. People are basically questioning if IAEA is authorized to verify the correctness and completeness. There's a group of states who are of the opinion that it is enough that the IAEA verifies the declared inventory and when all these items which have been declared are found, IAEA has done its job and go away. And behind all that is actually the IAEA access rights to all locations where nuclear material is used in the country. There are no sanctuaries. In order to put this to the perspective, go

to the IAEA website, take INFCIRC documents which are available to everyone. There is a letter from the Iranian ambassador on June 4 or June 6, just a month ago, where he challenges exactly the same things that this state-level discussion has taken up. And this at the time when Iran said that we have changed our policy, we are cooperating with the IAEA, et cetera. This goes accepted the way as (U.S.) Secretary of State John Kerry said a couple of weeks ago, that there are two faces of Iran in this business. One is the one which is the public as smiling, the other one is what happens in the meeting rooms where the atmosphere is very different. And this letter gives you an idea on that.

Then the other important thing that Tero mentioned was that this safeguards criteria was developed in end of the 1980s basically. That people are revisiting maybe some of the parameters. Criteria is an important thing, it is not something which you can just brush away. This is based on experience those parameters. Certainly you can revisit them and see whether they are reasonable in a current circumstances and with the tools you have. But I give you one example where I think, and this is not a criticism of IAEA. The safeguards conclusions for those countries that have only comprehensive safeguards agreement in force and all the nuclear material is in peaceful use. This is not a completeness declaration but that which has been declared, has been seen.

Then the SI criteria says every country which has one nuclear facility needs to be inspected once a year. This was implemented all along, the things described came into force in 1991. In 1991 there was a war in Yugoslavia. IAEA didn't make any inspection in one of the Yugoslavian republics on that year. And the safeguards conclusion was that IAEA was not able to make any conclusion for Yugoslavia because they didn't do any inspection. But when you take Syria, a country which is in noncompliance, whose dossier is in the United Nations Security Council, the conclusion is that all nuclear material is in peaceful use. Without visiting the country.

So I think these are the things that IAEA has still to revisit. When you make your conclusions that the basic elements are not compromised, because I think here something went perhaps wrong in the translation. This is important now when we come to this next phase and hopefully this Iranian dossier gets old. And Tero was very frank that it takes four-five years. I think he's a bit of an optimist like me. If you go back, we went through South Africa in 1993. So the first nine months when we went around all the nuclear material had been verified by when De Klerk made the announcement in March 1993 that they had nuclear program. IAEA by then had verified the material had been presented so you didn't need to do that part of the history.

It took nine months from that point to the next point to ascertain that not more than the amount that was required for the South African nuclear weapon was not missing from the inventory. But to come to this correctness and completeness, go back all this nuclear history in the country which had almost twenty years of nuclear activities. It took another twenty years, it was only 2010 when the IAEA came to this broader conclusion that all nuclear material in South Africa is in peaceful use.

So it's a tremendous challenge and for that one Tero was right, you need to have additional people, additional talents, and additional funds. I think the IAEA has good inspectors. They are motivated, but you cannot, as I said yesterday, win tomorrow's wars with yesterday's tools. Thank you.

Whitaker: Thank all of you very much. Now we have some time for questions or comments.

Audience Questions

Michael Rosenthal: In the SIR (safeguards implementation report) I think when Pierre Goldschmidt was DDG (deputy director general), he named the names of states that had not adopted the early reporting, a requirement that the board had called on states to agree to back in the '90s. I think that had a salutary effect in speeding the process of getting states to take that step. I wonder what the panelists think about naming the names of states in SIRs with respect to instances where they failed to take the steps necessary in accordance with their agreements: it could be late reporting, it could be failure to allow access in a timely manner, and so on. Is that politically feasible and would it not, it it were, help assist in speeding states on to doing a better job?

Varjoranta: Yes, thank you. Of course the SIR at this point in time already names quite a bit of names. It's not just without any names. You can read from the document all kinds of things from these member states and you can also read, for example, who is delayed, how much and for what in terms of supplying us with the reports.

One of the things we noticed during these past months in consultations with the member states is that the SIR needs to be relooked at in terms of understanding

what the whole SIR tells. It's very rich in data. Member states would like to see more information on how we conclude what we conclude. So we will be looking at that.

Naming more names. I think that's part of the transparency, that's part of the direction it is going. It's the same direction with also other areas. The aviation industry, if you go and have a look how different airliners are working, you can find really interesting things to read. Self-regulating is very important and in that respect naming the names contributes to that. So what I can say basically is that yes, we are looking into the SIR and next year it may look again slightly different and hopefully better in terms of transparency and what do we conclude from a lot of data.

Fernandez-Moreno: Just one comment because the naming names was an issue that was thoroughly discussed in the Agency for many, many years. There are pros and cons about putting out more about what is going on in the states. And anything as Tero mentioned is a delicate balance in which you have to be careful about what matters and that the community which is not specialized, to avoid that they get a wrong message. Sometimes you look into the SIR and you look under delays to report, on the partial goal attainments, and so many technical things that the safeguards community understand perfectly and frame it in the right context. But others when they read the word anomaly or nonattainment it can lead to the wrong conclusions. I think that the SIR is getting a good balance in the names particularly in cases in which you are talking about serious problems, relevant problems of concern in drawing conclusions.

And then while there is a little bit more of work to be done when you name states about delays and so on that are not impeding the Agency to draw a safeguards conclusion.

Heinonen: I was working with Pierre Goldsmith in those days and I feel the names should be there. I don't take this kind of defensive attitude. This is still the best way to fix the problems. I think that this question also asks, if your state doesn't provide the IAEA with the nuclear material accountancy reports, how can I make a conclusion? Because that's an official statement from the state. So I think these are serious things. They only get fixed when they get to the public and we have seen some of the countries who publish all these results like Australia, so they put all of their ninety statements out and one can see where they do.

And then the other thing is as you mentioned, Sonia, the SIR, it has become more in my view a passive document rather than a safeguards implementation report. For example, goal attainment. You have to work hard to find out where is the goal attainment. There are local numbers, how many days in the field, how many reports came and this one, but the most important thing is how did the IAEA derive the conclusions when there is no indication anywhere how the inspections were performed. I think it has to be here.

Audience Questions

Thomas Shea: I have two issues to raise, the first of which is I'm very uncomfortable with the notion that safeguards evolution is driven by constrained budget. And that's not anything new, it's periods of decades with zero real growth, et cetera that force the compromises in the system and continue apparently to be that case. If we go back to the beginnings when there was no nuclear industry, it's clear that apportioning a budget over states according to some formula was probably the only way to proceed. But today we have a vast nuclear enterprise and for example, in the United States, the Nuclear Regulatory Commission charges fees for licenses appreciating that the operator of a facility derives a direct benefit from that.

The same thing is very true from the obtaining an agreement from the IAEA that a state is operating in compliance with its undertakings. So whether there could be some fee-based structure that might replace or complement the existing arrangements, I think is something that perhaps should be examined.

The other consideration that I would put forth since I get two shots at this is the issue of sovereignty of states and the non-nuclear weapons states, every improvement of safeguards involves a relaxation or a diminution of its sovereignty. And that is at the expense of the nuclear weapons states that have no such restrictions and this disparity between the haves and the have-nots has long been a problem in the NPT and outside of that. With this situation we have very little progress in the article six NPT conference coming up. Laura and I are giving a talk tomorrow morning on the Trilateral Initiative, which was a rather extraordinary undertaking that didn't lead to anything in the end. And so that's a problem that we wish to address.

By the way, my comments are not intended to be critical of the United States. If anything I would be critical of many other states much more so that possess nuclear weapons. Thank you for taking on my points.

Manuel Recio: I am IAEA staff. I work in the technical cooperation department. But before I was in charge of safeguards implementation in my country of origin and I was involved in the negotiations with the IAEA on EURATOM to implement the Additional Protocol in EU countries and to introduce integrated safeguards.

I want to expand on Sonia's comment in her initial comments on this so-called safeguards culture. I still remember some seven years ago when we were discussing with IAEA and EURATOM, we had high expectation on the savings that the integrated safeguards were going to bring to the system. I understand that this has taken place but maybe at a slower pace than it was originally meant based on Mr. Varjoranta's comments in his speech.

So then it comes to my mind that probably to determine the resources that are necessary to sustain a safeguards system, the question has many terms, of course. One is the verification inspectorate and all the verification measures. But another term is the operator and we also listened to the previous speaker, this is a key factor. And I remember that at that time seven years ago some, we believe, that there was kind of a lack of enough safety culture among the operators. I don't want to say they didn't want to cooperate, what I want to say that there was a lack of interest. They perceived safeguards as a burden and this really makes the safeguards implementation much more difficult than it should be. Having further cooperation from the operators is essential to safeguards.

So then my question would be whether the IAEA and EURATOM are working on a communication policy to convey to the operators that at the end of the day are those regulated, if I can use the word, borrowing it from the safety environment, that the operators understand the benefits of safeguards. The positive message, how safeguards has contributed to keep alive the nuclear business, and how their own individual contributions helps to save resources and shift resources to address priority issues in the whole global system. Thank you.

Syzmanski: Let's talk about EURATOM. First of all, in a bit of a jocular manner, we don't need to convince the operator, they just have to obey. If they don't obey, they may be taken under administration for up to four months. That's the EURATOM Treaty. I understand that you are laughing because you are jealous that no one else says it.

That's exactly the point that we are addressing very strongly. First of all, we maintain close contact with operators exactly with the purpose of, if necessary, teaching them how things should be done. Helping with setting up the systems if they are not properly set up, including training for both operator representatives and people in the state authorities who are dealing with safety, security, and also sometimes have safeguards in their portfolio.

Very briefly, the more we help the operator, teaching them, showing them how things should be done, we can work much more efficiently because things are prepared when we inspect them. They know what we expect from them. They know where to signal the problems because sometimes operators have a problem how to report certain things, how to prepare for physical verification. So I'm fully on board. This is activity which we are keeping up. We invest in it even more. We even go to the countries to provide training for operators. Because this is money well spent. It puts extra burden on us. We use resources. We have to work more on a daily basis. We have additional burden related to these training activities but it pays off.

Tero Varjoranta: As Piotr says, we are a little bit different in the Agency in terms of EURATOM's legal mandate. Our partner so to say, our first point of contact is of course the member state. So we work with the member state. It's very important for us that the state takes care of whatever they have inside the state. And as I showed in my keynote speech, there are many things that states could still do to help us in the area of safeguards implementation.

Definitely communication is an important thing so when we act on the ground it is important that those operators that we deal with understand why we are doing things, what we are doing, when we are doing those things and how we are doing them. A certain level of understanding is very important.

Back in Finland when I was working there, one big surprise for me, small- and medium-sized countries like mine, was that we were fully dependent on world market to run our nuclear plants. And nuclear plants constituted about 30 percent of the electricity in my country. So 30 percent of electricity was fully dependent on how we got nuclear-related materials from the world market.

What's the best way to screw it up or what's the best way to guarantee it? It's the IAEA stamp that things are all right. Because if I don't have the stamp, I don't get the spare parts, I don't get the fuel, I don't deal with the problems. So in

Scandinavian countries, it was never for us any problem why IAEA safeguards is a value added. Why the stamp of doing things well was like an environmentally friendly stamp in any other products that we buy from any other markets. And this is part of the communication issue that in my current position I have to make sure that more and more people and more and more states understand. As I said in my speech, we are not adversaries, we are not causing problems, we are trying to help and make other, in particular, neighboring countries feel comfortable that the neighboring countries are taking fully care of their obligations and things are in the best possible way from safeguards.

Szymanski: What Tero mentioned is profit for the operator from being inspected. Another aspect is comparing the installation of a similar type which is under safeguards in Europe including EURATOM safeguards and is working elsewhere. We heard from the operators that the facilities elsewhere have to hire more people for quality control because in Europe, they say fine, we've got you, you are doing the quality and you are checking our work so we don't have to have redundant checking systems paid by the operator himself.

Rockwood: I'm really glad this question was asked because I have for many years thought that industry needs to take its ownership of this issue in the same way they have come to own safety and security. The IAEA and EURATOM can perhaps help states educate their operators but the industry needs to own this, they need to make it their issue. Because if you participate in the supply that ends up being associated with a nuclear weapons program, I'm not sure you're going to get a lot of business after that. Set aside whether the spread of nuclear weapons is actually good for business or good for the world community. And I think one of the best ways of ensuring that industry's attention to this is increased are these crosscutting educational programs where you have physicists learning about nonproliferation and the policy people learning about physics. I think that is our best hope for the next generation of industry people. Own it.

Willem Janssen: We heard quite a lot this morning about the necessity and also the mandate to have credible assurance on the verification of absence of undeclared activities. And then we heard the countries where you had concerns like Syria, North Korea, and Iran and so on. Where proliferation concerns were very often triggered by the availability of technology, possibly clandestinely obtained. So my question is basically which importance do you attach to not such delicate nuclear materials but the nuclear technology trading, sensitive and tangible technologies? What kind of recommendations would you have about what has to be enhanced in this area with respect to like industry outreach, licensing but also controls. And what would you think is the role of international organizations or even R&D in that respect. To modify the question I could ask that do you think one day we need an institute not only for nuclear materials but also for nuclear technology management?

Heinonen: Willem, you raised a very important question. I have a counter question. Who is in charge in this world on nonproliferation? Who has an overview? There's no such body. IAEA has its safeguards agreement. We have nuclear suppliers group there. We have some INFCIRC and1540 resolutions and states try to comply. Then we have this nuclear black markets that have been there for decades. This is not a new phenomenon. In the 1950s people were stealing, buying, and trying to get technology from the U.S. and elsewhere.

There is no focal point in this international system where all these are tied together. Someone may say it should be IAEA. But I don't think that really fits the portfolio of the IAEA. So we really need to think. And I think INMM perhaps also should have a look, make a focus area, or we should perhaps create a separate session next time or years to come or even working group.

Varjoranta: I agree with all of that. This system is not a complete system as such. From the Agency's viewpoint, as I mentioned in my presentation, the situation is extremely clear. We have the mandate for each and every state what the safeguards agreement says. Whatever it covers, that's the envelope that we function in and we do not function outside of that envelope. But that's all we said. It might be useful to have a quick broader consideration of how this all fits together.

Adams: I might just make an observation. One of the things that was built into the Additional Protocol was the concept that the annexes to the Protocol could be updated at some point in the future. It has been well over a decade since that has happened. The list on which those annexes were based have been updated multiple times since that time.

Leon Ratz: I'd like to ask the panel about

Iran and the implications of failure on the IAEA safeguards regime as a whole and the international community's confidence in it. In the unfortunate, hopefully, extremely unlikely scenario that an agreement is reached, Iran cheats on the agreement. The IAEA is unable to detect cheating in a timely manner. What would the implications be for the IAEA safeguards regime as a whole?

Varjoranto: As I've mentioned in my presentation, when we function in the legal framework, that's where we stay. Iran is a special case of course and it's a special case in terms of also implementing their safeguards part. If we look at the comprehensive safeguards agreement, what they have declared, that material, that part Iran has taken very well and good care of—what they have declared. Then there are lots of outstanding issues and the level of cooperation and trying to reach all those things is a completely different story. So there are two different things.

As I also mentioned in my presentation, whatever is the deal on comprehensive solution, the five plus one, and Iran will remake if they request the Agency to do safeguards or do monitoring work that will go to our Board of Governors. The Board of Governors will then concede whether we should do it or not. If we are to do it and we are looking for the objective of being able to confirm that all nuclear material in Iran is in peaceful use, as I mentioned, it will take a long, long time. It's not only Iran, it's all the other fifty-three states that we have the protocol conclusion. This conclusion is never taken lightly. And we all the time keep very clearly in mind that it's a credibility issue. It's not for us only, it's for the states that we are doing this. Because the Agency is not doing these things for ourselves. This is not fun for us. We are only here because of you. We are only here to serve the member states. So everything we do we do for you. And we very well recognize that if there is any doubt of any misuse, either materials or facilities, all you look at that in a very serious and cautious way. So therefore we are never ever rushing to any conclusions. Iran tries constantly to get all kinds of assessments done, rushing to the conclusions, but we are not in that type of business so we are taking it very, very seriously.

Heinonen: I wrote or actually gave testimony to the U.S. Congress a month ago and I wrote that my wish list of what needs to be for the IAEA to succeed in the verification and monitoring once the deal is there. But the whole things come really to that IAEA has the necessary authority to do that job. And then the P5+1 has to also to agree what they really want from IAEA. What kind of assurances and which confidence level. But it's for sure that it goes well beyond any additional protocol requirement on this because this cheating continue for two decades and even though some people now see that all the nuclear material that they have declared is under IAEA control. But I would be more worried about if there is still some material which has not been declared because if this is true, what is now, it's the first time in twenty years that all the nuclear material has been declared in Iran.

Varjoranto: Let me add a little bit in the light of managing expectations. The file on the situation is extremely complicated and personally I would not expect that there is going to be a black and white answer ever. The Agency will make its best effort we can and we will go with our observations and findings to the Board of Governors. And it's up to the Board of Governors then to consider and decide is it sufficient, is it enough, and what the next steps are. So we are not making final conclusions on the behalf of the Board; we are providing them facts as well as we can and it's then up to them to do the work.

But as I mentioned, I do not believe that there's ever going to be black and white answers to this question.

Adams: I don't think I'm going to answer your question either in a way, because of its hypothetical nature. But I would note that a number of countries in the last decade, decade and a half, two decades have felt they were smarter than the IAEA and IAEA inspectors. Their activities have been found out in time beginning with DPRK in the '90s, which people forget was actually before the Additional Protocol and was done using conventional comprehensive safeguards type measures.

Now, states aren't learning and it's important as the IAEA is transitioning to the state-level concept as others have pointed out, that effectiveness be as important or even more important than any efficiency gains.

Shirley Johnson: As an ex-inspector, of course my interests are always implementation. I have two specific, short questions. One is a continuation of the earlier discussion on culture. Iwamoto-san, many years ago the Japanese government made a big effort to change the culture with the operators and I'm very interested in how that has proceeded and what you have continued to do to

bring the operators on board with safeguards. They certainly, even before shift, there's the big rah-rah for safety and security. How are safeguards going?

And Dr. Szymanski, with the implementation of the state-level concept in the European community, how has that affected your inspections? With their optimization of their inspections, they may do fewer inspections. Do you continue to do your full inspections? Do you do them without the Agency or do you optimize along with the IAEA?

Iwamoto: So first of all, how do we create a safeguards culture? Most of the history is a safety culture in Japan. And the same thing, a security culture made by the educational effort. For instance, all over the nuclear facility have a material accounting degradation, which are approved by the safeguards authority in Japan. So in this point, prior to Rok nuclear facility need some education for the material counting and safeguards. One point.

Other point, the government introduced the … Corporation with Agency. We call the technical meeting of the IAEA safeguards. To Iran IAEA safeguards are declined. So both are good for creating the safeguards culture. For both of the government and the facility.

Szymanski: First of all, just for people who might not be familiar with EURATOM, we have comprehensive safeguards, Additional Protocol and conclusions in place in 2010 on the whole EU territory with the exception of Cypress, due to the division of the island. And since more than forty years we are working with the Agency, we are according to, as Tero pointed out, existing legal framework within the safeguards agreement coordinated the inspection and verification activities with IAEA. Also in the spirit of the new partnership approach. So we'll just continue doing it. Sometimes colleagues from the Agency complain that we are not very vocal in supporting the state-level concept during the technical meetings and then I recognize it's so obvious for us that's the way we work since ago. But the way we will continue to work so somehow nobody thinks about, okay, we have to stand up and speak out, yes, we support it because it's obvious.

Rob Goldston: I may have an appropriate final question for you all. When you're doing a fundraising campaign it's always good to have a goal. So how much budget would the IAEA require to not be budget limited but be limited by other things?

Heinonen: I leave this to Tero to answer. I don't think anyone talks here but a couple of people in the back said. But this kind of continuous squeeze, it's unfortunate because you have to balance your budget every year. You cannot save from the salaries unless you radically cut the staff because IAEA is kind of funny organization, almost 80 percent of the budget actually goes to the salaries and this is all where experts are there. So you are left with 20-30 percent and that's where you can then do in reality the cutting. You postpone investment to restructure. That's what you do. Then the result is like this level approach that they're now in in Cypress, which was postponed many, many, many, many years and then you will have to all of a sudden then invest $60 million when the annual budget is $180 million. So it's very difficult to get that money.

And the other place where you'll save is IT. That's actually even worse because then when you do this patching of your current IT system you start to maintain actually several systems. It's not anymore a homogenous one single IT system. There the IAEA now paying a heavy price on this safeguards information system finalization. So these are the ones that I think should be taken care of, the investment to infrastructure. Tero knows better the number but if you get maybe $50 million more, I think that would be a heck of a help.

Rockwood: There's a complication associated with the Agency's budgeting process. I don't know if you're aware of this but there has been an increasing emphasis on balancing the budget and it's not the bottom line, it's balancing what is perceived to be as the developed countries' interest, which is translated as safeguards, and the developing countries' interest which is translated as technical cooperation. So if you increase the budget in safeguards, there will be a quid pro quo request for technical cooperation.

I understand the dynamic and the political argument but I'm so sorry that we see these as a have and have not kind of situation. But it is our political reality and I guess Tero, it's appropriate that you get the last comment.

Varjaranto: Hopefully I'm not disappointing you by not giving you an exact dollar number how much more we want. But just echoing Olli, Olli knows this thing also from the past very well. It is not a new thing. It's only as I tried to describe. This is our understanding where the nuclear world is going. And it's not going into an easier direction, it's going into a more difficult. Question: We are

always in the budget structure itself. We are always criticized that you should be traveling less. You are traveling too fancy and too much. Traveling is the only added value of the niche that we have so we can't give up traveling. We have to do that. Traveling costs today are seven percent of our budget.

Inspection travel takes more than six percent from the seven percent so coming here, talking to you is less than one percent. So there is nothing much to try and save from those expenses.

The other thing in addition to the complications is the budget structure in the Agency itself, another thing that is more of a policy type of thing is to recognize that we fully depend on extra-budgetary funding. If extra-budgetary funding would stop today suddenly, if we would lose all the cost-free experts, all the R&D support, all the equipment support, everything, this won't fly.

So the other side of the coin is then the question that what would be the ideal amount of regular budget and extra-budgetary funding? Is it good that we have a huge amount coming from extra-budgetary or should it be something which is in the regular budget itself.

Again echoing Olli, if we look at the whole structure and if we look at just objectively, maybe the balance is not exactly what it should be. But it definitely is vital for our operations that we have extra-budgetary funding.

Whitaker: Thank you, although not a panelist and one not often accused of being reserved, let me put out a target of $1 billion. We'll put that on the table and debate whether that's too high or too low at a future conference.

So before adjourning, let me thank the panelists again for joining us and sharing your comments. And to followup on Olli's challenge of topics, let me challenge all of you if there are some specific topics or things that we as an Institute can address in a future panel, session, workshop, one of the things we highlight is the creation of WINS as a challenge to us. So I think while it's painful, we like to be challenged too and to respond to that.

I do want to thank the Institute for allowing International Safeguards Division to share this one topic that's kind of core to us with the entire Institute here this morning. Thank all of you for attending and your attention, and particular those of you that have asked questions for the panel. I want to thank Shirley [Johnson] who helped crafted this theme and personally I think reached out to everyone and made sure you were on the panel itself. And this concludes this morning session. Hope everyone has a wonderful, educational, and productive day today.

1st Place Student Paper

Simulated Response of Electrochemical Sensors for Monitoring Molten-Salt Fueled Reactors

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Abstract

Advanced reactor concepts featuring molten salts as either the primary coolant or the actual fuel are gaining increased interest from the U.S. Department of Energy and the nuclear power industry. Examples include the Advanced High Temperature Reactor from Oak Ridge National Laboratory, the Waste Annihilation Molten Salt Reactor from MIT, and the Accelerator Driven Sub-Critical Molten Salt reactor from Texas A&M. These advanced nuclear reactor concepts are anticipated to be deployed in the future within and outside the United States, potentially including non-nuclear weapon states. Traditional international safeguards approaches rely heavily upon material accountancy, but that may be insufficient for these systems due to the quantities or concentrations of transuranic (TRU) elements in the fuel salt. Continuous and unattended process monitoring should be an effective supplemental safeguards measure in this case to complement material accountancy. This approach, however, requires robust sensors that are sufficiently sensitive to actinide concentrations in the fuel salt. Voltammetric methods that utilize a simple three-electrode probe have widely been studied for this application—including cyclic, square wave, and normal pulse voltammetry. Based on the measured electrode potentials and peak heights, these methods can generally be correlated to concentrations of actinides and other ions in the salts. Some limitations to these methods may stem from the multi-component nature of these fuel salts. Most voltammetry studies published have focused on single actinides in a matrix salt. Even in single component studies, quantitative signal responses were found to be limited to a low range of concentrations. To provide the fundamental basis for development of advanced voltammetry systems that avoid or minimize these issues, a model called Enhanced REFIN with Anodic Dissolution (ERAD) was used to calculate voltage responses in molten LiCl-KCl with a range of UCl_3 and $ThCl_4$ concentrations. The model was developed based on first principles of mass transfer and electrochemistry. Based on ERAD simulations, the voltage response due to variations in hydrodynamic conditions and geometric configurations differs depending on the species present. Understanding the effect of these variations on voltage response is critical to developing electrochemical sensors and techniques for monitoring molten salt concentrations in advanced reactors.

Introduction

The Molten Salt Reactor (MSR) is a non-classical reactor concept originally developed in 1960s by Oak Ridge National Laboratory (ORNL). It has enjoyed renewed interest at the beginning of the 21st century with the creation of Generation IV Reactors International Forum (GenIV). This reactor employs several distinct features—it is a high-temperature liquid-fuel system with breeding capability in the thorium-uranium fuel cycle. The liquid nature of the fuel permits the employment of on-line refueling and recycling. These features bring advantages in economy and safety terms, as well as a substantial reduction in hazardous waste.

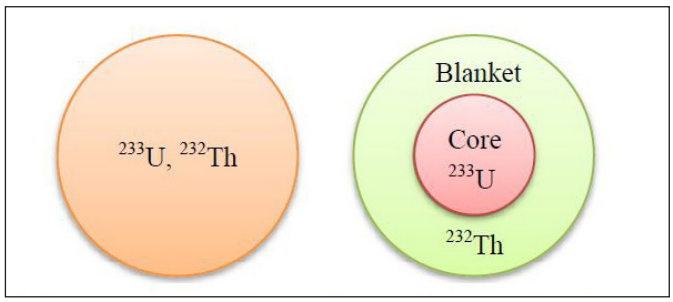
Due to the liquid state of the fuel, nuclear material is continuously being transferred between the reactor and supporting process equipment. Most importantly, online recycling extracts newly bred

U-233 (or its precursor Pa-233). The amount of U-233 and thorium (Th) flowing into and out of the reactor needs to be accurately monitored in order to keep the reactor precisely critical and to meet safeguards goals.

Molten Salt Reactor Design

Various designs of MSRs exist.[1,2,3,4] In general, the MSR operates at high temperatures (650-850°C) and uses LiF, LiF-BeF_2 (FLiBe), LiF-NaF-KF (FLiNaK) or another fluoride salt loaded with U and/or Th. This work focuses on a thorium-fueled MSR. A thorium-fuel MSR can be a single- or two-salt system, operated in either the thermal or fast neutron spectrum. As shown in Figure 1, in a two-salt system, a thorium-rich or "blanket"

Figure 1. Depiction of a single-salt (left) and a two-salt (right) reactor



salt surrounds the reactor core. The other salt is uranium-rich and forms the core of the reactor.

In a thorium fueled reactor, U-233 is produced when Th-232 absorbs a neutron and undergoes two beta decays, as shown below:

$$^{232}Th + {}^{1}n \rightarrow {}^{233}Th \xrightarrow[t_{1/2}=22min.]{\beta^-} {}^{233}Pa \xrightarrow[t_{1/2}=27days]{\beta^-} {}^{233}U$$

The first beta decay from Th to protactinium (Pa) has a half-life of 21.83 min. and can be assumed to primarily occur in the reactor. Subsequently, Pa-233 is removed from the reactor salt since it has a longer half-life of twenty-seven days and a high neutron absorption cross section. Then, Pa-233 is allowed to decay to U-233 outside of the reactor in a hold-up tank. At this point, U-233 could be returned to the salt containing Th, if the MSR uses a one-salt system, or it could be loaded into the core salt. In either system, U will be present with Th. In a one-salt system, the weight percent of U and Th could be 1 and 40 wt%, respectively.[5] In the two-salt system, a small amount of Pa-233 will have decayed to U-233 while still in the reactor or some Th may be co-extracted with U. Thus, an ability to detect the presence and concentration of U in the presence of Th would be vital for any measurement technique.

Safeguards of MSR

Due to the continuous flow of fluids in MSRs, they would need to be treated as a bulk facility, like PUREX, rather than an item facility, like a light-water reactor. However, unlike a bulk facility, the inventory is undergoing continuous nuclear reactions which constantly change the concentration of special nuclear material within a given unit. System clean-outs that would result in the inability to produce electricity must also be minimized. Thus, an unattended monitoring system (UMS) that can accurately measure the concentration of U and Th in a salt mixture is recommended to reduce the inspection burden on the IAEA and minimize interruptions to reactor operations.

Voltammetry is an attractive option for the UMS in a MSR that could potentially provide near-real-time measurements of concentration of elements, particularly uranium and thorium, in influent and effluent streams of the reactor. Voltammetry requires simple sensors that can withstand the high temperatures and the radiation environment. Several methods of voltammetry are available, such as: cyclic voltammetry (CV), linear sweep voltammetry (LSV), chronoamperometry, etc. The premise of each technique is to adjust the potential and measure the response of the current. Based on the current values, concentrations or species properties (e.g., diffusion coefficients) can be determined. One issue that can complicate voltammetric measurement is a high background current due to solution resistance. A MSR is particularly well-suited for voltammetry due to the low electrical resistivity of molten salts, which result in very low or negligible background currents.

Simulation of U and Th in molten salt

To investigate the feasibility and applicability of voltammetry to MSRs, the reduction peak(s) in CV or LSV of molten salt containing U and Th were simulated using a model called ERAD (Enhanced REFIN with Anodic Dissolution). ERAD has been validated by simulating the CVs of U and plutonium from open literature and comparing the results.[6, 7] Because ERAD is based on fundamental electrochemical relations, it requires several well-characterized properties for each element, including: standard reduction potentials, activity coefficients, diffusion coefficients, oxidation state, transfer coefficients and exchange current density. Unfortunately, the electrochemical data for actinides in fluoride salts (i.e., LiF, FLiBe, FLiNaK) is sparse.[8] However, significant research has been performed on eutectic LiCl-KCl salt due to the development of pyroprocessing in the U.S. under the Integral Fast Reactor (IFR) program and by other countries. Thus, the eutectic LiCl-KCl system was used for this work as an analog to a fluoride salt system. The trends and behaviors of U and Th noted in this work will be assumed to be applicable to fluoride salts. This is not an unreasonable assumption. Indeed, the limited existing electrochemical data of actinides in fluorides have been shown to be similar to their data in chlorides. Furthermore, the behavior of actinides in even less chemically similar systems, such as the aqueous and molten salt systems, has been shown to be analogous.[9-10]

As noted earlier, there exists a likely possibility that, in a MSR, small amounts of U would be found in mixtures containing significantly more Th. Therefore, the ability to make

quantitative measurements of the concentration of U in a mixture containing a significant amount of Th using voltammetry is of particular interest in this work. Currently, there has been limited experimental work on the application of voltammetry to LiCl-KCl eutectics containing more than one actinide in the matrix salt.[11] Therefore, this simulation work attempts to also address the analysis of voltammograms of LiCl-KCl containing multiple actinides.

Voltammetry Simulations

The properties used to simulate the electrochemical behavior of U and Th in eutectic LiCl-KCl salt at 500°C are displayed in Table 1. The standard apparent potential, diffusion coefficient, valance state, standard exchange current density and transfer coefficient are represented by E_o', D, z, i_o, and α, respectively. The number in brackets indicates the reference from which the value was taken.

Unfortunately, ERAD is not currently capable of simulating the multiple oxidation states of an element. Therefore only +3 oxidation state was captured for U. Th is supposed to only exist in the +4 oxidation state.[8,12] It should also be noted that interaction of U and Th metal deposits and its effect on the voltammograms is not captured in these simulations. However, previous work has shown that at 500°C no intermetallic is formed between U and Th and the solubility of U in Th is low.[13,14]

Several simulations were performed at varying levels of U and Th concentration. The concentration values used for each run are displayed in Table 2. The first sixteen simulations were used for calibrating the current-potential (*i*-E) curves to the weight percent values. The last three simulations were used as unknowns to test the performance of voltammetry in making concentration measurements. For each run, the potential was scanned from -1 to -2 V vs. Ag/AgCl(1 wt%) at a rate of 0.1 V/s, essentially a LSV, and the current was calculated based on a surface area of 4.53 cm^2 for the sensing (working) electrode.

The *i*-E curve for Run 13 is provided in Figure 2 to illustrate key features of the reduction peak that are common to all runs.

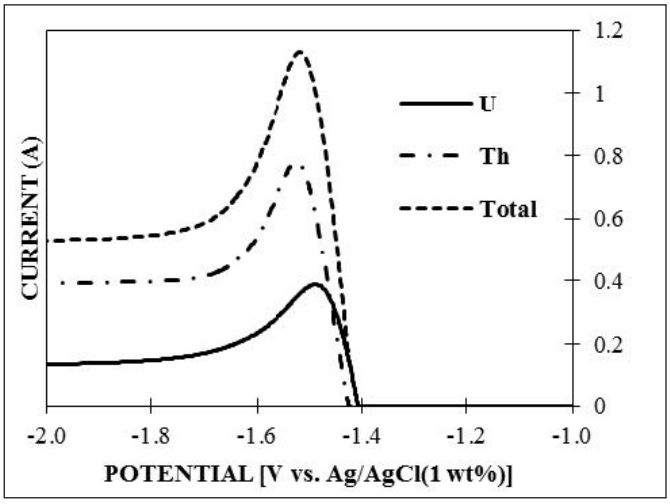
Table 1. Properties used for simulations

Property		U		Th	
$E^{o'}$	(V vs. Ag/AgCl)	-1.274	[15]	-1.325	[12]
D	(X 10^5 cm^2/s)	2.00	[6]	4.46	[12]
z		+3		+4	
i_o	(A/cm^2)	1.00	[6]	0.8*	
α		0.5*		0.5*	
*Assumed Value					

Table 2. Compositions of simulated runs

Calibration Data						Unknowns		
Run	U (wt%)	Th (wt%)	Run	U (wt%)	Th (wt%)	Run	U (wt%)	Th (wt%)
1	0.00	1.00	9	0.50	1.00	17	0.05	2.00
2	0.00	1.50	10	0.50	1.50	18	0.25	1.25
3	0.00	3.00	11	0.50	3.00	19	0.75	0.50
4	0.10	0.00	12	1.00	0.00			
5	0.10	1.00	13	1.00	1.00			
6	0.10	1.50	14	1.00	1.50			
7	0.10	3.00	15	1.00	3.00			
8	0.50	0.00	16	0.60	1.40			

Figure 2. *i*-E curve for Run 13 from Table 2



Due to the proximity of U's and Th's apparent standard potentials to each other ($\Delta E_o'$= 51 mV), the reduction peaks of U and Th almost completely overlap, as seen in Figure 2. This makes deciphering their separate peaks and respective peak heights impossible. Thus, the traditional method of relating peak height to concentration cannot be used. An alternative analysis method must be used.

Principal Component Regression

Principal component regression (PCR) is a multivariate analysis method that uses a greater amount of the data collected in a CV than the univariate analysis of peak height. PCR analyzes a set of data (training set) to determine the main contributors, principal components (PCs), to variance in the training set. Then using least-squares regression, a select number of the PCs are used to predict related variables from unknown data. The advantage of using PCs is that it retains the most useful information from the data while discarding the noise. However, just like any other analysis method, in order to make predictions using PCR, the conditions under which the unknown data is collected need to be the same as conditions of the training set. Only a brief explanation of PCR will be provided here, more

in-depth descriptions can be found elsewhere.[16,17,18]

The general approach to PCR is to compile a matrix (*n x m*), called *A*, containing a training set of data. In this case, the training set would be the LSVs generated for Runs 1-15 (i.e. *m* = 15 samples) in Table 2. The voltammograms in the training set need to be of the same length (*n* data points) and scale. Then, the PCs of the training set are found by using singular value decomposition (SVD) such that:

$$A=USV^T \quad (2)$$

where *U* is a *n x n* matrix containing the PCs or the eigenvectors of AA^T , *S* is a *n x m* diagonal matrix containing the eigenvalues, *V* is a *m x m* matrix containing the eigenvectors of A^TA. The main thing to note is that the PCs are contained in *U* and are essentially vectors in an abstract coordinate system which describe the variance of the training set.

Once the PCs are determined, the number of PCs to be retained needs to be determined. The method used for selecting the number of PCs to retain will be discussed later. For now, *k* will represent the number of PCs retained. It should be noted that *k* cannot exceed the number of observations (*m*). Having selected *k*, *A* is projected onto the selected PCs.

$$A_{proj} = U_k^T A \quad (3)$$

U_k is a *n x k* matrix containing columns 1 through *k* of *U*. Next, a matrix (*B*), containing the regression coefficients relating concentration to the selected PCs is formed.

$$B = CA_{proj}^T \left[A_{proj} A_{proj}^T \right]^{-1} \quad (4)$$

C is a *l x m* matrix with the concentration values of *l* components in the sample. In this case, *l* = 2 for U and Th. The concentration of an unknown data set (*X*) can now be calculated by projecting it onto the PCs and multiplying by *B*.

$$C_{unk} = B\left[U_k^T X \right] \quad (5)$$

In this work, the value for *k* was determined using the PRESS (Predicted Residual Error Sum of Squares) method. When selecting a value for *k*, it is important to reduce the error in the predicted variables and include all important features of the LSV while excluding noise and not over fitting the data. Run 16 was used to select a value for *k*. The concentration of Run 16 was predicted using Equation 5 and the residual sum of the squares (RSS) was computed by the following:

$$RSS = \sum_{l=1}^{2} \left(C_l - C_{unk,l} \right)^2 \quad (6)$$

where C_l represents the actual concentration of the *l*-th component. This calculation was repeated for *k* = 1 to 15 and the RSS of U and Th concentrations was plotted versus *k* for Run 16. As seen in Figure 3, the error is greatly reduced after the first 2 PCs making 3 a tempting choice for *k*. However, inspection of the residuals of predicted and actual i-E curves in Figure 4 show that for *k* = 3 features of the LSV are not accurately captured, such as the tail of reduction peak. At *k* = 6, all of the features of the LSV are captured. Thus, 6 PCs were used to predict the concentrations of Runs 17-19.

Results

Using PCR with 6 PCs, as described earlier, the concentrations of U and Th were predicted for Runs 17-19. As shown in Table 3, the predicted weight percent of U and Th are very close to the actual for each run with the exception of U in Run 17. Excluding the error of U in Run 17, the average error was 1.1 percent with a maximum of 2.8 percent.

In order to examine the sensitivity of PCR to perturbations in the sampling environment, Run 18 was re-simulated with a change of ±2.5 percent and 5 percent in the diffusion layer thickness (δ) and surface area of the sensing electrode (A). These are two parameters that could vary during the operating lifetime of an electrochemical sensor. Depending on the placement, the sensor could be in flowing or stagnant salt. If placed in flowing salt, the flow could vary during the operation of the MSR. The sensing electrode could corrode over time or become partially covered with crud altering the active surface area. Thus, understanding the effects of perturbations in δ and A on LSVs and predictions made using PCR would be helpful for determining whether an unknown LSV can be properly analyzed using an existing training set. If the conditions become too far perturbed, a new training set could be generated but this would require extensive sampling of the salt in the MSR.

Plots of the LSVs at varying A-values and δ-values can be found in Figures 5 and 6. As shown in Figure 5, the change in area affects the overall height and width of the reduction peak. On the other hand, as seen in Figure 6, δ only affects the tail

Table 3. Predicted weight percent of U and Th

	U (wt%)		Th (wt%)	
Run	Predicted	Actual	Predicted	Actual
17	0.025	0.050	2.012	2.000
18	0.257	0.250	1.248	1.250
19	0.757	0.750	0.494	0.500

Figure 3. Semi-log plot of RSS of concentration

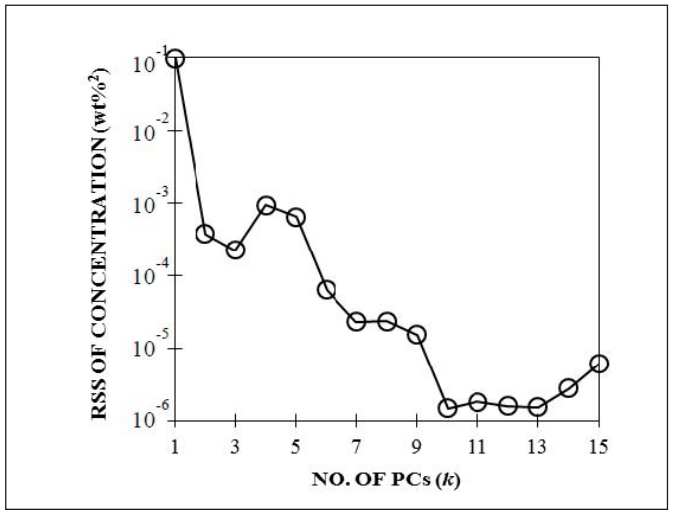
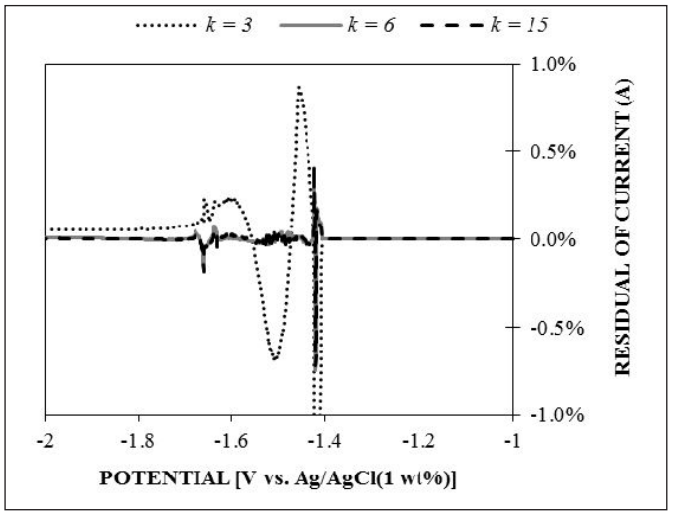


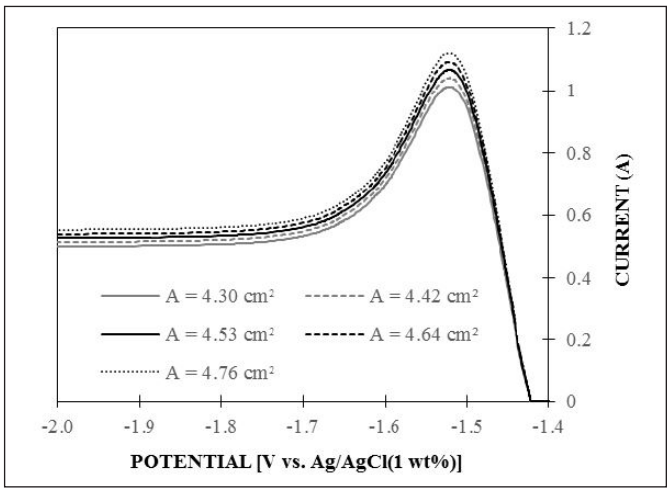
Figure 4. Residuals of the predicted current for Rum 16



of the reduction peak by causing the current to decrease with increasing δ. This is as expected since the hydrodynamic conditions should only affect the diffusion controlled portion of the reduction peak.

In order to analyze the effect of the perturbations on the predicted concentration for Run 18, PCR was applied to the

Figure 5. *i*-F curve for Run 18 with varying A



curves in Figures 5 and 6 using the training set generated under the original conditions (i.e. δ = 150 μm, A = 4.53 cm2). The predicted concentrations of U and Th are plotted in Figures 7 and 8, respectively, for the perturbed and original conditions. As can be seen in the figures, changes in the diffusion layer thickness (Δδ) have a greater effect on the predicted weight

percent of U and Th than changes in electrode area (ΔA). In the case of ΔA, Th absorbs the majority of the error. Alternatively, U absorbs most of the error in the case of Δδ.

It is quite unexpected that Δδ would have a greater effect on the predictions, since it had less of an effect on the LSV. However, this demonstrates that PCR, in the range tested, could be more sensitive to Δδ, or in other words, hydrodynamic conditions, than ΔA. Thus, the placement of the electrochemical sensor in a hydrodynamically stable environment would be an important consideration when designing a UMS for a MSR. Additionally, it would be important to develop a protocol for determining the sensing electrode surface area *in situ*, as that can affect the predictions. This could be done by simply varying the length of the electrode immersed in the salt and observing the effect on the height of the reduction peak.[19]

Future Work

The ability of PCR to accurately predict the concentrations of U and Th from the simulated, overlapping reduction peaks of U and Th is promising, but practical application of voltammetry to MSRs has several challenges. First, the detection of trace amounts U with Th present needs to be addressed, as the prediction of U in Run 17 had an error of 50% (see Table 3). Anodic stripping voltammetry may be more suitable for detect-

Figure 6. i-E curve for Run 18 at varying δ with magnification (right)

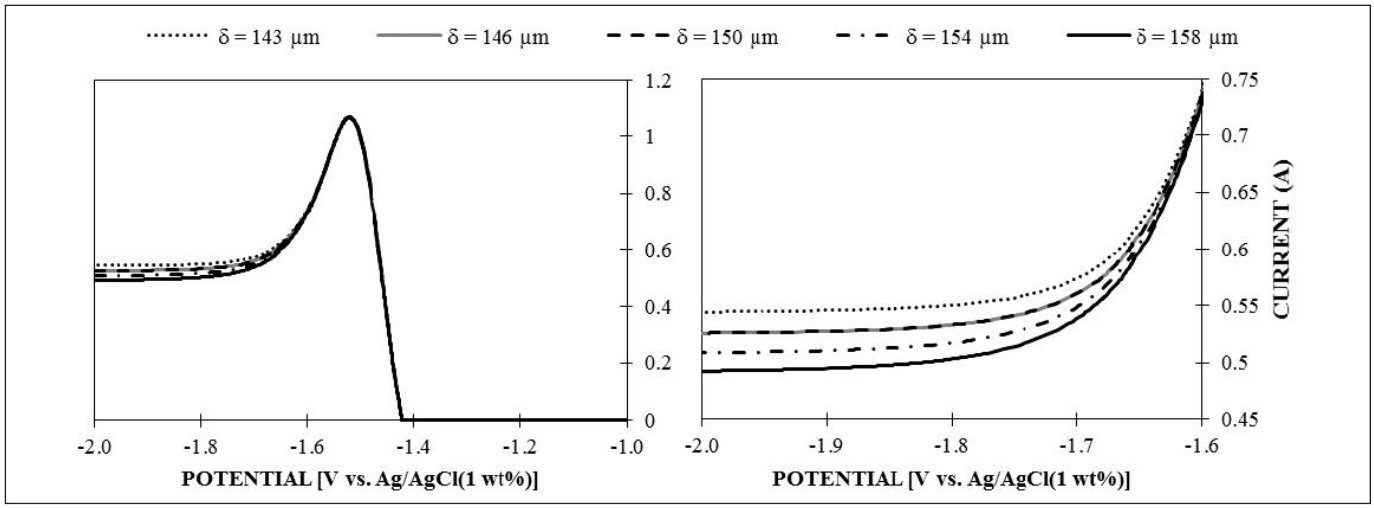


Figure 7. Effect of Δδ and ΔA on predicted U (wt%)

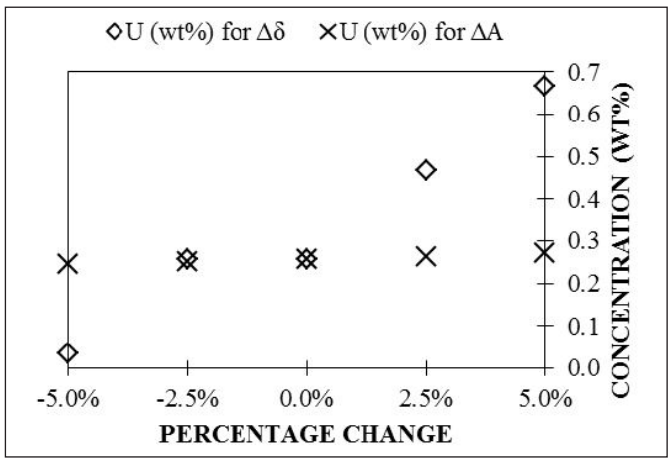
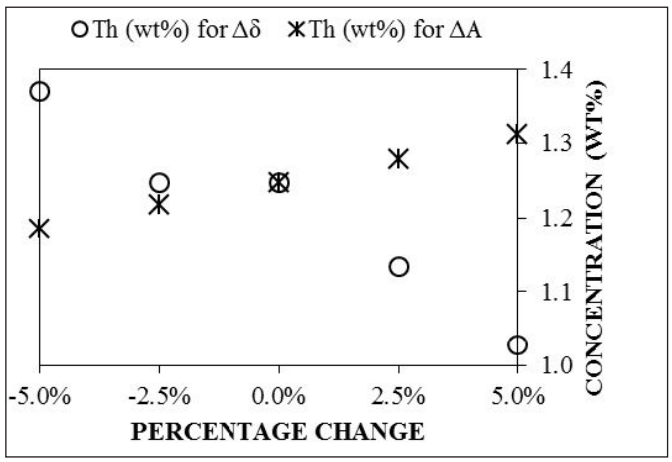


Figure 8. Effect of Δδ and ΔA on predicted Th (wt%)



ing trace amounts of U. Greater accuracy may be achieved in actual fluoride salts because, the apparent standard potentials (*Eo'*) of U and Th in fluorides could have greater separation. For example, at 773 K, according to thermodynamic calculations, the difference in the standard apparent potentials of U and Th (Δ*Eo'*) is 366 mV in FLiBe and preliminary measurements show that Δ*Eo'* = 320 mV in FLiNaK.[9, 20] In this work, Δ*Eo'* = 51 mV (see Table 1). However, this could come at a cost, the greater separation is created by *Eo'* of Th becoming even more negative than the *Eo'* of U, possibly causing the Th reduction peak to overlap with alkali metal reduction. A CV of Th in FLiNaK shows only a shoulder due to the commencement of reduction of one of the alkali metals in the matrix salt.[20] Another issue is that voltammetry is best suited for dilute concentrations (i.e. <10 wt%). As mentioned earlier, Th concentration could be as high as 40 wt%. This could be resolved by diluting the sample with a known amount of matrix salt (e.g. FLiBe). Although, this would make the ability to accurately detect trace amounts of U even more important.

Conclusions

Voltammetry is a candidate method for the online monitoring of the concentrations of U and Th in a MSR. However, LSV simulations of the U and Th reduction peaks in LiCl-KCl showed that the peaks can potentially overlap completely. Thus, traditional peak height analysis could not be used to predict the concentrations. PCR was used to predict the concentrations of U and Th. It was found that PCR provided accurate predictions except at low U concentrations. The prediction of U and Th concentrations in fluoride may be easier due to a greater separation of their standard potentials. However, there may still be complications due to interference from the matrix salt. In either

case, PCR provides a powerful tool that can be used to better capture the variance of the voltammetry signals with changes in the concentrations of U and Th.

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Status of the Implementation of Safeguards by Design in the International Safeguards Regime

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Abstract

In the international safeguards community, Safeguards by Design (SBD) is defined as the consideration of safeguards throughout the lifetime of a facility from preliminary conceptual design to decommissioning. This practice is being promoted by the U.S. Department of Energy's (DOE) National Nuclear Security Agency (NNSA) via its Next Generation Safeguards Initiative (NGSI) with the International Atomic Energy Agency (IAEA), industry, and like-minded collaborators in order to avoid costly and time-consuming redesign work or retrofits of new nuclear facilities and to make the implementation of international safeguards more effective and efficient at such facilities. To support NGSI, the Nonproliferation and National Security Department (NNSD) at Brookhaven National Laboratory has conducted a study to provide a reference that assesses the progress made in furthering the goals of SBD in the United States and other countries. Establishing SBD as a standard practice and giving safeguards the same importance as safety and security in new nuclear facilities is crucial to the future of the nuclear industry and its relationship with the IAEA. Furthermore, understanding the evolution of SBD enables the IAEA and its collaborators to identify key areas of success and improvement and it enables the NNSA to ensure its programs are strengthening international safeguards and nonproliferation efforts. The results of this survey present a great improvement on SBD culture headed by the U.S. and initiatives on behalf of Canada, Finland, Japan, and EURATOM. The NGSI guidelines for SBD have provided the primary SBD framework not only for the U.S. but for the international community, all of whom had expressed the need for written guidelines. Canada, Finland, and Japan have applied SBD to their new facilities and have shared the lessons of their undertakings with the IAEA and the safeguards community; in the case of EURATOM they have provided great technical expertise and solutions to properly implement SBD.

Introduction

The National Nuclear Security Administration (NNSA), part of the U.S. Department of Energy (DOE), began a project through its Next Generation Safeguards Initiative (NGSI) to promote the global practice of Safeguards by Design (SBD). The International Atomic Energy Agency (IAEA) has described SBD as an approach in which "international safeguards are fully integrated into the design process of a new nuclear facility from the initial planning through design, construction, operation, and decommissioning." SBD's two main objectives are to avoid costly and time-consuming redesign work or retrofits of new nuclear fuel cycle facilities and to make the implementation of international safeguards more effective and efficient at such facilities. To support NGSI, the Nonproliferation and National Security Department (NNSD) at Brookhaven National Laboratory has conducted a study to provide a reference that assesses the progress made in furthering the goals of SBD in the United States and other countries. The study has focused on the analysis of SBD efforts and results of all IAEA member state support programs, collaborating labs and state regulatory agencies (SRA) through publications, reports, and published guidelines.

International Safeguards by Design Action Plan

The "Facility Design and Plant Operation Features that Facilitate the Implementation of IAEA Safeguards" workshop was conducted in October 2008 at IAEA Headquarters in Vienna, Austria. Participants from the IAEA, member states, the European Commission and nuclear industry agreed on the need for the IAEA to:

1. Revise the Safeguards Manual to include the SBD initiative. This will formalize the SBD concept.
2. Provide existing IAEA safeguards documentation to the facility designers immediately.

3. Continue efforts to involve all stakeholders in the SBD process in discussions and workshops.
4. Create several expert working groups and task them with defining the SBD process and developing an implementation strategy.
5. Evaluate best practices by reviewing existing procedures and operating experience and identifying safeguards relevant design features.
6. Develop new design guidelines organized by facility type that can be published as part of the IAEA's Nuclear Energy Series.
7. Promote a safeguards culture within the facility design community so that it understands how safeguards are implemented and is motivated to apply the principles of safeguards to the facility design process.
8. Draft the SBD Nuclear Energy Series document.

Based on these suggestions, member states and their respective SRAs began collaborating with the IAEA to help reach its new goals.

United States

The United States initiative to support SBD is composed of a multitude of projects located in various DOE national laboratories, under the auspices of the NNSA. Projects include international technical collaboration with other IAEA member state support programs, such as the European Commission Support Program's (EC-SP) Joint Research Laboratory (JRC), in the creation of a three-dimensional (3D) laser scanning system and gamma-ray imaging systems.

NGSI has developed a series of facility-specific guidance documents for designers, operators and other stakeholders to be used as reference documents and to identify best practices and advanced concepts that satisfy IAEA safeguards requirements, (see table 1).

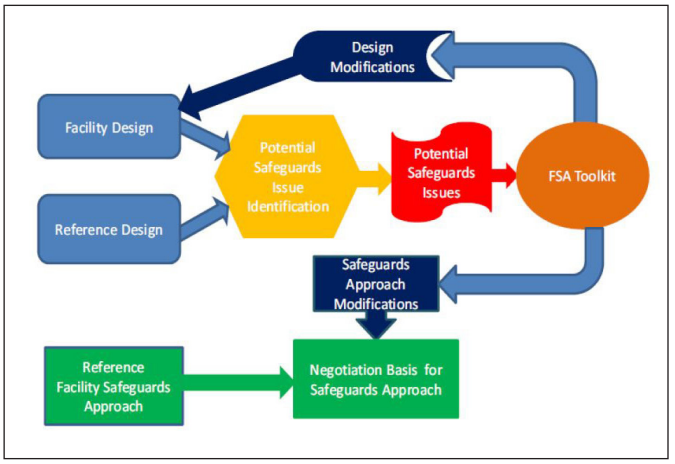
Best practices have been determined from lessons learned in operating facilities and advanced concepts, consisting of innovative instrumentation and novel design features. The preparation of the SBD final guidance documents will benefit from early engagement with industry by providing insight into industry needs. Initial engagement with industry for SBD has already begun by way of the NGSI effort.

An example of the usage and benefits of the NGSI guides is the *Overview of the Facility Safeguardability Analysis (FSA)*, shown in Figure 1. FSA is designed to cost-effectively identify differences between a proposed facility design and the design of a similar facility with an established IAEA safeguards approach. The process identifies potential changes in safeguards tools and measures needed to accommodate the new design. This process could also be used to evaluate the effect of facility design modifications on an existing safeguards approach.

Table 1. NGSI Reference Documents

SBD Guidance for Independent Spent Fuel Storage Installations	NGSI-SBD-001	May 2012
SBD Guidance for Natural Uranium Conversion Plants	NGSI-SBD-002	August 2012
SBD Guidance for Research Reactors and Critical Assemblies	NGSI-SBD-003	Sept. 2012
SBD Guidance for Pebble Fuel High Temperature Gas Reactors	NGSI-SBD-004	August 2012
SBD Guidance for Prismatic Fuelled High Temperature Gas Reactors	NGSI-SBD-005	August 2012
SBD Guidance for Gas Centrifuge Enrichment Plants	NGSI-SBD-006	Sept. 2012
Overview of the Facility Safeguardability Analysis	PNNL-21698	August 2012

Figure 1. FSA Process



An evaluation of the practical applicability of FSA has been conducted by the Pacific Northwest National Laboratory using the NuScale small modular nuclear power plant design. Major findings state that the "infrastructure" functional guidelines appear to provide more flexibility in accommodating evolving safeguards technologies over the lifetime of the facility, and the trial application of FSA demonstrated that the level of effort required to use this process to improve the Safeguardability of new SMR designs is likely to be acceptable to small modular reactor designers. These guides have been published in collaboration with the DOE national laboratories, such as Brookhav-

en National Laboratory, Pacific Northwest National Laboratory, Oak Ridge National Laboratory and Idaho National Laboratory and several consultants.

Canada

In Canada there has been an effort to take safeguards considerations into account early in the design phase, primarily in association with the design and construction of CANDU power reactors. On-load reactors, capable of refueling without shutting down, require installed IAEA safeguards equipment to monitor the continual flow of nuclear material. Since some instrumentation is located inside the radiological containment envelope, it is of utmost importance to have accurate plant layout requirements identified early in the process to ensure that appropriate design "space" is allocated for critical safeguards installations.

The CANDU safeguards system consists of installed IAEA technology for surveillance and item accountancy verification, reviewed either through IAEA inspections or through remote monitoring supplemented by unannounced inspections. The remotely operated and highly automated fuel handling process in CANDU reactors makes automated monitoring of individual fuel bundle movement a highly reliable and straightforward exercise. It is possible to track every CANDU fuel bundle throughout its life cycle, and detect with high probability any undeclared irradiation and movement of fuel bundles.

Without the presence of CANDU safeguards equipment the verification process done by the IAEA would require significantly more effort on behalf of the inspectors, resulting in higher costs, more resources and a longer presence in the facility. This can hinder the production and the day to day normal operation of the plant, resulting in loss of work hours, which in the long run will represent a much higher cost compared to the initial cost of implementing SBD.

SBD has also been introduced into smaller projects such as the Darlington Waste Management Facility where the implications of even the most fundamental design aspects, such as physical spacing between Dry Storage Containers (DSC) in the storage building, were discussed with the goal of identifying potential impediments to safeguards implementation and material verification. Using this simple example of DSC spacing, the benefit of early examination of safeguards considerations can be illustrated. Had the proposed design clearances between containers been too restrictive to allow random access by IAEA inspectors for safeguards work from an elevated platform, a design modification may have been necessary or significant resources deployed during inspections to move rows of DSCs.

Table 2. Common IAEA Safeguards Equipment for CANDU facility.

Safeguards Device	Location	Description
Core Discharge Monitor (CDM)	Reactor vault	A combination of neutron and gamma radiation detectors in the reactor vault is used to count irradiated fuel discharges from both reactor faces.
Spent Fuel Bundle Counter (SFBC)	Irradiated fuel discharge path from vault to bay	A set of radiation detectors is used to count irradiated fuel bundles as they are transferred through the irradiated fuel discharge port in the vault to the spent fuel bay.
Closed Circuit Television (CCTV) Surveillance System	Spent Fuel Bay and some vault penetrations	Video cameras monitor for undeclared fuel movements. All CANDU facilities have cameras in the spent fuel bays. Cameras may also be located in other locations to monitor for undeclared removal of irradiated fuel.
AECL Random Coil (ARC)	Sealing System Spent Fuel Bays	Irradiated fuel is stored in tamper-indicating enclosures with a lid fastened using IAEA-approved ARC seals to ensure that bundles are not removed.
Yes/No Radiation Monitors	Fresh Fuel Port, Auxiliary Port, two pipes in spent fuel bay.	Radiation detectors are used to detect discharge of irradiated fuel through vault penetrations other than the irradiated fuel discharge port; specifically, the fresh fuel port and the auxiliary port.
Spent Fuel Verifier	Spent Fuel Bays (only where ARC Sealing is not used)	A collimated gamma spectrometer is lowered into the spent fuel bay to verify the authenticity of spent fuel during IAEA inspections. This instrument is used at some stations that do not use the ARC Sealing System.
Cerenkov Viewing Device	Spent Fuel Bays (only where ARC Sealing is not used)	The CVD is used to verify the authenticity of spent fuel stored under water by amplifying the faint Cerenkov glow and making it visible to the inspector

Japan

Japan has been an avid supporter of SBD since the 1980s when the decision to construct the Rokkasho Reprocessing Plant (RRP) was made. RRP's throughput quantities far exceeded the reprocessing experience of the IAEA, having only dealt with two commercial reprocessing plants in the world:

the Tokai Reprocessing Plant in Tokai, Japan, and the Wiederaufarbeitungsanlage Karlsruhe facility in Germany. In an effort to mitigate the international concerns about the IAEA's capability, Japan funded a forum of experts to help the IAEA meet the challenges of SBD. This collaboration led to the initial understanding of the importance of early communication in the design stage. The challenges posed by RRP resulted in the need for newer technology for design verification, control and accountancy, measuring, process monitoring and authentication among others. All of which were addressed by various parts of the international community such as the U.S. laboratories and the JRC at Ispra, Italy.

An example of the challenges includes the desire for the facility's safeguards office to have real time access to operating and accounting data. This requires on-line measurement systems, continuous data transmission, and real-time calculations and reporting to the state authority and the IAEA. The design of the MC&A system must be considered in the early design of the facility and must be coordinated with the plant operations design and the requirements of the state authority and the IAEA. The three systems—operator, state and IAEA—must work as integrated, but independent, systems. This is a costly and frustrating experience, with less than optimal results, when the data handling systems are designed after the plant is almost built.

Finland

Finland's SBD initiative presents a very diverse experience due to the multiple construction projects at the Olkiluoto site including a new geological repository, a third power unit and the enlargement of the spent fuel storage pool.

The long-term preparation for construction of the geological repository introduced the problems related to the national legal framework and bureaucratic obstacles in preparation of official documents before the licensing phase, thus delaying and complicating the SBD process. The construction of the new power reactor shows that the confidentiality requirements between the design offices, construction companies and owner of the facility can delay the submission of the official Design Information Questionnaire during the licensing phase. In contrast to these new facilities, the enlargement of the existing spent fuel storage building at the site follows good practices, i.e., the early information about the safeguards system requirements, resulting in the much needed improved communication between the IAEA, State authority, and the designer.

For the enlargement, the number of new entrance routes to the storage building is minimized, and the existing IAEA and European Commission surveillance and sealing systems will cover both the existing and enlarged part of the storage. Minimal adjustments will be needed to maintain the continuity of knowledge. This adjusted safeguards system covers both additional security and safeguards requirements arising from the expansion.

European Commission

The European Union's European Atomic Energy Community (EURATOM) initiative is also very diverse due to its support via the JRC and the lessons learned from its reprocessing plants.

On April 20, 2005, the operator of the commercial Thermal Oxide Reprocessing Plant (THORP) in Sellafield, United Kingdom, became fully aware of an extensive leak and spill of spent fuel dissolver solution in the Feed Clarification Cell, Cell-220. The leak not only represented a mechanical failure at the Head-end Accountancy Tank-B (HEAT-B), but also a major plant operations and nuclear safeguards oversight. Detection of these failures was delayed due to inadequate monitoring arrangements, operational complacency, poor maintenance, and slow resolution of material accountancy by the THORP and EURATOM safeguards groups. The design of the "dark" cells, where the tanks were placed, did not anticipate the routine use of video surveillance. Since this was very effective in determining the extent of damage in the Feed Clarification Cell, the routine use of such surveillance should be considered more in the future, and had SBD been considered at the time of construction of THORP this could have been addressed. Other lessons include wider use of a high precision Solution Monitoring System, such as is used at the Rokkasho Reprocessing Plant in Japan and more extensive process sampling or on-line analysis.

The Joint Research Center (JRC) has three institutes with an active work programs in the field of Nuclear Safeguards that actively collaborate with the IAEA, however, the main laboratory for research on SBD related technology is the Institute for the Protection and Security of the Citizen (IPSC) in Ispra, Italy. The IPSC developed a 3D laser based tool (3DLR)[1] for Design Information Verification purposes currently being used by the IAEA at various facilities. An example of another SBD related technology developed by JRC aimed to aid in the safeguarding of reprocessing plants is Near Real-Time Nuclear Material Accounting (NRTMA) which has been used since the 1980s. THORP utilizes NRTMA for monitoring transfers of solutions

between large vessels. However as was learned in the analysis of the THORP leak, the fissile material quantity is not accurately known in the Head-end process. To aid in furthering and expanding the use of NRTMA, the JRC is developing software for reprocessing solution monitoring, data analysis, and interpretation, to be tested at the AREVA reprocessing plants at La Hague in France.

Multinational Industry Efforts

International efforts to advance SBD include the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), and Generation IV International Forum (GIF). Their methodology allows a user to systematically compare the relative proliferation potential associated with various nuclear processes and facilities. Such efforts can also be used as a mechanism to help communicate some of the assumptions and results of a proliferation assessment at facility level to the designers of a nuclear facility as well as make diversion or misuse more technically difficult and easier to detect.

Conclusion

Establishing SBD as a standard practice and giving safeguards the same importance as safety and security in new nuclear facilities is crucial to the future of the nuclear industry and its relationship with the IAEA. SBD's two main objectives are to avoid costly and time-consuming redesign work or retrofits of new nuclear fuel cycle facilities and to make the implementation of international safeguards more effective and efficient at such facilities. SBD has progressed throughout the years and its prolific results demonstrate the need for the SBD process to be integrated into the existing regulatory framework that addresses nuclear safety and security. This has been shown through the efforts to research and implement SBD by the United States' NNSA and its various programs, Canada in its CANDU reactor and its waste management site, Japan at its Rokkasho Reprocessing Plant, Finland on lessons learned from the Olkiluoto site, the European Commission's safeguards research via JRC and the lessons and implementations of THORP, and lastly the international support efforts of INPRO and GIF. The NGSI guidelines for SBD have provided the primary SBD framework not only for the U.S. but for the international community. It is only through global communication of lessons learned, best practices, advanced concepts and IAEA safeguards requirements that the SBD culture can become the international norm.

Acknowledgements

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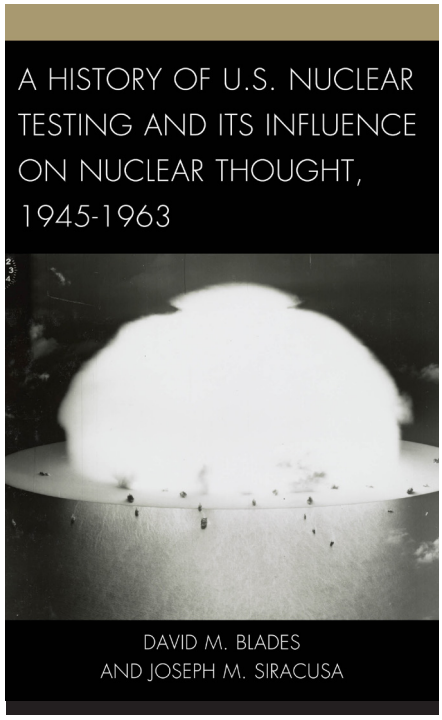
Book Review

By Mark L. Maiello,
Book Review Editor

A History of U.S. Nuclear Testing and Its Influence on Nuclear Thought, 1945–1963

David M. Blades and
Joseph M. Siracusa
Hardcover, 230 pages in two volumes,
ISBN 978-1-4422-3200-6
Rowman and Littlefield, 2014



It would seem obvious why the United States performed several decades of nuclear testing but until reading this book, how the testing itself changed American thinking on nuclear weapons may not have been as clear. The dynamic interplay of politics and science brought constant change that ultimately made nuclear testing, at first a normal choice for nuclear security, into an illegitimate option. How each nuclear test series influenced this transformation away from the "normalcy" of testing is the goal of the authors, both of whom are from Australian centers of learning.

Though the research is thorough and the story of the influence nuclear testing had on the political and societal dynamic of the U.S. is compelling, the conclusions presented here are not earth shattering. The value of the book lies partly with the story it tells but also with the perspective it brings from scholars outside the U.S. It is well written by its primary author with hints of influence from the more famous American ex-patriot co-author, Joseph Siracusa.

The story behind twenty test series and their respective families of 317 nuclear shots is clearly elucidated here. The authors explain that for the most part, there were sound technical reasons for each of the shots that were carried forth in a natural progression motivated by science and influenced (not always) by the changing ideas concerning the legitimacy of these weapons. At the start, nuclear weapons held great legitimacy. Testing was politically acceptable and motivated by technical and defense concerns. Tests were categorized and ranged from those broadly defined as "radiation effects shots" such as those conducted at high altitude, to "human effects shots" involving military operations conducted post-explosion in or near the blast area. Nuclear tests were designed that ultimately determined the size of the U.S. arsenal and allowed the military to miniaturize its atomic weapons for tactical battlefield use. Even the nascent space program benefited from nuclear testing. But, perhaps the best example of how nuclear testing changed the thinking behind the very idea of testing is that of radioactive fallout and its effects. Indeed, the Castle Bravo shot which resulted in the radiation exposure of the crew of the Japanese fishing vessel *Lucky Dragon*, revealed the inadequacy of meteorological prediction and that radiation's deadly effects could be far flung. The authors peel away the onion of influences and changes to the U.S. test program in a paced, methodical approach. This is a revealing assessment if a bit anticlimactic. However, human history does not set out to entertain. It is not scripted for historians to turn into best sellers. It is what it is.

An excellent job is done organizing the narrative of nuclear test operations by presidential administration. Thus cataloged, the reader can clearly ascertain the influence of the personalities that headed the Atomic Energy Commission and the other interested governmental parties that sought the necessary presidential authorizations to conduct testing. The Truman era shots represent the development stage of nuclear weapons leading from uranium-based implosion devices to fusion mode thermonuclear weapons. Later, the Eisenhower administration saw miniaturization and varied deployment to multiple battlefield and submarine platforms. Finally, the Kennedy administration saw the perfection of

underground nuclear detonations, their detection and the somewhat haphazard response to Moscow's resumption of testing after the voluntary test moratorium of 1958. The result of the Kennedy era testing was the achievement of the Limited Test Ban Treaty (LTBT).

The U.S. response to the Soviet resumption of testing is perhaps, one of the more fascinating sections of the book. Here, unlike other sections where technical issues dominate the motivations for further nuclear testing, we find politics and national pride taking center stage with the result that testing was carried forth purely to sway world opinion. *Sputnik* had the world convinced of Soviet technical superiority. The U.S. thoroughly shaken by its own space program failures, compulsively launched into a poorly planned, politically motivated testing program largely conducted to regain its stature. If that thought puts fear into your heart, then the book serves yet another useful (and moral) purpose. Beyond its value as a chronicle of testing and the subsequent consequences, it announces—rather quietly as do most scholarly works—that political restraint can be easily subsumed by the fear of existential threat (or minimally, by damaged national pride). However, that would be a flawed, narrow view. As the authors point out, the resumption of testing in 1961 to 1963 and its simultaneity with the Cuban Missile Crisis lead to a more durable agreement: the LTBT. And there, by providing such historical clarity, the book scores a high grade.

Is such an analysis worthy of a read? Clearly, those interested in the history of the nuclear testing era will find valuable information here. Well-constructed and well-written, the book will not bore. There is however a tinge of pedestrianism here. Some of the conclusions will seem obvious. The Truman era legitimacy of nuclear testing as the new technology was explored in the face of the perceived Soviet menace; the Eisenhower expansion as the technology matured and the arms race was on; and the pull back in the Kennedy era hastened by environmental concerns, the Cuban Missile Crisis, and ultimately by international treaty—all seem to be part of a logical progression obviating the need for an in-depth study. But, the authors contend that illumination was needed and a curious reader will not be disappointed.

The authors call upon the work of political scientists Scott D. Sagan (Stanford University) and Nina Tannenwald (Brown) who both have written on the manner in which states come to legitimize certain behaviors. The "domestic politics model' of Sagan is, thankfully for the casual reader, very briefly discussed in Chapter 4 and lightly applied in subsequent discussions to the behavior of nuclear testing. Thus, the story about the evolution in thinking regarding the defensive need and legitimacy of testing is in no way obscured by this political analysis. Instead, the story unfolds logically and sometimes dramatically as military men, politicians, scientists and anti-testing forces tried to sway the nation's nuclear testing future.

In 230 pages, the authors have scripted a concise, neatly written and well referenced story (the book is referenced by chapter and supplemented with a seven-page bibliography and ten-page index). Lest you think that road they traveled is too narrow or uninteresting consider that they skillfully and accurately framed their narrative with a reference to nuclear weapons development ascribed to Lewis Strauss, chair of the Atomic Energy Commission: He called it "this awesome field." Indeed it is. Perhaps it is too big for most of us to fully grasp in a professional lifetime. This book is a very good starting point for those brave, scholarly, and ambitious enough to try.

Suggest a Book

Is there a book you would like to see reviewed in *JNMM*? Send the book title and author name to psullivan@inmm.org. Books must have been published no earlier than 2012 to be considered.

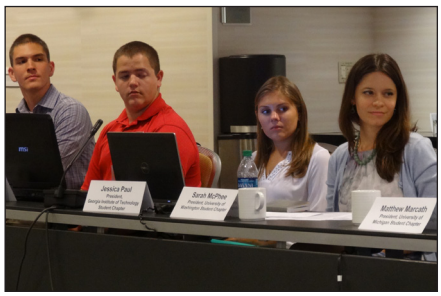
Taking the Long View in a Time of Great Uncertainty

Turning the Corner

By Jack Jekowski
Taking the Long View Editor and Chair of the INMM Strategic Planning Committee

September 11, 2014

In many ways, this year's successful Annual Meeting (the 55th!) gave hope that the Institute has "turned the corner" with respect to many of the challenges it has faced in recent years. Among the indicators of this turnaround were improved attendance at this year's event in Atlanta, with participants from thirty-two countries; more than 400 papers in more than sixty technical sessions; and a record-setting attendance by students and student presenters (more than fifty student papers were judged this year for the J. D. Williams Student Paper Award competition). These positive signs have not happened overnight or by accident, but rather, they represent strategic actions and on-going efforts of Institute leadership, INMM Headquarters, and the membership to promote the importance of the Institute's mission, enhance collaborations with other organizations and governmental entities, and seek support for the Annual Meeting wherever their spheres of influence reside. Efforts continue by the Executive Committee (EC), seen here in their all-day Saturday session at the Annual Meeting, to enhance these strategies to elevate the visibility of the Institute, and to make the Annual Meeting an extraordinary experience for its members. Of note, this year's EC meeting had representatives from almost all of the Institute's fifteen student chapters (four shown in Figure 2.)—all of whom actively participated in the discussions during the meeting.



The enthusiasm and interest shown by the students this year was contagious as they engaged in hallway discussions and asked question in the technical sessions as well, picking up the "gauntlet" thrown down by the Institute to ensure the legacy of nuclear materials management is sustained.[1]

Partnership for Nuclear Security Opens Doors for International Students

The positive turnaround was exemplified by the presence of The Partnership for Nuclear Security (PNS)[2] personnel from the Department of State and CDRF Global. PNS seeks to promote a self-sufficient nuclear security culture, ingrained in partner countries' nuclear technical organizations by encouraging responsible science and nuclear security-related best practices. PNS has partnered with INMM on a number of projects in order to establish sustainable linkages between nuclear technical professionals and their counterparts at U.S. and international institutions. PNS supported efforts at INMM to build nuclear security in PNS partner countries by bringing more than seventy experts to the 2014 Annual Meeting. The experts included representatives from student and national INMM chapters in India, Indonesia, Jordan, Morocco, Nigeria, and South Africa who shared their strategies for promoting nuclear security culture and the safe and secure management of nuclear materials in a series of side meetings convened by PNS, and through technical papers delivered at the conference.

The delegation of attendees included participants from three PNS-sponsored projects:

- Graduates from the Texas A&M University (TAMU) Nuclear Security Certificate Program
- Students from the Indian Nuclear Security Training Series (NSTS)
- Officers from various PNS partner INMM national and student chapters

The meetings facilitated by PNS during the Annual Meeting allowed attendees to build relationships with international nuclear security experts and enhance the capabilities of their INMM chapters to promote nuclear security best practices. This included a Sunday workshop (shown in photo), prior to the start of the Annual Meeting, on chapter sustainability planning, where INMM chapters from PNS partner countries and members of the Executive Committee worked on chapter sustainability ideas and discussed best practices for promoting nuclear security culture through INMM chapters. A special panel comprised of Amanda Sayre, student liaison, Willem Janssens, chapter Relations Committee chair, and Jack Jekowski, chair of the Strategic Planning Committee, provided insight into the activities of the Institute. Other members of the Executive Committee in attendance discussed resources available to international INMM chapters, and identified avenues for chapters to develop closer links to the nuclear security community. Each of the PNS-sponsored chapters presented on current and future efforts to promote nuclear security culture and drafted INMM chapter sustainability action plans. PNS also announced the launch of the INMM Chapter Nuclear Security Activity Grant[3] Competition. This competition will provide INMM chapters in PNS partner countries with support grants to implement nuclear security activities in their home countries. During the week, PNS also hosted a technical paper session on nuclear security best practices and concepts of nuclear security culture.

Three newly founded INMM chapters were commemorated during the meeting by PNS:

- Pandit Deendayal Petroleum University (PDPU) INMM Student Chapter
- South Africa INMM National Chapter
- Ibn Tofail University INMM Student Chapter

In addition to these three new chapters, PNS also honored representatives of the Gadjah Mada University INMM Student Chapter, whose application was pending vote by the INMM Executive Committee at the time of the reception.

PNS also announced the launch of the Nuclear Security Multimedia Competition, an open competition to promote nuclear security culture and best practices among educational institutions, nuclear facilities and research laboratories through illustrations, posters, infographics, videos, mobile applications and games.[4] Winners will receive a guest lecture from a nuclear security subject matter expert at their institution or textbooks, training tools or a remote lecture from an international expert.

Other Student Activities

The Texas A&M students also drew crowds this year in the poster session where they provided a preview of a Non-Destructive Assay (NDA) training video that was developed for NA-70 to help acquaint non-technical personnel with the important mission of that discipline at Department of Energy (DOE) National Nuclear Security Administration (NNSA) sites. The entertaining eight-minute, professionally edited, video has subsequently been posted on an NNSA YouTube site for viewing.[5] If there is successful feedback from this initiative we may see more educational resources like this made available through our student chapters. This year Amanda Sayre stood in for Steve Ward to help guide the students through their time at the Annual Meeting, and also worked with the J.D. Williams Student Paper Award Committee, led by Jim Andre from Pacific Northwest National Laboratory, standing in for Glenda Ackerman. Amanda did a remarkable job of gathering feedback from the students that will be helpful in future years as we continue to adjust our strategies for the Annual Meeting to make it a highly desirable event for a growingly diverse membership. Also, the Student Activities Committee has "institutionalized" the T-shirt booth near the registration desk—and any student chapter now, within the rules set up by the Committee, can raise money for their chapter through the use of this resource. Texas A&M was the early innovator so far in this new venture, but we are excited to see other chapters beginning to use their imagination in this endeavor to raise funds for their chapters. New research in the area of networking and making large conferences more amenable to engaging strategic conversations will be the topic of a future column, as INMM Fellow Paul Ebel works with the Strategic Planning Committee to develop new strategies to better engage the new generation now inheriting the mission of the Institute.[1]

As the World Holds its Breath

Previously, we have attempted in this column to identify many of the global "externalities" that impact the mission of the Institute, from the efforts by the Obama Administration to muster world-

wide support for reducing the threat posed by unsecured nuclear materials to the growing unrest and challenges posed by crises from Africa to the Far East and now to Russia. This year, 2014, seems to have become a seminal year for such crises as the world continues to deal with an economic downturn and hostilities that touch virtually every nation. Although technology advances at an ever-increasing pace, the fleeting promises for a bright new millennium, characterized in Peter Schwartz's Wired Magazine article of 1997, entitled the "Long Boom"[6], have long since faded, as the realities of a conflicted world emerge. It is through the international dialogues and collaborations that we witnessed at this year's Annual Meeting that we might hope to see a turnaround toward a safer and saner world, but in the interim we all have a long road ahead of us to do what we can in our spheres of influence to help guide the next generation into this challenging world they are inheriting.

This column is intended to serve as a forum to present and discuss current strategic issues impacting the Institute of Nuclear Materials Management in the furtherance of its mission. The views expressed by the author are not necessarily endorsed by the Institute, but are intended to stimulate and encourage *JNMM* readers to actively participate in strategic discussions. Please provide your thoughts and ideas to the Institute's leadership on these and other issues of importance. With your feedback we hope to create an environment of open dialogue, addressing the critical uncertainties that lie ahead for the world, and identify the possible paths to the future based on those uncertainties that can be influenced by the Institute. Jack Jekowski can be contacted at jpjekowski@aol.com.

Endnotes

1. See "*Throwing Down the Gauntlet to the Next Generation of Nuclear Stewards – the Enduring Nuclear Legacy" Journal of Nuclear Materials Management,* Volume 42, No. 4, pp. 86-89.
2. See http://www.pns-state.net/en-us/ for information on the program and http://www.pns-state.net/en-us/news/103-2014-inmm-annual-meeting.html for details of the PNS activities during the Annual meeting.
3. See http://www.pns-state.net/en-us/inmm-chapter-nuclear-security-grants.html.
4. See http://www.pns-state.net/en-us/nuclear-security-multimedia-competition.
5. See https://www.youtube.com/watch?v=SbYIn9aaOjk&feature=youtu.be.
6. See http://archive.wired.com/wired/archive/5.07/longboom.html.

Calendar

January 12–14, 2015
INMM 30th Spent Fuel Seminar
Crystal Gateway Marriott Hotel
Arlington, Virginia US A

March 17–18, 2015
INMM Reducing the Risk Workshop
George Washington University
Elliot School of International Affairs
Washington, DC USA

July 12–16, 2015
INMM 56th Annual Meeting
Renaissance Esmeralda
Indian Wells, California USA

September 14–16, 2015
INMM VA Tools Workshop
Renaissance Boston
Waterfront Hotel
Boston, Massachusetts USA

October 4–7, 2015
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Jackson Lake Lodge
Grand Teton National Park
Moran, Wyoming USA

September 11–16, 2016
PATRAM 2016
Kobe Portopia Hotel
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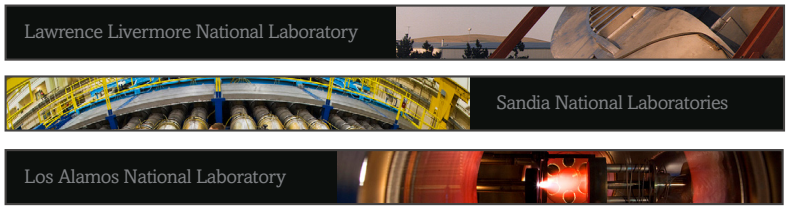

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