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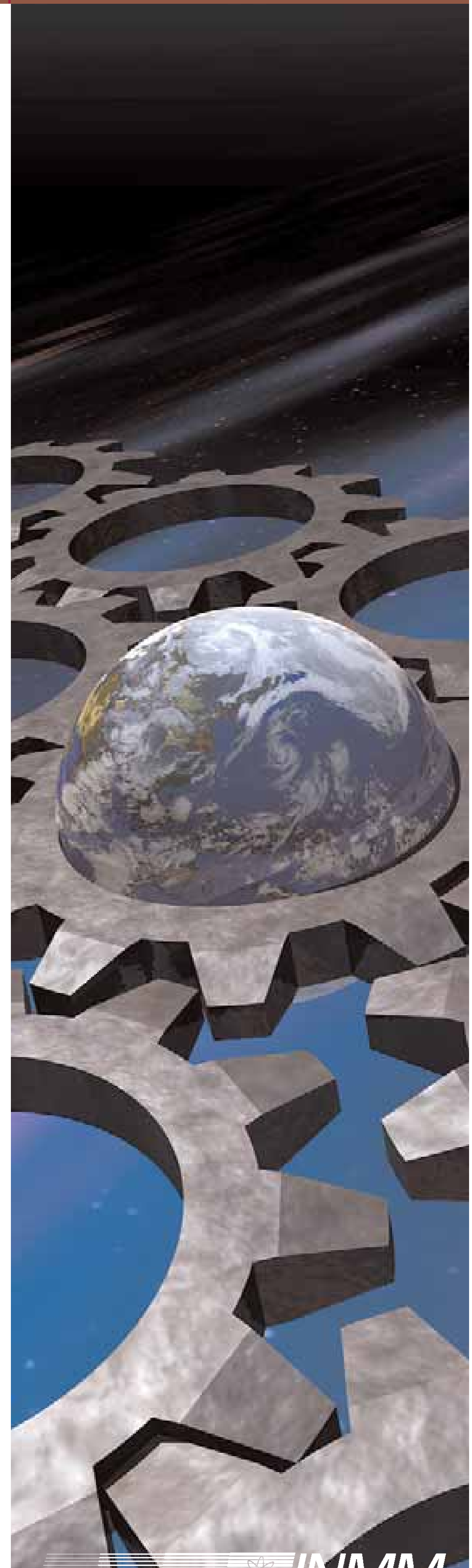

INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT INMM
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INMM
INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT

Volunteers Make INMM Strong

By Nancy Jo Nicholas
INMM President

A global renaissance in the nuclear power industry already has led to expansions in nuclear engineering and research programs in developed and developing nations. At the same time, threats of nuclear proliferation and nuclear terrorism have kept pace with the growth and increased visibility of nuclear energy. As a professional society, the Institute of Nuclear Materials Management provides a global forum to explore and understand challenges to nuclear materials management in this changing environment. The INMM continues to grow and attract the next generation of nuclear materials management experts who can meet these challenges. An important sign of this is the expansion of INMM student activities and chapters. Chapters at Texas A&M University, at Mercyhurst College and the University of Missouri are active, and another university is in the process of establishing a student chapter. I'm extremely pleased to see the growing student participation in our annual meetings, regional chapter activities and workshops. This winter, INMM will be co-organizing the American Nuclear Society Annual Student Conference to be held at Texas A&M University.

Successful Annual Meeting

The 48th INMM Annual Meeting in Tucson, Arizona, was a tremendous success, drawing nearly 800 attendees and guests. During the opening plenary, we learned about the Global Nuclear Energy Partnership vision, strategy and technology development plan from Paul Lisowski, the deputy assistant secretary for Fuel Cycle Management in the DOE Office of Nuclear Energy. Adam Scheinman of DOE/NNSA's office of Nonproliferation and International Security outlined the nonproliferation goals of GNEP during the closing plenary. Also in the closing plenary, former INMM president Jim Tape discussed the current plan for a World Institute of Nuclear Security, or WINS, to address INMM's expanding role in sharing global best practices in nuclear safeguards and security. We also commemorated the IAEA's fifty years of dedicated service to the goal of Atoms for Peace in several ways. At the International Safeguards Technical Division's meeting, many INMM members reflected on their personal experiences with IAEA. All the INMM technical divisions enjoyed cake provided by Canberra Industries/Canberra Aquila and short ceremony led by Jim Larrimore, Jacque Baute, and me that marked the agency's milestone and celebrated the decades of cooperation between the IAEA and INMM. On Monday I had the pleasure of chairing a special session that provided a retrospective of IAEA safeguards, which also was the topic of our most recent issue of the *JNMM*.)

The outstanding technical program of this year's annual meeting included a total of 303 papers and posters presented. The quality of this program directly reflected the contributions to the field by INMM members and meeting participants, as well as the dedication of the volunteers who support Charles Pietri on the Technical Program Committee. I also want to recognize the contributions of the Registration Committee, chaired by D.L. Whaley; the Exhibits Committee, chaired by Cathy Key; and the Poster Session, chaired by Taner Uckan. We had a number of high-quality student papers and posters this year, thanks to a crop of enthusiastic INNM students and to the diligent work of Yvonne Ferris, Cary Crawford, and the members of the Memorial Education and Outreach Committee in judging these student papers and posters. B. R. Grogan and S. D. Clarke won the J. D. Williams Student Paper Awards. Their papers can be found beginning on page 27.

Opportunities for INMM Members to Get Involved

INMM is a volunteer-driven professional society and today the mission of INMM is more relevant than ever. We are fortunate to have many dedicated and active members, and there are plenty of opportunities for interested members to get more involved. I encourage members to participate in regional chapter activities such as technical workshops and seminars. A number of INMM committees could use some enthusiastic volunteers. The Student Activities Committee and Communication Committee both are actively engaged in raising the profile of INMM.

The preparation for and celebration of INMM's 50th anniversary provides a unique opportunity to get more involved in the Institute. We will kick-off our anniversary celebration next May as we commemorate the founding of the INMM on May 17, 1958. Long-time INMM member Ed Johnson is leading an ad hoc committee that's planning a year-long celebration of our 50th anniversary. Our 50th Annual INMM Meeting will take place in July 2009 at the JW Marriott Starr Pass Resort in Tuscon, Arizona.

If you have comments, ideas or questions about INMM, I encourage you to e-mail me. My e-mail address at work is njnicholas@lanl.gov or you can send e-mail to my personal e-mail address: n.j.nicholas@earthlink.net or contact INMM headquarters at inmm@inmm.org.

The Flavor of INMM

By Dennis Mangan
Technical Editor

I always enjoy the fall issue of our Journal. Its focus is on our major event of the year – the INMM Annual Meeting—and somehow the personalities of our membership and others who attend the annual meeting seem to shine. Charles Pietri does his usual excellent summary of the meeting, and the Roundtable discussion that the JNMM associate editors and officers of the Institute and a few select others had with Plenary Speaker Paul Lisowski, the U.S. Department of Energy's Deputy Assistant Secretary for Fuel Cycle Management, is also very informative. Lisowski's plenary speech focused on the Global Nuclear Energy Partnership (GNEP) Goals, Implementation and Recent Progress (which unfortunately is not published in this issue). As you read the Roundtable discussion, I believe you'll agree that Lisowski fielded some tough questions and did an exceptional job in responding. We owe our thanks to Lisowski for his contributions to the Annual Meeting.

The Closing Plenary Session of our meeting featured two distinguished speakers, Jim Tape (a retiree from Los Alamos National Laboratory (LANL), a past INMM president, and now a consultant) and Adam Scheinman (the assistant deputy administrator for nonproliferation and international security for the U.S. Department of Energy's National Nuclear Security Administration) Government Industry Liaison Committee ChairAmy Whitworth provides an excellent summary of Tape's presentation on the World Institute of Nuclear Security, and Scheiman's discussion about the GNEP nonproliferation efforts.

This issue also begins to address our age. The message from our president Nancy Jo Nicholas notes that we are preparing for our 50th anniversary of the Institute. Our celebration will begin with our next Annual Meeting in Nashville in 2008 and will end with our 2009 meeting in Tucson. Also in this issue, in celebration of its thirtieth anniversary, is an interesting summary of the activities of our first INMM chapter, the Japan Chapter, provided by Kaoru Naito, the current vice president of the chapter, and Ted Osabe, the chapter secretary. As an aside, I'd like to note that this year the International Atomic Energy Agency (IAEA) celebrated its fiftieth year, and LANL celebrated its fortieth year in safeguards.

Included also in the issue are the two student papers that won the first and second J. D. Williams Student Paper Awards at our Annual Meeting.: MCNP-PoliMi Simulation of Neutron Radiography Measurements for Mass Determination for a Trough of UO3 by B. R. Grogqn and associates; and Multiplicity Analysis During Photon Interrogation of Fissionable Material by S. D. Clarke and associates. These are impressive papers and reflect the Institute's interest in encouraging student participation.

This issue contains the first "letter to the editor" that I can recall. Maybe it will be the breaking of a new era?

Finally, did you know that DOE's former Rocky Flats weapons production site will be a national wildlife refuge, that DOE will award up to $340,000 in fellowships to eight graduate students to advance research in the nuclear fuel cycle, and that there is a new symbol launched by the IAEA to warn the public about radiation dangers?

Should you have any questions or comments please feel free to contact me.

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

Report of the 48th INMM Annual Meeting: Is This All There Is?

by Charles Pietri
Chair, Technical Program Committee

At the 48th INMM Annual Meeting held July 8-12, 2007, at the JW Marriott Starr Pass Resort in Tucson, Arizona, we found that the weather was not that hot; the hotel, although somewhat isolated from other activities, was superb; and the papers were just as good, if not better in some instances, than at previous meetings. Total attendance was normal (844) including companions. There were 303 papers presented including twenty-two posters, and fourteen student papers; there were thirty-three student attendees. An interesting note: the 303 papers were presented by 264 people—we'll explain later. The meeting evaluation (our Report Card) from the electronic surveys, Session Chair reports, and verbal comments at the meeting were of the usual variety, many complimentary, a few critical, and several with positive suggestions for future meetings. Even the number of final papers submitted on time for the *Proceedings of the INMM Annual Meeting* showed significant improvement. (We'll walk through some of the comments later on.) So, have we reached a plateau—or is there still more to do to improve our Annual Meeting to make it more attractive, enjoyable, and informative to the nuclear materials management community? Are we so satisfied that we can't show some enhancements for INMM's 50th Anniversary Celebration Year starting in 2008? Is this all there is? (Read on—we may have an answer for you.)

It's not that we had a *perfect* meeting but that we had a generally *uneventful* operation or were able to make accommodations on site when difficulties arose—many of which were not even evident to our attendees. It was almost like flying these days—one hopes for a great but uneventful flight. One of our most important changes was the Plenary Speaker. Once again we were disappointed that Dennis Spurgeon, Acting Under Secretary of Energy, U. S. Department of Energy (DOE), was not able to be at the meeting because of other last minute events requiring his presence. However, INMM was fortunate to have Spurgeon's Deputy Assistant Secretary for Fuel Cycle Management, Paul Lisowski from the Office of Nuclear Energy at DOE present a most informative paper entitled "Global Nuclear Energy Partnership (GNEP), Goals, Implementation, and Recent Progress." It was evident to all that he thoroughly understood the meaning and impact of GNEP that focused on the need to establish an international framework for expanding nuclear power taking into consideration all concerns especially for waste disposal and weapons nonproliferation. The latter two issues may be the major perceived impediments to public acceptance of the urgent need for a revival of nuclear energy to meet the ever increasing needs for global energy.

Paul Lisowski, DOE Deputy Assistant Secretary for Fuel Cycle Management

As is our custom, an interview with Paul Lisowski was conducted after the Plenary Session at the INMM Roundtable by *Journal* Technical Editor Dennis Mangan. Some piercing questions were posed by the attendees and some very reasonable, realistic, and forthright responses were given by Lisowski. You can read about them in the Roundtable Interview that is located elsewhere in this *Journal*.

As I stated previously, there seemed to be no *major* concerns at this meeting after resolving the Opening Plenary speaker.

Mangan asks "Pietri, is there a question here?" (read the interview)

There were less than usual overall paper withdrawals (thirty-four) and especially during the actual meeting (five) but we had more than expected speaker changes (forty) and several unexpected "no shows" who never contacted INMM that they would not be presenting their paper. The latter issue severely disturbs all of us but especially our Session Chairs many of whom take pride in a well-orchestrated session. In fact, it makes INMM feel that we should not invite these people to present papers in the future if we cannot rely on them. Some of the meeting speaker changes were caused by several overseas speakers who could not get their visas in time to attend the meeting and present their papers. On the bright side, to save the day many of these papers were presented by their U.S. coauthors mainly from Sandia National Laboratories.

We continue to be indebted to the Registration Committee who almost flawlessly started the meeting process on

Sunday afternoon. For the past several years, Glenda Ackerman had been Chair of the committee and when D. L.Whaley assumed that position this year there was not even a perception of a change in management. Of course, all of the committee members, including Whaley, are veterans of many years dealing with our attendees and with some of the unique registration tribulations.

We are further thankful for our INMM HQ Staff lead by Leah McCrackin, our Executive Director, who, as I have said previously, knows everything; Lyn Maddox, our Conference Manager, who manages the hotel activities so well you don't even know that you had a problem; Madhuri Carson, our Conference Administrator who continues to make order out of the chaos that we sometimes create; Deb Pederson, coming back to help the team again (she must like us); Patricia Sullivan, the *Journal* managing editor, being everywhere that help is needed to make the program function well; and especially, our new INMM Administrator, Jodi Metzgar, a rising star just a few months in this position but acting like she has been with us for ever!

Speaking of registration, the official opening of the 48th Annual Meeting occurred on Sunday, July 8 but on the day before two important planned events happened: the INMM Executive Committee met to review and ponder issues of significance to the Institute and hopefully to the international nuclear materials management community; and the attendees for the Annual Meeting of the New Brunswick Laboratory Measurement Evaluation Program assembled to review progress in the program for the past year.

Again, this opportunity for organizations to meet in conjunction with the Annual Meeting not only has an economic factor but a logistics element that benefits all. We say again: the INMM Annual Meeting is where everybody is!

Sunday is an important day not only for registration purposes but for the five INMM Technical Divisions that meet in the afternoon and discuss meaningful issues and topics. I understand this year several lingering (malingering?) issues were resolved by some Divisions. Attendance was generally good for most but somewhat sparser for the Packaging and Transportation members. Fortunately, Jim Larrimore, consultant, in spite of some personal conflicts, was able to chair the International Safeguards Division and was in top form with his unique style.

Intense thoughts at the Executive Committee meeting

On Sunday morning, Amy Whitworth, NNSA, chaired a meeting of the NNSA MC&A Implementation Panel to address interests in that area. After that meeting, Whitworth chaired the Government and Industry Liaison Committee (GILC) meeting.

At noon that day, the ANSI/INMM 5.1 Analytical Chemistry Laboratory Measurement Control Committee, an ANSI N15 subcommittee, chaired by Charles Pietri, consultant, also met to discuss the status of the draft document N15.51 *Measurement Control Program—Nuclear Materials Analytical Chemistry Laboratory* that is going through the balloting process for renewal. A major task for the next renewal of this standard will be to review in depth the statistical treatment with reference to the generally accepted *Guide to the Expression of Uncertainty in Measurement (GUM).*

However, the real highlight of Sunday was the 50th anniversary of the International Atomic Energy Agency that was celebrated with four gigantic cakes at the afternoon coffee break. (The IAEA "officially celebrated its golden anniversary on July 29, 2007, marking the day 50 years ago when its Statute officially entered into force. UN Secretary-General Ban Ki-moon, Pope Benedict XVI and others have sent anniversary messages voicing congratulations and support.")

With a few pointed words of appreciation by Jacques Baute, Director, Iraq Nuclear Verification Office, representing the Director General Mohammed ElBaradei and Jill Cooley, Director, Division of Concepts and Planning, representing Deputy Director General for Safeguards, Olli Heinonen, the hundreds of attendees tried to devour the four anniversary cakes – but, alas, they failed! So, the Student Orientation session later that evening benefited from an extra treat. (We can always depend on students when it comes to food—consumption, that is.)

Announcing the IAEA 50th Anniversary celebration

Exhausted from meeting colleagues, registering, attending pre-meetings, attendees were thankful to end the day by participating in the President's Reception on Sunday evening. It was a very active evening complemented by food, beverages, and fellowship. Not to be outdone, Mark Leek, had a Student Orientation session afterwards. With all of this activity in one day it's a wonder how we all (or most of us!) were able to get up so early the next day for the formal opening of the Annual Meeting – but, of course, we did.

Again this year the exhibitors set up their exhibits on Sunday and had plenty of

How many dignitaries does it take to cut an anniversary cake?

space to work and for the attendees to easily visit the various booths. We did run out of space and had to set up one exhibit in the outer area nearby – probably a plus for that exhibitor with so much access to the attendees. We planned various activities such as the President's Reception and the refreshments breaks in the Exhibit Hall to expose more of our attendees to the exhibitors' wares. It appears to have been a successful approach.

On Tuesday July 10th the Business Meeting followed by the INMM Annual Awards Banquet took place. At the Business Meeting the INMM Sustaining Members were recognized.

Student orientation and mentoring meeting – rapt attention

For the Banquet we had a few complaints but generally everyone enjoyed the meal and presentations. (Some of the older crowd were thankful that there was not the live and loud music we had in Nashville last year. But folks, next year we're back in Nashville for the meeting – so beware!) Resolutions of Respect for several of our deceased members were read: Greta Joy Dicus, and Wayne Delmer Ruhter. The following awards were presented:

"Old Timers" – Glenn Hammond and Ted Sherr

Distinguished Service Award, Tom Shea and IAEA; Meritorious Service Award, Stephan Mladineo, and the Special Service Award, Shirley O. Cox. Details are provided elsewhere in this *Journal*.

Professor Paul Ebel, BE, Inc., returned this year by popular demand, to conduct his Speakers and Session Chairs tutorial following the Speakers Breakfast each day. This year Ebel provided a brief

INMM Sustaining Members recognition – why is Ed Johnson hiding?

summary of the past tutorials followed with an emphasis on the important role the Session Chair in making each session an exceptional success. We have even noted that there has been a gradual improvement over the past few years not only in speakers' presentations but in managing the sessions by the chairs. (Paul, they *are* listening.)

In addition to his duties as our esteemed lecturer, Paul Ebel also coordinates the LCD PowerPoint© projection systems for the speaker presentations. He is indebted to the Technical Division Chairs and colleagues including troubleshooter Chris Hodge, RSL-NV for their invaluable

Chris Pickett wore out his thumb as the new MC&A Division Chair

contributions. The process appears to be managed well once again with only a few instances of problems that will be resolved by next year.

Now I know you have been patiently waiting for the "Report Card" that describes how those of you who provided feedback to INMM really rate the Annual Meeting. We told you at the beginning of

Professor Paul Ebel exhorting his students at the Speakers Breakfast.

this report that a variety of means were used in the evaluation including the electronic survey. The Report Card this year was better than the ratings received in previous years with some notable exceptions and the ratings were mostly very positive. If the Annual Meeting continues to improve it is because of your input that we heed (the sensible stuff only, of course) each year.

The responses we get from the electronic survey are relatively small. For example, only 28 percent of the attendees responded to the survey. In 2006 it was 29 percent, 2005 (25 percent), 2004 (31 percent), 2003 (5 percent - last year of the written survey). So, in spite of the fact that responses have improved dramatically since we moved to electronic surveys, be aware that these findings may not be typical of the entire group of participants but only those who took enough interest to respond. (We would like to think that the non-responders were sufficiently satisfied – or neutral – so that they did not feel a response was needed.) In any case, INMM is very grateful for your comments – it's your meeting.

As in the recent past, this year the Overall Annual Meeting process was rated similar to previous year's - mostly as satisfied-very satisfied (highest rating) with the highest commendations for the Call for papers, Online Abstract Submission process, Preliminary and Final Programs, the Online Program, the Technical Program Committee, The Pocket Schedule-at-a-Glance, the hard working Onsite Registration Process and Staff, and the ever effective and gracious INMM HQ Staff had the highest rating had the highest ratings of the entire meeting. We had a great student turnout and the papers and their presentation were good. Two-thirds of our attendees responding rated the Opening Plenary session as good-excellent while 44 percent of the respondees similarly rated the Closing Plenary. Unfortunately, attendance at the Closing Plenary was very low and requires INMM to take some action to improve this part of the meeting.

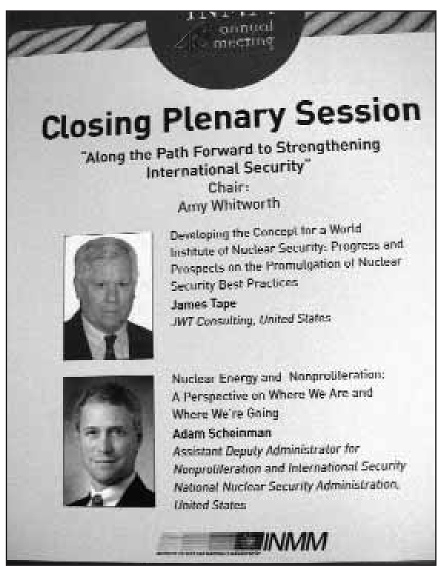
Most importantly, 91 percent of the responders indicated that the INMM Annual Meeting was satisfactory-very satisfactory and 96 percent said that the program met their professional needs! INMM Annual Meetings have consistently rated above 90 percent in these categories for many years. In fact, about 82 percent of the responders thought that the papers and their presentations were good-excellent with only a few individual comments to the contrary. Maybe that's why we have such great participation each year.

The Technical Information Exchange and Logistics areas were also rated highly good-excellent (mostly good). The Hotel Accommodations were not rated as high as in previous years as

Closing Plenary Speakers Luncheon

two-thirds of the responses gave a good-very good rating this year. However, nearly 90 percent rated the hotel Facilities (meeting rooms, etc.) as good-excellent. One curious anomaly in the ratings is that although 92 percent of the attendees visited the Exhibit area, we did not have any responses (except verbal) as to their quality or value. (Did our system break down?)

Posters: Our Poster Session Chair, Taner Uckan, ORNL, was so thrilled with another quality session this year that he gleefully wrote me the following report: "As a short report, the Poster Session … went well … [and] was well attended from the very beginning for the presentation of



Closing Plenary Speakers Announcement

22 … papers. [One] paper … from Latvia, was [a] no-show, maybe due to visa problems? The poster room size … was good and well arranged, thanks to you and Lyn [Maddox]; and also thanks to Jodi [Metzgar] for providing the list of presenters in advance. And again, the popped corn was the added attraction to this excellent poster session - thanks Lyn!" Remember, posters are just as important and significant as oral presentations – they are just another way of presenting the information.

One disappointment was the use of the Program Planner with itinerary builder since this innovation was prompted by several of our attendees last year.. Those few that used it found it to be helpful but only a handful did so. Hopefully, next year it will have greater popularity.

For six years now INMM has actively promoted student participation. This year the number of student attendees and papers presented were not as great as last year's record breaker in Nashville but very commendable for a growing INMM activity. We see a lot of movement in the student area with new student chapters being formed and the high quality of the papers being presented. Some of our more mature presenters might take a lesson from this fact. The competition for the J.D. Williams Best Student Paper Award resulted in 1st Place going to Brandon Grogan, Oak Ridge National Laboratory, for his paper titled "*MCNP-PoliMi Simulation of Neutron Radiography Measurements for Mass Determination for a Trough of* UO_3"; and 2nd Place going to Shaun Clarke, Purdue University, for his paper titled "Multiplicity Analysis During the Photon Interrogation of Fissionable Material".

It was a bit difficult to evaluate the value of the Student Orientation/Mentorship Program and the Student Career Fair & Reception because of so very few responses. However, I did see all of the attending students paired with a mentor. Let's see what progress is made from these contacts. We did get a few excellent suggestions: "… make a list of students and their interests and … a website where INMM participants can contact students if they are interested in assisting them with their careers." "[Hold a] student social hour to meet other colleagues – perhaps an informal standup-lunch. Perhaps a student discussion/meeting on up-coming issues in the nuclear industry to help us gain perspectives on careers" "We tried to have a student booth in the exhibit hall, but somehow lines got crossed and we were unable to have that arranged for us." I have referred these comments to Leek, our Students Activities Committee chair who, I'm sure, will give them serious consideration.

The New Member/Senior Member Reception was a well attended, successful event. New regular members and Senior Members along with new student members had the usual opportunity to meet. Students, especially, were encouraged to become involved in both their technical divisions and local regional chapters.

INMM takes the time review all comments and provides responses to those significant remarks that warrant further discussion even though they may not entirely represent attendee sentiment.

Coffee break – why is Yvonne Ferris trying to get hot water out of the coffee urn?

Perhaps that's why we continue to receive comments and helpful suggestions for improvement. In trying to provide a balanced perspective, a few selected comments, some provocative, are addressed below.

- "Well planned and executed as usual. Many very good speakers with interesting talks." "Great hotel and services. Excellent technical program, effective layout of parallel sessions, good break location, outstanding organization." "As a member of INMM since about 1970, I felt this was the best Annual Meeting I had attended." "The Sherwood staff [is] outstanding." Response: *I always like to put the most favorable comments first!*
- "Need more papers on proven theories, most were not proven and still more papers were looking for funding to move forward. Second, having a paper on the status of MPC&A efforts to meet a milestone is not appropriate for the INMM, in my opinion. Finally the student papers were actually better than others. Instead of lining them up on the last day, they should be given throughout or have a special session for them prior to the last day." Response: *Papers are placed in sessions according to the appropriate topical material not by organization or professional category. It was just a coincidence the bunching up of student papers on one day. We'll try to see that they are more evenly spaced, if possible.*
- "Unfortunately I couldn't get a room at the hotel and had to stay some distance away in a motel, which required me to travel in each day by taxi." Response: *INMM HQ staff makes every effort to place attendees at the meeting hotel and has been successful in almost every case if notified far enough in advance. We have a waiting list and as cancellations come in the waiting list is activated. Be sure to notify INMM HQ of your situation.*
- "Hotel was too isolated …" "Although dramatic, the Tucson location was in a very inconvenient [and] isolated area requiring additional expense for car rental. These are important considerations especially for our international guests who may not have the funds that [our] U.S. colleagues may have, nor U.S. driving abilities, but who would like to go shopping, etc., during their off-hours. The meeting rooms and parking were very far from the main part of the hotel and rather inconvenient." "As noted in the program, a car was a necessity unless you were willing to be held captive by the hotel." "This hotel was ten times better than in Nashville." "Although the JW Marriott was a beautiful facility, and the meeting arrangements were excellent, the parking was extremely inconvenient. ….the costs for meals and other amenities … were extremely high…. I heard these same complaints from many others." Response: *We recognized this situation and did forewarn folks. We may be able to arrange some relief for the stranded attendees by the time we revisit here again in 2009.*
- "A terrific activity. I made many new contacts and one day several may even be friends." "Did not gain much from the papers. Highlight was meeting with other individuals from other sites and countries." Response: *A "mixed bag" – but there is always something for everyone.*
- "LCD projection needs some attention to assure that it is functioning as intended. A few problems occurred that were eventually resolved but could have been prevented. Response: *INMM is aware of the few problems that were encountered and is developing plans to remedy them.*
- Plenary sessions: The Opening Plenary session was excellent with new information applicable to an audience of wide and varying background. It was presented in a very understandable way and was a real value." "I thought the opening plenary was the best in years …" "The Opening and Closing Plenaries were great". "Closing Plenary was not well attended but the WINS and the Nuclear Energy & Nonproliferation talks were good.… not the usual dry, bureaucratic messages of little importance. They addressed real and positive activities of value to me." "Closing plenary was terrible." "The WINS presentation in the closing session could have been more interesting if organised around topical areas throughout the week…Why not [try] organising more

1 to 2 hours open panels devoted to specific technical topics? - with someone in charge of making minutes with conclusions. This would be highly appreciated by international participants. If the topic is of general interest and there is a good moderator, it is guaranteed success." "…the Closing Plenary was excellent." "Closing plenary speakers didn't seem to be sufficiently senior enough in the nuclear industry to warrant their participation in that venue. …[that is] one reason, among others, that people are scheduling their departure from the INMM on Wednesday evening or early Thursday. …. focus on either recruiting more attractive speakers or evaluating the value of the closing plenary. …useful to sensitize plenary speakers to the international flavor of the institute. … there is clearly a U.S.-leaning bias from the speakers … we have a strong international contingent … [so INMM should] … make more of an attempt to cater to at the plenary sessions." Response: *Plenaries especially in recent years, have been problematic for all the stated reasons and more. The individuals best suited for INMM are either not available or after committing to the meeting are called away to more important duties of their profession. INMM has been fortunate in obtaining suitable surrogates to represent these speakers but that does not resolve the basic issue. Inviting "sufficiently senior enough" speakers is easy to say but increasingly more difficult to implement. And the value of the lower level speakers may not be fully appreciated since they may not be in a position to make more comprehensive and authoritative presentations. INMM has been addressing this matter for several years without a definitive solution as yet. However, for example, for the INMM 50th Anniversary presentations, serious consideration is being given to rearranging plenary sessions into multiple sessions as well as more panel-type presentations throughout the week. In all cases, INMM would expect final papers from the speakers for publication in the Proceedings in order to maintain our historical legacy. Remember, as a great sage once said: "If it's important enough to present at the Annual Meeting, it's as important to preserve in the Proceeding of the INMM Annual Meeting." (Name on request.)*

- "For my particular interests (uranium enrichment and MC&A measurements) most of the papers of interest were scheduled at the same time on Tuesday, with very little of interest on Wednesday." Response: *The Technical Program Committee tries to maintain a balance with topical material, number of session per day, avoidance of subject conflict but that does not always work for we usually have more conflicting information to coordinate than we can accomplish pragmatically.*
- "There were quite a few instances when the actual speaker for a paper was not the main author or was not the person listed in the program. I know that this is not your fault when people don't show up, but I wonder if it is possible to send the programs out for print just a little bit later so that it can be minimized." Response: *INMM is in total agreement but the current publication schedule is stretched to its limit – please see more detailed comments about this issue elsewhere in this report.*
- "[Future INMM activities could include] expanding the technical base beyond primarily DOE work to NRC, commercial utilities, NEI initiatives. Desire to see technical session that addresses new concepts, new ideas, new approaches to industry challenges of the 21st century — instead of by topical technical division, group presentations with others who bring out-of-the box thinking to the core competencies represented by INMM or have a broad impact across the board." Response: *Good suggestion. INMM has already started this expansion you mentioned and continues to have multi-sponsored sessions that cross some artificial "boundaries" – we will accept all new ideas and approaches to address within our stated nuclear materials management mission.*
- "It would be better if the Organizing Committee provided participants with the Internet free of charge." Response: *As you have noticed, hotels make profit from all items for the Annual Meeting not included in our intensely negotiated hotel contract. Outrageous internet charges are one of these items. I will recommend that we try to negotiate a no-charge or substantially reduced rate in the future hotel/meeting contracts.*
- "The Banquet was probably the best in the last five years. The food was very good and the red wine was great." "The food was cold." "Banquet food was overcooked, and the DJ kept killing the vibe with slow songs." "Please do not allow anymore companies … to reserve so many tables that no one else can find a [seat]. This also seems to isolate people into groups [rather than] mingling and getting to know new faces." Response: *No disagreement about the seating arrangements. INMM will remember to distribute reserved seating at the banquet more evenly.*
- "The conference was outstanding. Every time I have attended one of these here in the west, I have been impressed. This is the second best of the series from an informative technical viewpoint. The first in excellence for me was the 38th in Phoenix. It was absolutely invaluable for the graduate course in nuclear waste that I was teaching. The final program was an excellent publication easily accessed; however, it needed desperately the pocket program in order to effectively refer to the schedule unless you were planning on remaining in the same session." Response: *So, forgive me again! I like to end these comments on a positive note just like we began!*

So you see from some of the comments, there are a variety of perceptions about the Annual Meeting and its activities. We can't please everyone but we try to please most. INMM plans to fix those issues and consider those suggestions that are reasonable and within our control but such differing viewpoints sometimes make it difficult to evaluate practical courses of action.

The significant issues facing INMM in managing the Annual Meeting program continue to be excessive paper withdrawals, frequent speaker changes, and, to a much lesser extent this year, late and absent final paper submittals. INMM will continue to try our best to keep paper withdrawals and speaker changes under control. We need to prepare the Final Program one month prior to the Annual Meeting in order for it to be proofed, printed and shipped to the meeting. Any changes during this one-month period cannot be reflected in the Final Program and are posted in the addendum at the meeting. Further, we have many speaker changes at the meeting that can only be noted in the daily Addenda. Some of these issues could be avoided by greater diligence from the speakers but others (like speakers not receive travel visas) may be more complex to resolve.

Join the Martini Club and visit us next year

INMM acknowledges the efforts of many individuals and groups who continue to make the Annual Meeting a success: the hundreds of speakers, Session Chairs, Technical Program Committee and especially the Technical Division Chairs, and, of course, our superb INMM HQ staff. This report is a brief vignette of what happens at these Annual Meetings and does not include all individuals, groups, and events. I know from your conversations with me and your evaluations that most of you will be back next year depending mostly on funding and schedule. You've told INMM how important and useful INMM Annual Meetings are—now tell your management!

Next year we return to the Nashville Convention Center and Renaissance Hotel in Nashville, Tennessee (the Music City) on July 13-17, 2008' for the 49th Annual Meeting' which inaugurates the year-long 50th INMM Anniversary Celebration. Be there—you can't miss this event! So, as I say each year, start planning for it now by completing your research, getting your subject approved by management, writing your abstract, and submitting it by February 1, 2008. Then write your paper and submit it early — certainly no later than the June 9, 2008 deadline. Remember, for those of you who are planning to organize a special session, you need to contact me by November 15 or sooner and be prepared to attend the Technical Program Committee review meeting in March 2008. Please—no exceptions!

On behalf of Nancy Jo Nicholas, INMM President, we look forward with pleasure and anticipation of your presence at the 49th Annual Meeting next year—be there!

INMM Roundtable

Monday, July 9, 2007
Tucson, Arizona, USA

Opening Plenary Speaker
Dr. Paul W. Lisowski
Deputy Assistant Secretary for Fuel Cycle Management
Office of Nuclear Energy,
U.S. Department of Energy

Participants:
Obie Amacker
Fellows Committee Chair

Cameron Coates
JNMM Associate Editor

Robert Curl
INMM Treasurer

Pamela Dawson
JNMM Associate Editor

Vince De Vito
INMM Secretary

Debbie Dickman
INMM Constitution & Bylaws Chair

Leslie Fishbone
JNMM Associate Editor

Ed Johnson
INMM Waste Management Technical Division Chair

Cathy Key
INMM Immediate Past President

Dennis Mangan
JNMM Technical Editor

John Matter
INMM Past President

Nancy Jo Nicholas
INMM President

Steve Ortiz
INMM Vice President

Charles Pietri
INMM Technical Program Committee Chair

Sara Pozzi
INMM Communications Chair

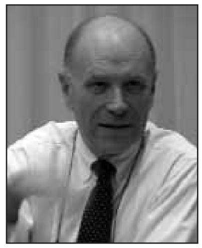
Bernd Richter
JNMM Associate Editor

Gottard Stein
JNMM Associate Editor

Patricia Sullivan
JNMM Managing Editor

Jim Tape
INMM Past President

Scott Vance
JNMM Associate Editor



Paul Lisowski: I have to say that there is a lot of expertise in this room associated with the entire fuel cycle, in safeguards, and in all of the areas important for GNEP for the future. It is great to be here and important that we have a chance to have this conversation. I will try to answer your questions, but where I don't know the answers, I will tell you.

Dennis Mangan: That's fair enough. I think that the INMM was happy to hear the announcement about GNEP because that's the business that we're in, to support activities like that. I would like to ask you a question that follows a question you got in your presentation that had to do with congressional support for GNEP. You said that part of the problem of congressional support was educating the congressional community, as well as the GAO, the Government Accounting Office, and organizations like that. You indicated that you were trying to do that. Could you give more details with regards to exactly how you go about educating the congressional folks?

Lisowski: The Office of Nuclear Energy (NE) now has a deputy assistant secretary whose office handles interactions with Congress, does our communications work, interfaces with U.S. Department of Energy (DOE) public affairs, and with DOE Congressional Affairs. That office has been effective in improving our communications strategy. Normally, they respond to requests for congressional briefings and arrange for NE staff to provide technical or educational information. The interactions are not as frequent as one would like to have with Congress, simply because our congressional affairs office and the congressional staff are busy dealing with many other programs. In particular, the congressional staff has information that comes in from many perspectives and they have to integrate the information to reach a conclusion for legislation. Sometimes the information that they have put together gives a very one-sided picture and where possible, we try to provide our perspective. As I mentioned today, GNEP is a complicated program involving both international and domestic aspects. GNEP is involved with waste management and nonproliferation. The congressional staff have a very limited amount of time to actually assimilate the complexity of this information. They take what they can in meetings that last thirty minutes to an hour and that, along with other public documents, is what they have to use. Perhaps equally important to congressional staff is third-party validation of the information about GNEP. For example, other information relating the importance of nonproliferation, that dealing with the waste problem is important, that we have to have adequate safeguards in the facilities, are all important to supplement what we have time to tell them in brief meetings. Perhaps it is a question of adequate education for Congress from many different directions. We have had statements of support from professional societies – and there may be a statement from this organization stating the position with respect to GNEP that I am unaware of; communications providing professional information are very helpful. There are many people opposed to any form of advancement of the nuclear fuel cycle. Those people seem to have more time than we in the DOE do to present their views to the Congress. Recently, there was a session held in the basement of the Capitol in which an opposing view to GNEP was presented. It would be very useful to have a professional society that supports GNEP to provide that kind of briefing to Congress. If you believe that this is important, then your society must speak up soon.

Charles Pietri: Very interesting, as that you flagged at the beginning of your presentation what I consider two major issues of GNEP, which are waste and nonproliferation. Those are the kinds of concepts issues that are being spread around and I think they that the responses are not being communicated well-enough to the public and even to our own community. We've got people like Von Hippel who have definite thoughts about GNEP and the nonproliferation and waste management aspect. So when I looked at your list, (I think it was a list of GNEP priorities), you had communication down there as number eight. I don't know if that was prioritized or just a list.

Lisowski: Just a list.

Pietri: But the point is I'm hearing in my own neighborhood—near Argonne National Laboratory—where they talk about new initiatives at Argonne for GNEP and perhapsrestructuring the Morris, Illinois site, thirty or forty miles away, the newspapers and the local media were up in arms because they think it's another bomb factory—there's a lot of misconception that is really at a grassroots level. It has gotten so bad that I got a call from the staff of my local congressman who wanted to understand what this was all about. What I am afraid of is that we will eventually have such a negative groundswell that will reach up to the congressional level, and then when you guys look for funding, you will have a whole bunch of protagonists there with the only information they've got is from the negative and erroneous viewpoints.

Mangan: Was that a question?

Pietri: My question is, can we move that communication issue up to a top level even though probably not all the answers are available yet? Can we start contacting the communities, the folks not only in Congress, but people that are out there at the grassroots level?

Lisowski: There are eleven communities interested in hosting GNEP facilities. We are continuing to work through the Energy Community Alliance to keep those communities involved and to continue to have them provide information for our Environmental Impact Statement. We are communicating information to communities that could be affected by GNEP. The people who oppose GNEP are well-organized. They also appear to be well-funded, and often appear to have no challengers when they put out misinformation. So it is necessary to get a complete picture out. We also have asked each of the industry applicants to propose work under our funding opportunity to develop a communications strategy in order to try to explain what they are planning so that they can explain it in the kinds of terms that they and their professional communicators would say and not in the language of the Department of Energy.

Cameron Coates: In terms of your discussion this morning, you said you had received 24,000 comments. If you could share with us some of the more significant areas of those comments and do you see a role or would you support a role for the INMM either through invited journal articles, co-sponsored workshops, or other such activities to address those significant areas from a positive educational scientific point of view?

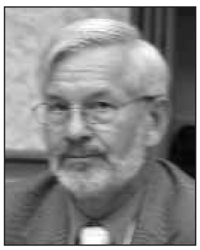
Lisowski: I have not really thought of a role of the Institute in actually trying to address that, but that is not a bad idea. Unfortunately, it is one that would be very hard to implement as part of a federal process. There were significant concerns about transportation. I can say I have certainly not read all comments; but someone in the department is reading all of them, and it is a bit daunting. As a note of correction, the department actually received about 14,200 comments. We know people in communities are quite concerned about transportation safety involving movement of spent fuel and processed materials through their communities. People are concerned about the long term impacts of waste disposal. They want to know what is going to happen to the waste if the facility is built in their community; what guarantees they have that the separated materials will actually go off-site; what guarantee the government will give them that we will actually take possession of the material. There are concerns about radioactive material release. We have different standards than other processing facilities around the world. So, we have to plan our facilities to meet the environmental standards of this country. People are concerned that we won't meet our commitment to do those things. Hopefully we will be able to address the concerns in a way that makes public acceptance possible.

Coates: Will there be a summary of those significant general topic areas? That might give us some guidance of where we might look for papers.

Lisowski: Yes, that will be included as part of the environmental impact process in the documentation.

Coates: In advance of that?
Lisowski: To date I don't think we have been able to make them publicly accessi-

ble. I do believe that a summary of the public comments and information from the sites will end up being made public as part of the process. I went to several of the public hearings. It was pretty eye-opening to participate. The meetings were reasonably balanced in terms of pro-GNEP and con-GNEP comments. The positive comments were mostly about jobs and standard of living and economic development in the area. The negative comments were mostly about the environment and health impacts and transportation. Those are very different perspectives and hard to compare.



Bernd Richter: I very much enjoyed your presentation because overall I found it very technical. Since I am more technical than political, I enjoyed it very much. But I want to address the political part of your presentation. You avoided very much the term reprocessing and instead used the term separation. I wonder what is the difference between reprocessing and separation. For me, it is still reprocessing. It has got very much the features of reprocessing. In this connection you said the concept, the GNEP concept, is considering the use of fast breeder reactors, sodium-cooled fast breeder reactors. Do you exclude the use of mixed oxide fuel? I mean, this is just adding to the concept. You didn't mention the use of mixed oxide in light water reactors.

Lisowski: Our concept is to provide a fast reactor and to use sodium technology, because that is the most mature technology available for us to use. We are not presently considering fast breeder reactors, but fast reactors to use as burners. We are considering both metal and oxide fast reactor fuel forms and have considered, in our system analysis studies a two-tier system with both light water reactors and fast reactors as well as a single tier system with only fast reactors as I presented today.
Richter: That is interesting.

Lisowski : The conversion ratio for reactor systems that GNEP has considered is less than one. In fact, the lower it is, the better it is because one destroys more of the transuranic elements. We believe that with adequate design you can reach a fast reactor conversion ratio of 0.5, where the conversion ratio is the amount of transuranic material produced divided by the amount destroyed. A breeder reactor would have a conversion ratio higher than one. It appears to us that at the present time the resource issue for uranium supply, does not push us towards breeder reactor technology for some time. If you look at the uranium supply, and there are probably people in this room who know much more about this than I do, it appears with the growth in use of nuclear power worldwide, shortages, or price increases will force breeder reactors to be in place sometime around 2100. Then, we will want to use breeder reactors in order to effectively use uranium resources. We really aren't pursuing breeder reactor technology for GNEP at the present time in the U.S., although there are international efforts underway.

We are looking at two fast reactor fuel types, metal fuel and oxide fuel. There is a lot of experience with oxide fuel worldwide, because the Japanese, French, and Russians, all use an oxide fuel, as did the U.S. Fast Flux Test Reactor. We developed metal fuel with EBR-I and II very successfully. Pyroprocessing, one of our baseline processing technologies, feeds nicely into metal fuel. We've not made a technology decision that says we should chose one or the other. We are trying to carry both and we are interested in finding out what industry is going to say.

John Matter: I have a question about the global partnership part of GNEP. You mentione there are already GNEP agreements with four countries: Russia, Japan, France, and China. What are the important components of those four agreements, what are some of the differences among them, and what do you expect the most important contributions to be from each of those partnerships?

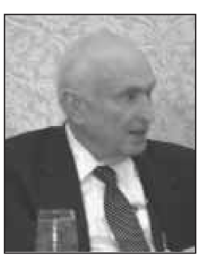
Lisowski: You know we have been working on GNEP for a year, but we still are at a very early stage in dealing with nations other than ones that we've worked with in the past. Countries with similar goals can still have somewhat different perspectives. So the first thing we are trying to do is reach an agreement among the five initial states as the detailed wording of the GNEP statement of principles. We feel strongly in the U.S. government that finding a way to move away from separation of plutonium is one of those issues in recycling that is an important attribute because it produces a stream of material that could be diverted and used to make a nuclear weapon. As a result, we want all countries to agree to develop processes that do not separate plutonium. Countries with existing facilities aren't going to change their reprocessing scheme, until their next generation of facilities is built. We believe that if we work within the GNEP partnership, the next generation of reprocessing facilities put in place will not separate plutonium. As a result, there has been a lot of give-and-take to get agreement on how the principles are stated. Once the principles are agreed upon, and that will soon be done, other nations will be invited in as partners. Once the GNEP partnership is formed, the very important issue of fuel supply and take back can be addressed. This could be done in an international center, perhaps even under IAEA auspices. There has been quite a bit of discussion, but we have not settled on the approach.

Gotthard Stein: You mentioned reprocessing, especially the perspectives for reducing the radiotoxicity of waste for final disposal, and you pointed out that waste has reached in 300 years the radiotoxicity level of natural uranium ore. What was the uranium concentration in this ore?

Lisowski: I do not know what the uranium concentration of the ore was in the calculation, but the isotopic abundance of natural uranium ore was assumed to be 0.7 percent ^{235}U.

Stein: We are trying to establish global standards also for dealing with nuclear waste in different fuel cycle alternatives with or without recycling and separating plutonium, e.g., with the goal to reach such a radiotoxicity goal of 300 years for waste. What can be done to convince also countries like Germany to follow fuel cycle strategies with recycling?

Lisowski: I think recycling is going to be driven by economics, much more than by anything else. My view is that the spent fuel that we're taking out of reactors contains incredibly valuable material and putting both the resources and waste in geologic storage is going to be recognized as a mistake at some point in time.



Ed Johnson: In getting down to the work on the UREX process, the question that I have is how do you overcome the burden of the restrictions on dissemination of technology under 10 CFRC 10.8, and the matter of a department's restriction associated with the applied technology? How do you get to the point that you can integrate U.S. technology with foreign technology so that you to have an optimized flow sheet?

Lisowski: I really don't know the answer to that question at this point. We understand the restrictions, but, we haven't fully addressed how we will do the integration.

Leslie Fishbone: The Russians have an operating fast reactor, they have an operating zero power facility, and I think we just signed an agreement with them, it was a 123 agreement.

Lisowski: I think that 123 agreement must yet be approved by Congress.

Fishbone: Right. So are we likely to cooperate with the Russians on the technology of fast reactors?

Lisowski: We have had discussions with the Russians about fuel cycle research as well as fast reactors, and they have a lot to offer us. Once agreements are reached, there are many things that we can do in collaboration with the Russians. We have put in place a civil nuclear agreement. We recently had our second meeting to work out areas of collaboration. When the 123 agreement is actually approved by Congress, we will be able to expand that effort. One of our challenges is in fast reactor fuel qualification as we develop a fuel with transuranic constituents because we don't have a source of fast neutrons in the United States. The French reactor, Phenix, is going to stop operation in 2009, and getting adequate space in the Japanese fast test reactor is likely to be an issue because they have their own high-priority program for fast reactor fuel development. Being able to access the Russian reactor as part of our agreement is likely to be important.

Vince DeVito: It appears to me that fuel cycles are still going to need enriched uranium for the reactors. With the potential price of natural uranium going to, as you said, $150 a pound, we have DOE-owned depleted uranium, of approximately 250,000 tons in storage. DOE is in the process of taking that uranium in the form of UF6 and going to oxide, putting it back in the containers, and burying it. Now, if we could reprocess that depleted uranium which is approximately 0.3 weight percent U-235 through the enrichment processes, down to 0.2 weight percent U-235, then we recovered another third of the U-235. Would it be a good thing to hold right now on burying the current depleted uranium stockpile and consider putting it through the enrichment plants again?

Lisowski: For me to comment on that would not be too useful because I am not involved in the program. My opinion is that all energy resources are valuable and that one should be doing the best to conserve them for the future. But, the department has reasons for its actions, and some of those are driven by funding streams and mandates which are not apparent without considering all of the issues involved.

DeVito: Well the other thing is that this decision may have been made prior to DOE thinking about GNEP and the price of “separative work,” if you are familiar with the term, for the enriching process, could be much cheaper than $150 a pound.

Lisowski: Funding for work on the front end of the fuel cycle exists in another part of NE so I do not have the information to give you an answer.

DeVito: I would hope it would agree with mine.

Lisowski: Well, as I have said, I personally agree that we should be conserving these resources. I think they are valuable and they are going to be important, but the department is driven by its own budgetary constraints and activities.

Jim Tape: Thanks. I really enjoyed the presentation. I thought it was a very nice overview. I would like to give you my sense of what I have thought is important about the concepts that underlie GNEP. In my view, the most significant aspect of GNEP is that it is a technology development activity that would produce technologies that enable much more rational management of spent fuel, and that the primary nonproliferation benefit would occur from spent fuel take back. I felt this morning that you shied away from going quite so far and maybe it is because it is not ready for prime time discussion, but it seems to me that if we could make spent fuel management sufficiently, how should I put it, acceptable to publics, whether they be in the United States or Germany or wherever, the United States could imagine taking back spent fuel, and in my mind this would have the greatest nonproliferation benefit. I am a great believer in safeguards, but bringing the spent fuel back, recovering the materials of concern, getting the energy out of them one way or another, to me is the far superior thing to do. So I wonder if you would comment on my perhaps distorted view.

Lisowski: Well, I think both parts of the fuel cycle are important for preventing proliferation. We know that it is possible to put in an enrichment program in place that could potentially be used to make nuclear weapons material. That is extremely dangerous because a weapon using ^{235}U is easy to hide and hard to detect. On the back end of the fuel cycle, the reprocessing part, nations have information on how to do plutonium extraction, but that process requires facilities that are harder to hide and produces material that is somewhat easier to detect because of its radioactivity. From the public perception perspective, the back end of the fuel cycle is more important because of the connection between proliferation and waste management. As a result, having a way to recover spent fuel from reactor countries and reuse the energy will make a bigger impact. So in that sense I agree with you. Right now the United States is prohibited from actually recovering spent fuel because we have no recycling or geologic storage facilities in place. But eventually we will have to find a way to participate, hopefully through GNEP.

Obie Amacker: I would like to get back to Charles' question and communication. I know you talked about the guide that Vanderbilt is generating for journalists, etc., but I know how well-organized the anti-folks are. I am familiar with the numerous public hearings that are held relative to Hanford activities and quite frequently you see where they have contributed to articles and actually run ads in Portland and Seattle in order to get busloads of people to attend the hearings. I think one of the shortcomings of the nuclear industry for a long time is the lack of a proactive, positive, outreach program for public communication and I am just wondering if there are other things that you (the department) might be contemplating relative to that end or as Cameron asked, if there is something that INMM could perhaps do to help facilitate an outreach effort?

Lisowski: I think professional societies that are vocal in presenting a rational viewpoint make a big difference. I do know that the American Nuclear Society in its spring meeting in Washington often has visits with congressional delegations. I believe that the department might be criticized were it to try to organize an effort through a professional society, but I think that whatever, in good conscience, you feel that you should do because the society feels it is important, you can carry out as part of your mission.

Amacker: To follow on, not to be critical of the department, I agree with you that they might be criticized for working through a professional society, but it still does not appear that the department on its own is very proactive with outreach. I mean they diligently follow requirements relative to environmental impact meetings and hold other community meetings where it is required or deemed necessary, but it just does not appear that they are really proactive relative to positive communication and outreach which is critical to the success.

Lisowski: It is pretty hard for the department to have a significant public relations campaign. It is a lot easier, for example, for a national laboratory to have activities that provide this information because they are not strictly part of the federal government and have access to other sources of funds to cover their expenses.

Coates: In terms of university outreach, there has been a very successful nonproliferation intern program that PNNL has had over the years. Is that a possibility for GNEP intern program that maybe springboards off of that program?

Lisowski: Good idea. I have asked the program director for the Advanced Fuel Cycle Initiative, to look at ways to improve the university program within GNEP. In 2007, when the department made a decision to put $25 million, it was also decided that those funds would be put into university consortia. For 2008, we want to take a somewhat different approach. We are considering how each of the technical areas can fund research tasks that closely match their areas of interest and then to fund those activities. Part of that work could easily involve internships.

Richter: Back to a different subject, you mentioned this concept of suppliers and users. If a group of countries provide supplies and the rest of the world are the users, then you will have a lot of transportation. You mentioned that in your talk. Right now, for the time being, we have a problem of, for instance, Greenpeace organizing demonstrations against transportation of nuclear materials. They have a great influence on the acceptance of the public. It is not only that you have to overcome this educational problem, i.e., to educate new experts in the professional area, but you also have to overcome a problem of public acceptance. For instance, in Germany, we always realized that Greenpeace has the greatest influence on public opinion. That is why the acceptance by the population of nuclear energy is not very large. How would you suggest we overcome this problem?

Lisowski: Educating the population on this is a very difficult issue. It is hard for the Office of Nuclear Energy to take this on because I believe it really requires starting at almost the grade-school level. It is actually something that is an over-arching issue for the education system - ensuring that we educate our children to have a basic understanding of science and what role it will play in their lives. GNEP is limited in what it can do, but if we can convince the public and other parts of the government that closing the fuel cycle is critical to the world's stability and to safeguarding the world's energy supply, then, we will be able to overcome the criticisms of organizations such as Greenpeace. Nevertheless, it is a very long-term activity. It is incumbent on the scientific community and the professional and technical communities wherever possible to talk to people about the risks and benefits of nuclear energy what they really mean to society.

Pam Dawson: When you use the term safeguards, I define that in my world as domestic safeguards to include physical protection, armed forces, safety, and MC&A. Then you talk about nonproliferation and in my world I think of nonproliferation in terms of the threat is the state, the threat against the proliferation of nuclear materials. So now in the context of today's threat and when I say today's threat I am talking in terms of anti-nuclear extremists, terrorist threat, those types of threats. Do you think that advances in physical security systems technology will change the emphasis on protective forces as the primary means of deterrence against those attacks or those possible attacks in transportation, toward the reactors, or any of the fuel site facilities of GNEP? Are you considering that?

Lisowski: That is not an area of expertise for me, so it is hard for me to answer that in detail with any technical fidelity. From a high-level perspective, I think you have to do everything you can do to protect fuel-cycle facilities, because the public is going to demand that, and because it is the right thing to do.

Dawson: So then my next question is has any systems analysis group been considering or are looking at physical protection systems in that true integration to make safeguards truly inherent and an upgrade?

Lisowski: We have had the systems analysis team working with the people designing the facilities. They have been really trying to make sure that the best safeguards are there. The systems analysis does not have the fidelity yet to look in detail at physical protection, so far as I know. There is still a lot missing from the systems analysis, and so that is yet to come.

Stein: I understand that GENEP has a long term perspective at least of twenty years. When you are trying to strengthen nonproliferation and international safeguards with such a time perspective you might think about safeguards scenarios for the future.

Lisowski: The campaign that we have put together to investigate that is going to have to do that and must take a long-term perspective because GNEP literally goes out for the rest of the century.

Johnson: When you negotiate these agreements with other countries, you're talking about agreement in principle. What kinds of things are they agreeing to?

Lisowski: Well, I can read the statement of principles to you since I brought with me the statement of principles actually as it stands—the latest version, which I thought there might be a question about. I also have lots of other information here. So this is the latest version of the statement of principles:

Global Nuclear Energy Partnership
Statement of Principles

Global Nuclear Energy Partnership (GNEP) is cooperation of those States which share the common vision of the necessity of the expansion of nuclear energy for peaceful purposes worldwide in a safe and secure manner to accelerate development and deployment of advanced fuel cycle technologies to encourage clean development and prosperity worldwide, improve the environment, and reduce the risk of nuclear proliferation. States participating in this cooperation would not give up any rights, and voluntarily engage to share the effort and gain the benefits of economical, peaceful nuclear energy.

Commitments and international obligations, including IAEA safeguards and the requirements of UN Security Council Resolution 1540 will be strictly observed. The highest levels of nuclear safety and security will be maintained.

The cooperation will be carried out under existing and, where appropriate, new bilateral arrangements as well as existing multilateral arrangements such as the Generation IV International Forum and the International Project on Innovative Nuclear Reactors and Fuel Cycles.

While recognizing the need for a variety of approaches and technical pathways in achieving a long-term vision of the future global civilian nuclear fuel cycle, which will help ensure that nuclear energy makes a major contribution to global development in the 21st century consistent with non-proliferation and safety objectives, this cooperation will be pursued with the following objectives:

- Expand nuclear power to help meet growing energy demand in a sustainable manner and in a way that provides for safe operations of Nuclear Power Plants and management of wastes.
- In cooperation with the IAEA, continue to develop enhanced nuclear safeguards to effectively and efficiently monitor nuclear materials and facilities, to ensure nuclear energy systems are used only for peaceful purposes.
- Establish international supply frameworks to enhance reliable, cost-effective fuel services and supplies to the world market, providing options for generating nuclear energy and fostering development while reducing the risk of nuclear proliferation by creating a viable alternative to acquisition of sensitive fuel cycle technologies.
- Develop, demonstrate, and in due course deploy advanced fast reactors that consume transuranic elements from recycled spent fuel.
- Promote the development of advanced, more proliferation resistant nuclear power reactors appropriate for the power grids of developing countries and regions.
- Develop and demonstrate, inter alia, advanced technologies for recycling spent nuclear fuel for deployment in facilities that do not separate pure plutonium, with a long term goal of ceasing separation of plutonium and eventually eliminating stocks of separated civilian plutonium. Such advanced fuel cycle technologies, when available, would substantially reduce nuclear waste, simplify its disposition and draw down inventories of civilian spent fuel in a safe, secure, and proliferation-resistant manner.
- Take advantage of the best available fuel cycle approaches for utilization of energy resources.

Other countries that share this vision will be welcome to participate.

Johnson: What do you envision, after that, the role of these other countries?

Lisowski: That will depend on the details of how the partnership is actually organized, However, the next step may well be to organize a group to investigate fuel supply and take back and to put together a way to actually make that come into being.

Pietri: I spent the week in Maine at the ISO standards meeting and the question that was brought up is, what do we as professional societies and technical committees need from GNEP or from someone else in authority to prepare us for the next ten or twenty years? We need to know what direction shall we take because we have gotten into a plateau on the current, and I use the U.S. word, separations rather than reprocessing. What do we need to know from GNEP to prepare for the next generation of technical input to the system? Also, is GNEP thinking about this, are they prepared to provide that insight?

Lisowski: We have developed a baseline separations approach using UREX. We view UREX as having potential advantages in terms of waste forms that are produced and with group actinide separation yielding some advantages in terms of proliferation protection. But there are some disadvantages as well. As you gain more information about this, you step back and you look at it and you always have to ask, “Are we really doing the right thing?” Ideally when GNEP was rolled out we would have had all the answers. It was rolled out with the best information available at the time and a stunning idea. In view of the world situation, including climate change, concerns about proliferation and energy supply - it was precisely the right time to bring GNEP onto the world stage. But, it is going to take time to get the details necessary to fully develop the promise of GNEP in terms of repository benefit and waste management. One way that we are getting answers beyond the ones that have been developed in the laboratories is to bring industry into the picture and ask them, “What are the practical approaches?” We have asked industry to give us both proprietary and nonproprietary reports that we can make the nonproprietary information available to the scientific community. We can then share that information with professional societies and peer-review groups in a way that allows people to understand where we are going, what we are doing, and what we might implement. We want to take what industry believes is necessary for putting technology in place in the near term and make improvements there.

I talked about the program organization. GNEP actually is a very structured organization. We have six technical campaigns and two cross-cut activities aimed at developing solutions to both near-term and long-term problems. We have applied NASA technology readiness level assessment to each individual part of the technology, often at a subsystem or process level to develop an assessment. We have divided the program so that lower technology readiness levels, items that have technology readiness levels that are far from ready to be commercialized or implemented are actually driven by activities determined by technical experts at national laboratories. Activities that have higher technology readiness levels are actually driven by the needs of the three projects that we have within GNEP, the reactor project, the recycling facility, and the advanced fuel cycle facility for R&D. The projects provide a set of systems requirements to the technology program which then addresses those issues.

Matter: This morning you presented a vision of the roles for the government, the national labs, and industry in GNEP. Is the nuclear industry accepting that vision? Or do they see things differently, and are they going in a different direction?
Lisowski: To date we have not talked very much with industry on a one-on-one basis simply because we knew there was going to be a grant process to fund them. As a result, their view of how GNEP is viewed is not as clear. Once we actually make awards, it will be possible for us to work with them and have them work with the national laboratories as real partners. I believe once they understand how we want to make GNEP work, they will become engaged. Early in the program we sent a letter to the laboratory directors telling them that we were considering the laboratories as government-furnished services and government- furnished equipment to assist industry in developing GNEP technology, and that funds would be supplied through the Department of Energy to the laboratories in order to make that happen. We stated that any "work for others" for industry involved in GNEP would need to be cleared with the department in advance of signing an agreement with industry. So far we have had excellent cooperation from all the national laboratories and from industry.
Mangan: I would like to close by saying I think your presentation today was just outstanding. I believe the formal paper will be highly referenced by various people as kind of like a bible of what GNEP is today. I want to thank you for letting us ask you questions, taking pot-shots at you, but you have been very, very gracious and I want to thank you very much.

A Summary of the Closing Plenary Session of the 48th INMM Annual Meeting

Amy Whitworth
Chair, Government-Industry Liaison Committee

In planning this year's Closing Plenary program, the Government Industry Liaison Committee discussed speakers and potential topics that would be timely and provide additional information on key topics of high interest to the nuclear materials management community. The Global Nuclear Energy Partnership (GNEP) and World Institute of Nuclear Security (WINS) are two topics that clearly fall into the category of high interest. GNEP is of paramount interest to the community with its comprehensive strategy to increase U.S. and global energy security, reduce the risk of nuclear nonproliferation, encourage clean development around the world, and improve the environment. WINS is also attracting significant attention within the community with its efforts to bring the international community together to strengthen security of nuclear materials by the global sharing of best practices.

We were fortunate to have two very distinguished presenters, James Tape and Adam Scheinman. Tape, a former employee of Los Alamos National Laboratory and currently a consultant, is a member of the WINS Coordination Committee and spoke about the WINS efforts to date and next steps. Scheinman, assistant deputy administrator for nonproliferation and international security for the U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA), spoke about the GNEP nonproliferation efforts. Summaries of these presentations are published here.

Attendance at this Closing Session remained high with more than 300 conference attendees present. It is the goal of the Government Industry Liaison Committee to maintain this high level of quality for future Closing Plenary sessions.

James Tape

Development of a World Institute of Nuclear Security

Tape discussed Developing the Concept for a World Institute of Nuclear Security (WINS), Progress and Prospects on the Promulgation of Nuclear Security Best Practices. He described the history of the WINS concept, its development, and possible organizational structures. In addition, he provided examples of nuclear security best practices and outlined next steps.

In his presentation, Tape noted that the collection and development of best practices (or good practices) has become a common management activity involving, for example, information exchanges, site visits, benchmarking, lessons learned, and peer reviews, leading to improved performance in a variety of processes.

The Nuclear Threat Initiative (NTI) and INMM collaborated on a nuclear security best practices workshop in Prague in June 2004. NTI president Charles Curtis' INMM plenary address in July 2005 challenged the INMM to help identify and institutionalize the sharing of nuclear security best practices globally. A committee of INMM Fellows developed ideas for an organizational entity and activities to facilitate the promulgation of nuclear security best practices and proposed the name—World Institute for Nuclear SecurityWINS—in December 2005.

Tape described some of the nuclear security challenges and opportunities.

New threats include motivated, capable, and determined terrorist organizations or rogue states. New opportunities for strengthening nuclear security take advantage of world attention and reaction to these threats, including the IAEA nuclear security program, the Global Initiative to Combat Nuclear Terrorism, the Convention on the Physical Protection of Nuclear Materials, UN Security Council Resolution 1540, and the Nuclear Terrorism Convention. Other opportunities are new institutional arrangements to limit numbers and locations of facilities with the most attractive materials, new technical measures to reduce the attractiveness and accessibility of nuclear materials, and anticipated growth and expansion of nuclear energy.

Best practices in nuclear materials management include the sharing of best practices and benchmarking procedures. This has been accomplished through INMM meetings and workshops, the *Journal of Nuclear Materials Management*, the work of INMM technical divisions and chapters, ESARDA meetings, the American Nuclear Society, and within the industry.

The presentation outlined examples of best practices used in the nuclear community. The World Association of Nuclear Operators (WANO) describes good practices as a technique, program, or process that has proven particularly effective at improving safety and reliability at one or more nuclear power plants. WANO also observes that the identification of good practices and bringing them to the attention of other members is a good practice. WANO facilitates operator exchanges, which includes sharing plant operating experience and ideas for improvement through face-to-face communication, emulating each other's best practices, exchanging visits and exchange personnel, and sharing documentation.

DOE's Energy Facility Contractors Group defines the term "best practice" as a practice with redeeming qualities and attributes that have been proven through implementation and would be beneficial for others to use. The term does not mean the best of all similar practices. Best practices typically are a proven and practiced system, process, or program that has been recognized by managers as having positive attributes, would be applicable complex-wide, and is supportive of continuous improvement in a topical area.

In the presentation, Tape posed the following question: How can collecting and promulgating nuclear security best practices help mitigate the threat? The answers may be to work at the grass roots, facility-operator level, in a manner that complements and supplements other (e.g., International Atomic Energy Agency (IAEA), government/regulator) efforts, and establishes a forum for exchange of ideas, involving practitioners rather than policy makers. That leads into a question of how the nuclear materials management community can help.

The INMM Executive Committee (EC) established a WINS Steering Committee (SC) in March 2006. Representatives from NTI and DOE attended the EC meeting and agreed to establish a WINS Coordinating Committee (CC) to manage a WINS concept development project, with representative from each of the three organizations (the co-authors of this presentation—James Tape and John Matter—INMM, Joan Rohlfing and Corey Hinderstein—NTI, and Joyce Connery—DOE-NNSA). The CC, SC, and EC agreed that the initial effort of the project should focus on international outreach and socializing the WINS concept. Contact with the IAEA was the first priority.

The presentation summarized coordination activities with the IAEA Nuclear Security Program. A key issue was how could the WINS concept complement and supplement the very extensive IAEA nuclear security program as described in Anita Nilsson's comprehensive presentation to INMM in July 2006. WINS would focus on facility operators, whereas the IAEA works with states. WINS could also include operators from military nuclear facilities. Expertise and activities in WINS could also supplement IAEA programs.

International outreach and socialization was promoted through an international experts meeting to explore the WINS concept in November 2006 in Baden, Austria. There were twenty-five participants from seventeen countries, including the IAEA, government regulators, ministries, and private industry. There was a general consensus on the value of the WINS concept, the need for further development, and to take a step-by-step approach. The initial focus was on nuclear security for highly enriched uranium and plutonium. The experts suggested pilot projects could be used to demonstrate the value of WINS-type activities.

Tape described briefly three possible WINS organizational models: a contact experts group, which would have a low overhead operation with perhaps a director and administrative staff to bring experts together on a regular basis; a WANO-like association of operators; or a business entity with a board of directors, office space, professional staff of in-house experts. Further discussion of organizational structure with a small group of international participants is planned for fall 2007 in Washington, D.C.

Examples of nuclear security best practices drawn from previous INMM workshops were outlined. For example, the Prague Workshop recommended using a graded approach to implement requirements and to instill a "security culture" in all organizations with operational responsibility for nuclear facilities, using international resources and working cooperatively. The Holdup Workshop in the United States emphasized the importance of understanding facility needs for the holdup measurement and its use; predicting holdup location before construction, and adjusting designs to minimize holdup; allowing holdup measurement equipment introduction; and supporting reference material fabrication and funding training. The May 2007 Risk Management Workshop emphasized employing a risk management approach for nuclear security, establishing a "design basis threat" policy, designing protection systems using a systems approach, and using performance testing and conducting vulnerability assessments.

Tape described the next steps in addition to holding a WINS organizational structure meeting in 2007, there will be a research reactor operators' nuclear security best practices workshop in Norway in October 2007. The WINS CC will continue international outreach and coordination with the IAEA; continue to socialize the concept and collect ideas to support the WINS concept development; expose senior managers and government officials to the WINS concept and develop leadership support; seek support for additional pilot workshops; and expand efforts to collect and disseminate best practices (a key opportunity for INMM to do more!).

Tape concluded with the following points. There appears to be broad international support for the WINS concept—"if WINS existed, we would make use of it." There are best practices in nuclear security that can be shared. There remains much work to be done and support to be generated—patience and determination are required. INMM should continue to support the development of the WINS concept.

Adam Scheinman

Scheinman began his discussion by referencing the opening plenary conference speech by Paul Lisowski on the future on nuclear power and the U.S. Global Nuclear Energy Partnership (GNEP). He continued stating that he would be addressing nuclear energy's growth in the context of our nonproliferation efforts and where we may be headed. We have many possible futures, but our task is to work to bring about a future and conditions that provide for more nuclear energy with less proliferation, more cooperation on the means to prevent proliferation and if possible reverse it, and consensus on measures to keep the global system strong.

As background, Scheinman spoke of concerns involving Iran, North Korea, and nuclear terrorism, which together have the potential to unleash serious consequences. On the other hand, Iran and North Korea are isolated and subject to UN Security Council sanctions because of proliferation activities, and there is universal agreement that neither regime should acquire or keep nuclear weapons. If there are differences on approach, they are tactical not strategic.

Scheinman asked whether this argues for standing still on nonproliferation? The answer, he said, is no. A lesson from the history of nonproliferation is that the regime and associated elements must continue to evolve to meet a shifting environment. He mentioned the following examples of such change:

- International safeguards and nuclear export controls have been substantially updated since the end of the Cold War
- New UN Security Council authorities and related instru ments that address terrorism and proliferation have been adopted or improved
- Huge progress has been made dealing with legacy Cold War nuclear materials

He noted that these actions to improve the regime have come in response to, not in anticipation of, crisis. We can do better, but this will require political will, resources, and impetus. It will require nuclear energy's resurgence as a clean source of power. The U.S. Energy Information Agency predicts 75 percent growth in world electricity demand by 2025 and a greater increase by mid-century. Nuclear power is the most promising available, clean technology to meet these base load requirements.

Scheinman believes we can grow nuclear power securely by putting in place a strategy for which nonproliferation remains an over-riding global interest, major challenges to the system are contained (Iran and North Korea), and gaps in the regime are closed to buffet it against a new or unanticipated blow. That strategy would cover the following four priorities:

1) *Fissile materials stocks must be secured.* Fissile materials stocks must be secured and civilian stocks of direct-use materials drawn down or eliminated. Enormous resources have been allocated for these and related efforts. In 1992, the budget for threat reduction was tens of millions of dollars. In 2008, there is a projected $1.3 billion for threat reduction. In the civilian sector, the trends are less favorable. Stocks of separated plutonium are currently on the order of 250 metric tons. Plutonium in the world inventory of civilian spent fuel is even greater, exceeding historical weapons stocks by a factor of ten. GNEP offers a new way forward: one with advanced recycle technologies that avoid the separation of pure plutonium and its accumulation; one that draws down stocks of plutonium already separated or in spent fuel using fast burner reactors; one that incorporates nuclear material forms that are less easily made into nuclear weapons that separated plutonium and are less attractive to terrorist or proliferators; and one that promotes cradle-to-grave fuel services.

2) *Limiting the further spread of enrichment and reprocessing technologies.* The greatest proliferation risk associated with nuclear power's resurgence comes from the possibility that sensitive fuel cycle plants will spread and be misused to produce material for weapons. In 2004, U.S. President George W. Bush recommended measures to prevent nuclear proliferation. This included the world's leading nuclear exporters should ensure that states have reliable access at reasonable cost to fuel for civil reactors. GNEP expands on the Bush's proposal by offering comprehensive nuclear fuel services for countries that might otherwise consider developing their own enrichment and reprocessing plants. There is a dilemma in that GNEP styled recycle technologies may not be available for years, whereas proliferation and interest in nuclear power are issues to be addressed today. Interim solutions will be needed. The good news is that there is not now a problem in the commercial nuclear fuel market and there is no shortage of fuel service proposals. What is needed is implementation and action.

3) *Promoting and building national capabilities for nonproliferation.* Proliferation support is not limited to a handful of supplier states. All states are vulnerable to exploitation by proliferation networks – those with weak regulatory, border, or export policing capacities present even easier targets. A reasonable expectation is that states will implement and enforce the controls and practices needed to block determined proliferators. Cooperation and assistance should be offered for those who need it. Priority should also be given to updating international standards and practices, including the physical protection guidelines in INFCIRC/225 and new guidelines for the management and minimization of HEU in civil use.

4) *Revitalizing international safeguards.* Revitalization of international safeguards is critical and a prerequisite for the safe and secure expansion of nuclear power. IAEA safeguards provide irreplaceable assurances of peaceful use, deter diversion through the threat of detection, and ultimately help promote transparency and stability. By exposing violators, safeguards also provide an internationally accepted tripwire for sanctions and enforcement by the UN Security Council. There are two sets of challenges facing international safeguards. One relates to legal authorities and access to information and locations in making compliance determinations. The other relates to the adequacy of resources, technology and expertise to manage IAEA's increasing scope of responsibility. Improved safeguards technology is needed for the

current generation of nuclear energy systems and to strengthen capabilities to detect undeclared nuclear activities.

Scheinman suggested that follow through will require political consensus. Nonproliferation takes many forms, but its power is rooted in agreement among states that the spread of nuclear weapons would cause far more harm than good. Some will criticize GNEP and related proposals as eroding that balance and perpetuating an already discriminatory system. Scheinman believes reasonable countries will see the prospect of reliable fuel services and, as the United States and Russia recently proposed, new and attractive opportunities to participate in nuclear power projects as a sensible trade-off for avoiding the unnecessary spread of enrichment and reprocessing capabilities.

Scheinman closed where he started by stating “there are many possible nuclear futures.” We are nearing a fork in the road between a world of more nuclear energy and less proliferation and its antithesis – new proliferation risks and deferral of nuclear energy as a serious option. Scheinman believes the first possibility can be achieved. But to get there, we should acknowledge that success will be measured not just by technical fixes, but by our ability to cooperate and raise the political, institutional, and cultural barriers to proliferation needed to make nuclear energy a viable option through the next century and beyond.

Thirty Years since the Creation of INMM Japanese Chapter

Kaoru Naito, Vice President, INMM Japan Chapter, President, Nuclear Material Control Center
and
Takeshi Osabe, Secretary, INMM Japan Chapter, Technical Advisor, Nuclear Material Control Center

On behalf of Japan Chapter, let us first express our sincere appreciation of the kind recognition of our thirtieth Anniversary by INMM at the Annual Awards Banquet, on July 10, 2007, at the 48th INMM Annual Meeting, in Tucson, Arizona, USA. It was a great honor for us to receive a beautiful plaque on which the following sentence is inscribed:

> The Institute of Nuclear Materials Management recognizes the Japanese Chapter for 30 years of dedicated service to the Institute of Nuclear Materials Management; and to the international nuclear community by promoting safeguards and verification, safety and security, and science and technology.

With the great assistance of the parent organization, INMM, and especially Roy Cardwell, then president of INMM, Japan Chapter came into existence as the first chapter of INMM in 1976, when most of the U.S. members were celebrating the bicentennial year of U.S. independence.

In the same year, Japan ratified NPT, and it was in the following year of 1977 that the relevant Japanese domestic law and related regulations were revised in order to accommodate the provisions of the NPT safeguards agreement concluded between Japan and the IAEA, which entered into force in December 1977.

In this context, INMM Japan Chapter was created. Ever since, Japan has been exerting her efforts to materialize the effective and efficient IAEA safeguards system. In 2004, we became the first country among those with a fully developed fuel cycle to obtain the broad conclusion that there had been no indication of diversion of declared nuclear materials and no indication of existence of undeclared nuclear materials and activities. This enabled Japan to shift into integrated safeguards in a phased manner. We believe that INMM Japan Chapter made a modest contribution to this achievement.

The Japan Chapter has been successful in bringing together the people in different sectors, i.e., industry, academia, and government, who are involved in nuclear material management, and also in nurturing the safeguards culture in Japan. We owe much to all INMM members who supported and helped our chapter over the last thirty years. We also recognize the unfailing support and assistance rendered by Japan Chapter members, and those in Japanese government agencies, academia, and industry. Special thanks should be given for the invaluable support of Nuclear Material Control Center (NMCC) for the daily operation of our chapter by providing an office space, personnel assistance and so forth.


Nancy Jo Nicholas, president of INMM at the Chapter's 27th annual meeting commemorating Chapter's 30th anniversary

We commemorated our thirtieth anniversary at our Chapter's 27th Annual Meeting held at Techno Community Square Rikottee in Tokai-mura, Ibaraki, Japan on November 16-17, 2006. We were very much honored by the presence of Nancy Jo Nicholas, president of INMM as a keynote speaker at this commemorative event. Other foreign guest speakers included Hun-Gyu Lee, president, Korea Institute of Nuclear Nonproliferation and Control (KINAC); Russell Leslie, director, International Safeguards Section, Australian Safeguards and Nonproliferation Office (ASNO); and Roger Howsley, director, Security, Safeguards and International Affairs, British Nuclear Fuels plc (BNFL). Dr. Rainosuke Hara, one of the founders of Japan Chapter and Ex-President/CEO, Seiko Instruments, Inc., also made a keynote lecture, outlining how the special technologies developed and utilized in safeguards/nuclear materials management had been successfully applied in our daily life for enhancing its quality and convenience.

When we started the Japan Chapter, we had only a handful number of members. After thirty years, the membership has now grown to 130, the largest chapter in the whole INMM family.

Some of the highlights in the chronicles of our chapter are listed in this article.

During the first two decades since its founding, our chapter's regular activities were limited to holding annual meetings because of small membership and unavailability of working funds other than membership dues. However, we strived for a new business strategy that would allow us to meet the objectives and the role of INMM. In 1996, Our chapter's Executive Committee (EC) authorized initiating a sustaining membership regime that is unique to the chapter. This enabled us to embark on a new business program such as conducting periodical technical workshops and upgrading secretariat activities in a stepwise fashion.

Invited speakers and Japan Chapter's Executive Committee members

Meantime, a planning committee was created under the EC to plan and implement a detailed annual business program such as conducting technical workshops, holding technical tours to nuclear related facilities, peer reviewing the Japanese translation of major articles in *JNMM* and so on. The committee also exerted their efforts in the development of Japan Chapter's Web site that came into existence in November 2005 (http://www.jnmcc.or.jp/~inmm/). Unfortunately it is only in Japanese at present.

In addition, the Annual Meeting Program Committee has been established under the EC to plan and conduct the chapter's annual meetings that are normally held in November each year.

Our EC meetings are held normally once every three months with the participation of EC members, including immediate past president of Japan Chapter, chair of the Planning Committee and, as appropriate, the chair of the Annual Meeting Program Committee in order to deliberate and decide on the issues related to the management of our chapter such as formulating a business and financial plan for each fiscal year, formulating a business and financial report of the previous fiscal year, approving detailed management rules and regulations, and authorizing the proposals made by the Planning Committee and the Annual Meeting Program Committee.

As a part of the program for commemorating INMM's 50th Anniversary, we are planning to host an INMM/ESARDA workshop with a tentative title of "Meeting Safeguards Challenges in an Expanding Nuclear World – Safeguards for a Growing Nuclear Market" in Tokyo, October 6-9, 2008. We hope that many INMM members will have the opportunity to participate in this important event.

The Japan Chapter is determined to continue to be actively engaged in the established business program such as holding annual meetings and technical workshops. However, looking for the future, one of the most urgent challenges to our chapter is how to nurture those persons who will carry forward the chapter's mission, in view of the ageing membership demography and a very small students membership. In order to meet the challenge, it is imperative to raise the interest of young generations on our activities as well as to increase collaborations with academic circles. Our chapter should play a role of mentoring them so that the knowledge and experience of nuclear materials management could be carried forward. In this context, the parent organization, INMM, has set a good model to follow, emphasizing the importance of enhancing student activities. We hope that you will help us in this regard.

In Japan and also elsewhere in the world, you are supposed to reach manhood or womanhood at the age of twenty. However, according to the teachings of Confucius, a great Chinese philosopher who lived from 552 to 479 B.C., at the age of 15, he already had his mind bent on learning. At the age of 40, he became totally free from vacillation. Then, what about the age of 30? Does he say anything about the age of 30? Yes, he says: he could finally stand on his feet.

If he had set a standard to follow, the Japan Chapter has definitely passed the age of maturity, which is 20, but may still lack decision, which you attain at the age of 40. Therefore, we still need the active advice and guidance of the parent organization. We hope that you will continue to do so.

Let us reiterate our sincere appreciation of your unchanging

N.J. Nicholas, President of INMM at the Chapter's 27th annual meeting commemorating the chapter's 30th anniversary

support and guidance over the course of our thirty years of progress. Thank you very much and wish you ever more the success and the prosperity of INMM, our parent organization.

Some Highlights in Japan Chapter's History

- A kick-off meeting to create INMM Japan Chapter was held on May 6, 1976, chaired by Yoshio Kawashima and the petition for establishment of the chapter was sent to the INMM Executive Committee in September 1976.
- The INMM Executive Committee approved Japan Chapter's Constitution and Bylaws in July 1977.
- The chapter's first Executive Committee Meeting was held on January 19, 1978, at Nuclear Material Control Center, Tokyo. The chapter's annual membership dues, candidates for member-at-large, and the election procedure for executive officers were discussed.
- The charter of the chapter was presented by Roy Cardwell, then president of INMM, on April 11, 1978, at Japan Chapter's headquarters in Nuclear Material Control Center, Tokyo.
- The first Annual Meeting of the chapter was held on September 28, 1979, at Nuclear Material Control Center, Tokyo with seventy-two participants. Subsequently, the chapter's annual meeting has been conducted regularly. A typical annual meeting runs for two days, consisting of invited lectures, a panel discussion, if necessary, and technical sessions for presenting technical papers. At each annual meeting, three outstanding technical papers are selected by Program Committee for recognition. Japan Chapter's business meeting is normally held in conjunction with an annual meeting.
- In order to vitalize the chapter's activities, Executive Committee approved the establishment of Planning Committee on November 7, 1986.
- In March 1988, the Japan Chapter became an ex-officio member of the INMM Executive Committee.
- Roy Cardwell, past president of INMM who contributed greatly to founding of the Japan Chapter, and Charlie Vaughan, then president, were invited to the 10th Annual Meeting, commemorating the chapter's 10th anniversary, which was held on June 9, 1989.
- Howard Menlove, Los Alamos National Laboratory, delivered a lecture titled "Cold Fusion" at Tokyo University of Technology in August 1989. The meeting was conducted in collaboration with Atomic Energy Society of Japan.
- The Chapter's Executive Committee members and Dr. Lowenstein, then president of ANS had a Roundtable Conference in Tokyo, on September 11, 1989, to discuss the future direction and the possible collaboration between ANS and INMM.
- Since 1977, the chapter has been playing a major role in peer reviewing and selecting Japanese technical papers to be presented at IAEA Safeguards Symposia. The chapter also provides financial aids for social activities of the symposium through the INMM Vienna Chapter.
- Since 1990, in order to encourage the chapter's members to participate in INMM annual meetings, the chapter has been organizing, when possible, a technical observation mission to leading U.S. nuclear related installations in conjunction with an INMM annual meeting.
- Since 1993, the chapter has been conducting technical workshops for chapter members, providing them with the opportunities to study a wide range of nuclear materials management technologies. Currently, six workshops are being conducted every year.
- In 1996, the chapter's Executive Committee authorized to establish the Japan Chapter's own sustaining member-ship system to enhance chapter's financial foundation.
- In July 1996, INMM Executive Committee approved the modification of the Japan Chapter's bylaws that allowed the increase of the number of members-at-large from four to six.
- On October 22, 1999, the Chapter's Executive Committee approved the creation of Student Membership.
- In July 1999, INNN Executive Committee approved the modification of the chapter's bylaws that allowed the appointment of an auditor from the chapter's membership who was assigned the task of auditing chapter's financial

activities.

- May 14-16, 2003, International Seminar was held in Tokyo, in corroboration with INMM, the Japan Chapter and Central Research Institute of Electric Power Industry.
- The 3rd INMM/ESARDA workshop was held in Tokyo, from November 13-16, 2000, on the theme of "The Science and Modern Technologies for Safeguards." There were nintey-three participants. The 6th INMM/ESARDA workshop will be held in Tokyo October 6-13, 2008, as mentioned above.
- On January 27, 2004, the INMM Japan Chapter and the Japan Atomic Industrial Forum jointly held a workshop on Non-proliferation and Safeguards in Tokyo.
- In order to disseminate the chapter's activities to the general public and enhance the utility for the cchapter members, the chapter's own Web site was created on November 1, 2005. The Web site constitutes of the following: What is INMM, How to Join the INMM, Event Information, INMM President Message and *JNMM* Editor's Note on *JNMM*. It is available only in Japanese now.

Past Presidents

1977–1984	Yoshio Kawashima
1984–1986	Ryohei Kiyose
1986–1992	Mitsuho Hirata
1992–1998	Tohru Haginoya
1998–2004	Shunji Shimoyama
2004–present	Kaoru Samejima

Officers and Executive Committee Members as of August 1, 2007

President:
Kaoru Samejima
Vice President:
Kaoru Naito
Secretary:
Takeshi Osabe
Treasurer:
Manabu Masuda

Members-at-Large:
Yoshifumi Abe
Kazunori Fujimaki
Nobuo Ishizuka
Tetsuzo Oda
Masao Senzaki
Yoshinori Shinohara
Auditor:
Tomohiko Kita

INMM Award Recipients

Distinguished Service Award

Haruo Natume	(1988)
Mitsuho Hirata	(1992)
Tohru Haginoya	(1997)
Hiromasa Nakano	(2000)
Hiroyoshi Kurihara	(2003)

Meritorious Service Awards

Takeshi Osabe	(1995)

Special Service Award
Power Reactor and Nuclear Fuel Development Corporation (1990)
Nuclear Material Control Center (1994)

Fellow

Takeshi Osabe

Senior Members (as of August 1, 2007; by order of recognition)

Mitsunori Akiba
Kouji Ikawa
Hiroshi Okashita
Takeshi Osabe
Hiromasa Nakano
Hideo Nishimura
Hiromasa Sano
Masayori Tsutsumi
Kaoru Naito
Mitsuho Hirata
Manabu Masuda
Tadatsugu Ishikawa
Takeo Adachi
Keisuke Kaieda
Shunji Shimoyama
Masahiro Kikuchi
Nobuo Ishizuka
Shoko Iso

Japan Chapter at Inauguration

MCNP-PoliMi Simulation of Neutron Radiography Measurements for Mass Determination for a Trough of UO_3

J. D. Williams Student Paper Award – 1st Place

B. R. Grogan, J. T. Mihalczo, J. A. Mullens
Oak Ridge National Laboratory
Oak Ridge, Tennessee, USA

Abstract

The Nuclear Materials Identification System (NMIS) with a deuterium–tritium neutron source has been used to image fissile material inside containers to determine geometry. This paper investigates the possibility that the NMIS could be used to determine the mass of UO_3 powder of variable shape or density in a container of arbitrary but known shape. The MCNP-PoliMi computer code was used to model measurements of several fill scenarios of a trough-shaped container by the NMIS to estimate how accurately the mass of the UO_3 powder could be determined.

Introduction

The Nuclear Materials Identification System (NMIS) was developed at the Oak Ridge National Laboratory and at the Y-12 National Security Complex for the purposes of characterizing both fissile and nonfissile material.[1] The NMIS uses active neutron interrogation to conduct nonintrusive scans. In the past, the NMIS has been used to image the contents of sealed containers and other objects that could not readily be opened and physically inspected.[2, 3] In this paper, NMIS measurements were simulated using MCNP-PoliMi to determine if the system would be useful in determining the mass of UO_3 powder of unknown distribution and density in a container of known shape.

The NMIS consists of three components: a neutron source, two or more fast detectors, and computer hardware and software that measure time correlations between the detectors to ~1-ns accuracy.[4] In the modeled configuration, an associated-particle sealed-tube neutron generator (APSTNG) is used for the neutron source. The D-T reaction in the APSTNG produces an alpha particle and a 14.1-MeV neutron that travel away back-to-back. An alpha detector attached to the DT generator defines a fan of neutrons traveling toward the fast detectors, in the opposite direction of the alpha particles.[5] This fan of neutrons is aimed toward the target of interest, and other detectors are placed on the opposite side of the target. The NMIS processor records each alpha particle detected as well as any pulses in the other detectors. It then calculates, in real time, the time-dependent coincidences between the alpha detector and each of the other detectors.[1]

In order to model this NMIS measurement, the MCNP-PoliMi code was used. The PoliMi code was developed from the standard MCNP-4c code.[6] The methods used by the standard MCNP code will sometimes model the physics of a single interaction incorrectly for reasons of efficiency.[7] While these methods may produce excellent results when averaged over a large number of particle histories, they are not satisfactory when the measured quantity involves the time-dependent correlation of individual particle histories. [7] MCNP-PoliMi models each neutron–nucleus interaction as closely to physical reality as possible in order to accurately track each particle for time-of-flight measurements.[6]

Simulation

The simulations were modeled using the MCNP-PoliMi computer code. The target of the simulation was modeled as a stainless steel trough-shaped container based on a design that might be used to store UO_3 powder. The container walls were 0.95 cm thick and constructed with SS 304L stainless steel. The bottom of the container was rounded, with an interior radius of 6.35 cm. Overall, the exterior of the container was 45.7 cm long, 18.9 cm tall, and 14.6 cm wide. Inside the container was placed a quantity of UO_3 powder of unknown mass and density profile. Figure 1 shows a diagram of the container.

The APSTNG was modeled as a monoenergetic 14.1-MeV neutron source. The neutrons were generated in a fan 45 degrees wide by 10 degrees high, the same as the neutron fan defined by the alpha detector on the physical APSTNG. The centerline of the

Figure 1. Diagram of the UO_3 trough

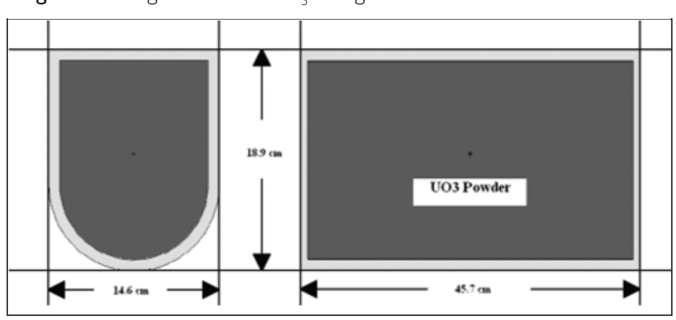
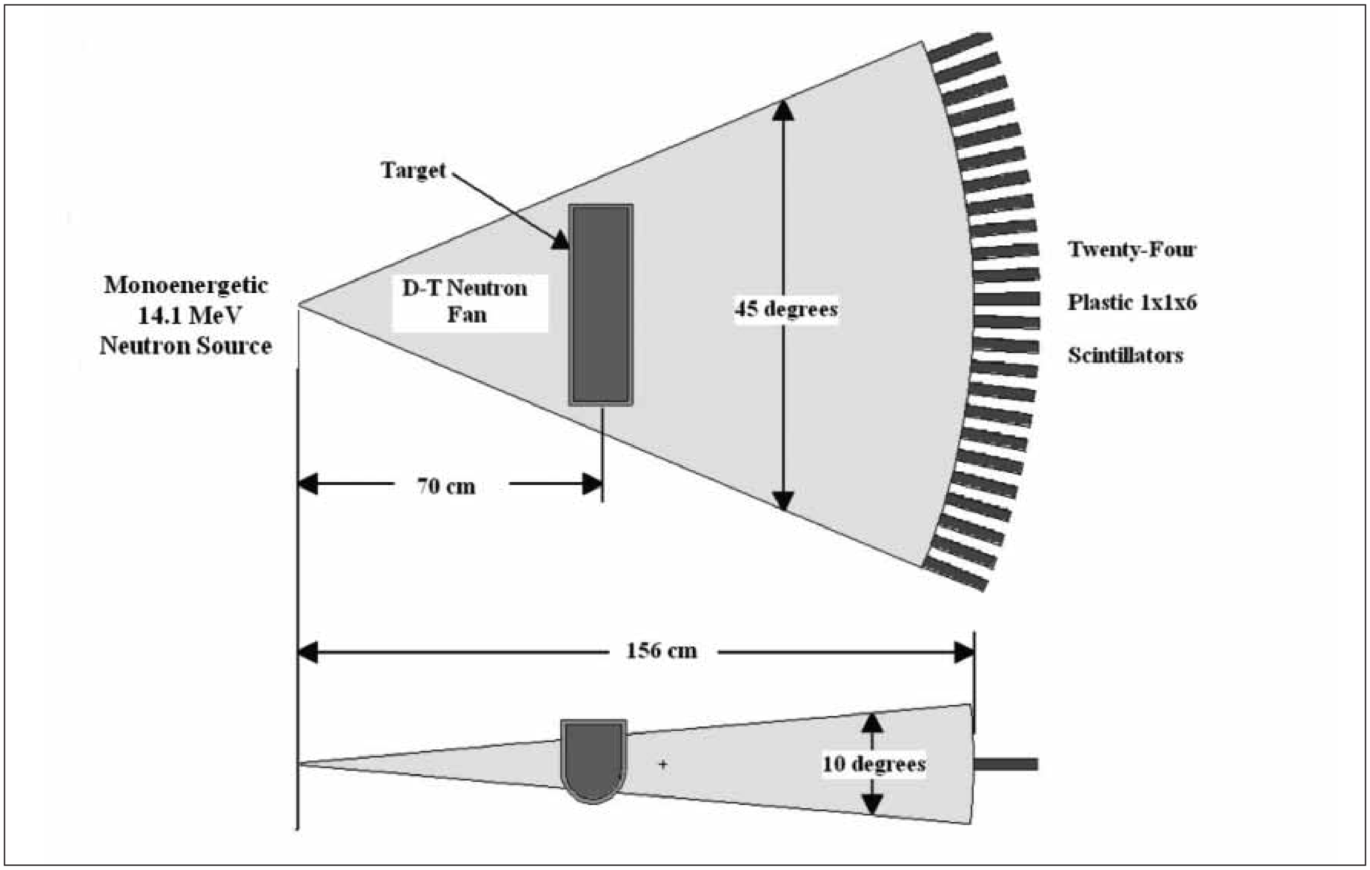


Figure 2. MCNP-PoliMi problem geometry

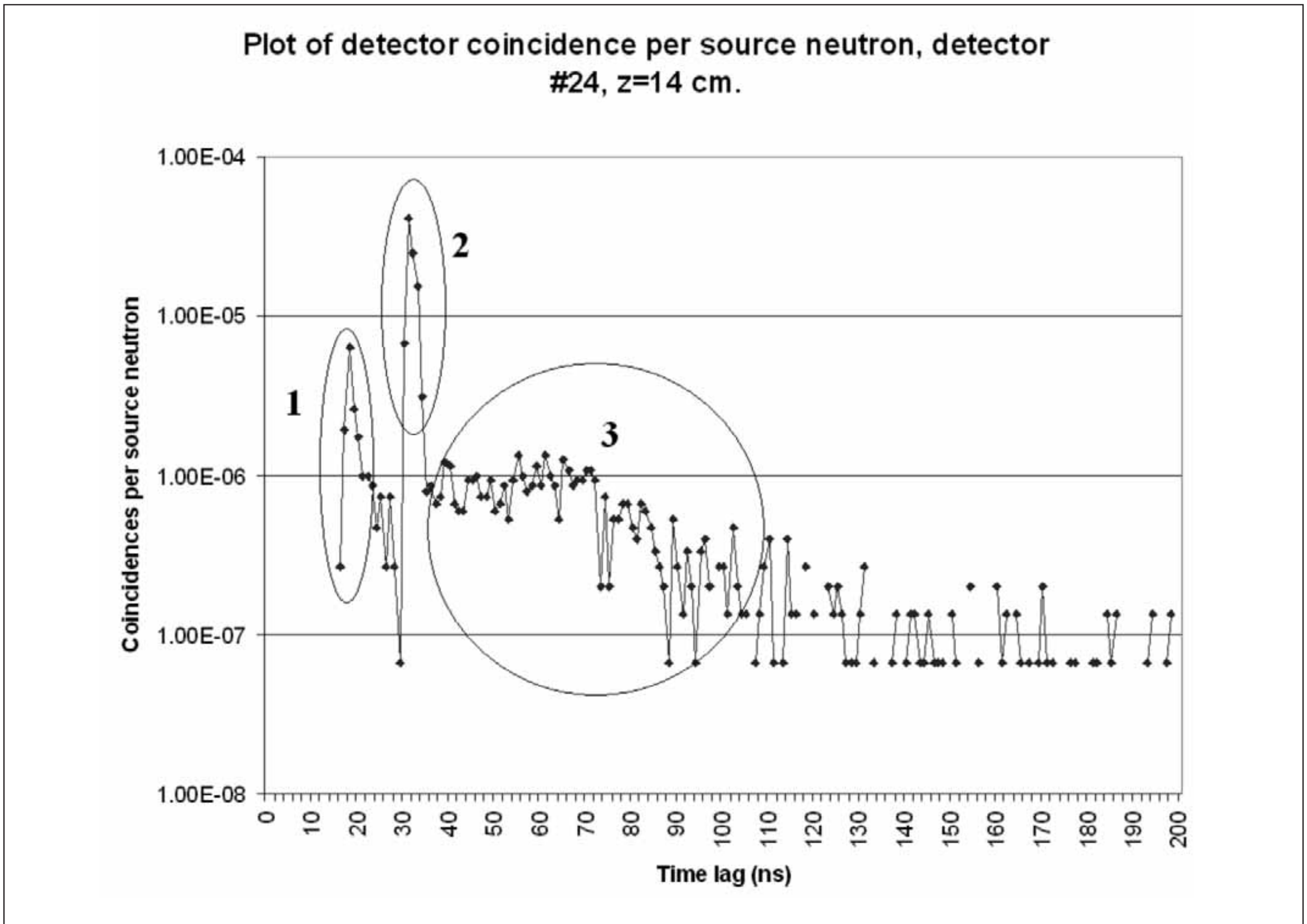


trough was placed 70 cm away from the source and the front faces of the detector array were placed on a circular arc 156 cm away. Twenty-four 1 x 1 x 6 in. fast plastic scintillators were modeled for each simulation and spaced so that there was one open position between each pair of detectors. A second MCNP-PoliMi run then shifted each detector one position to the left so that the entire horizontal arc of the APSTNG was covered. Vertically, the source and the detectors began approximately 1 cm below the container bottom, and they were then raised in 1 cm increments until they were approximately 1 cm above the top of container. In total, there were two MCNP-PoliMi runs at each height and 22 heights, for a total of 44 PoliMi runs per simulated container measurement. These measurements define a radiograph with 1056 total pixels of resolution. A setup of the problem geometry is shown in Figure 2.

The APSTNG generates approximately 3 x 10^7 14.1-MeV neutrons per second isotropically. The modeled D-T fan covers approximately 3.47 x 10^{-3} of the total solid angle, and the alpha detector was assumed to have an efficiency of approximately 8 percent, which is the approximate efficiency of the alpha detector currently in use on the APSTNG.[8] In MCNP-PoliMi, source neutrons were generated only in the fan beam. 8.85 x 10^4 source neutrons in the MCNP-PoliMi neutron fan are approximately equal to 1 second of measurement time. In a typical measurement, the NMIS processor gathers 10^7-10^8 blocks of data, with each block consisting of 512 ns of data. In order to match the MCNP-PoliMi simulations with the physical NMIS configuration, each individual simulation was given a source term (nps card) that was an even multiple of 8.85 x 10^4 x 5.12 s = 4.53 x 10^5 neutrons. For forty-four measurements, this equates to 225 s (3.75 min) of total measurement time (excluding the time required to move the source and detectors between each measurement). Although the NMIS software allows for smaller measurement times, they are impractical in this case because of the hardware movement times.

The first two MCNP-PoliMi simulations consisted of two long reference measurements. These two simulated measurements were made for the purposes of determining the neutron transmission through the UO_3 powder as a function of density. The first modeled an empty container, and the second a container with a known configuration of UO_3 powder, in this case, completely filled with a density of 8.00 g/cm3. Each reference simulation had a total of 4.53 x 10^7 neutrons per PoliMi run. Summed over all forty-four detector positions, this is equivalent to a total of approximately 6.25 h for a physical measurement. The simula-

Figure 3. Time-correlation graph of time-dependent source-detector coincidences with three regions of interest labeled



tions were each broken down into three equal parts. Each part was run with a different random number seed (using the DBCN card) to ensure that the results were not unduly influenced by a single random number. MCNP-PoliMi produced a data file that contained every neutron and gamma collision in the detector cells. The MCNP-PoliMi post-processor was run to extract only those collisions that would produce a light pulse of 1 MeVee (MeV electron equivalent) or greater in a physical detector.[6] These pulses were then correlated with the source-particle number to produce a time-correlation graph. Figure 3 shows a typical time-correlation graph that has been normalized to show coincidences per source neutron.

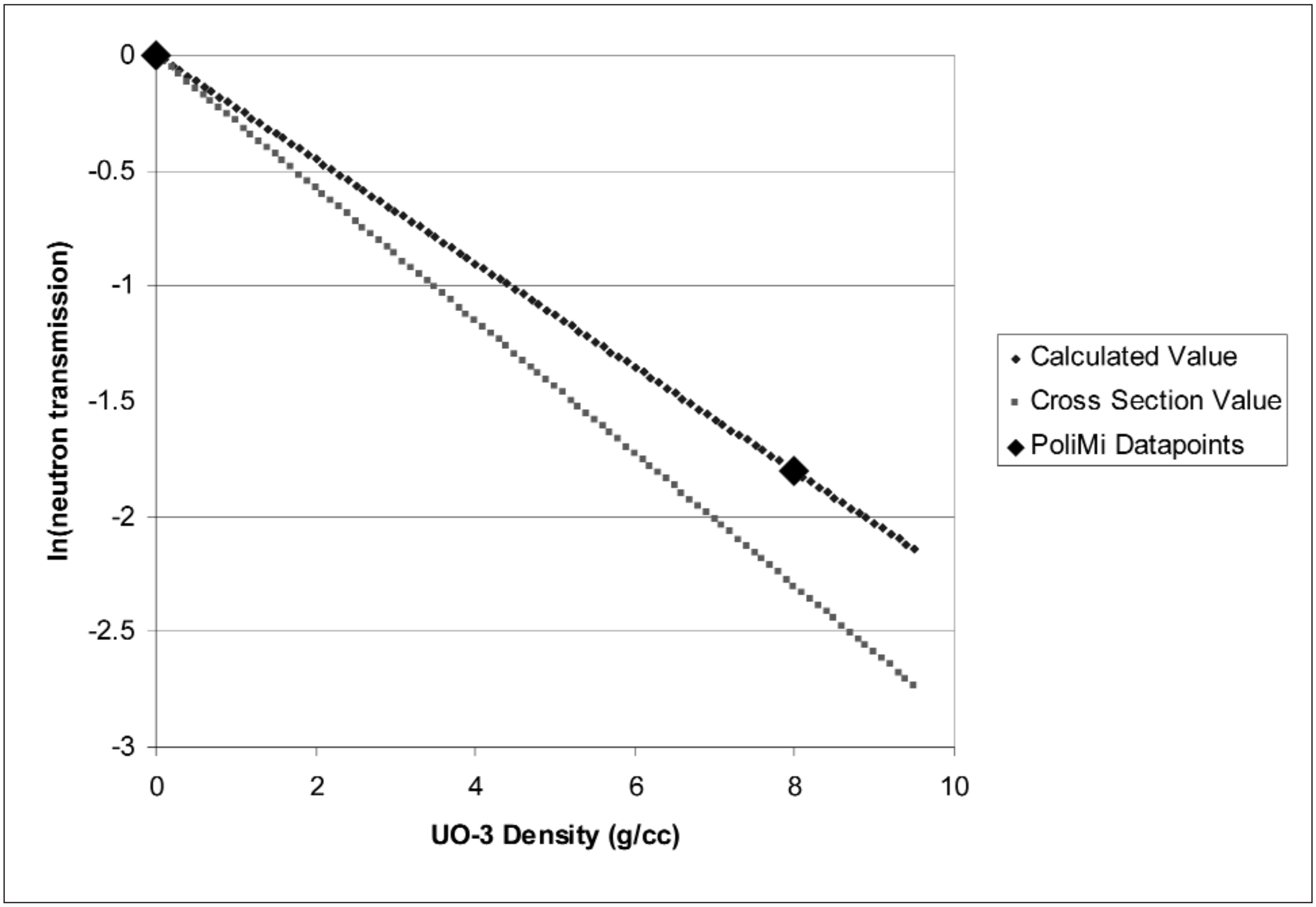
The time-correlation graph in Figure 3 shows several of the features of the D-T source. A 14.1-MeV neutron travels at 5.14 cm/ns. At this speed, the neutron interactions with the container will occur after 13-16 ns. Gamma rays might then be produced by inelastic scattering, (n,γ) reactions, or induced fission, and travel to the detector array at the speed of light, arriving 2-4 ns later. This produces the 15- to 19-ns peak labeled as 1 in Figure 3. After 30-34 ns, 14.1-MeV neutrons passing directly through the container without an interaction arrive at the detectors, creating the peak labeled as 2. Finally, the broad peak labeled as 3 consists of neutrons produced by induced fissions as well as source neutrons that have been significantly slowed by scattering.

For the purposes of fast neutron radiography, only those neutrons that passed through the target uncollided, corresponding to region 2 of Figure 3, are of interest. For each of the 1,056 detector positions, the area under region 2 (from 30 to 34 ns) was integrated to measure the value of I0 (for the empty container) and I8 (for the known, Ú=8 case.) With the I8 and I0 values known, the neutron transmission was then calculated using the following equation:

$$\frac{I_8}{I_0} = e^{-a\rho} \Rightarrow a = \frac{-\ln\left(\frac{I_8}{I_0}\right)}{8\,\frac{g}{cm^3}} \qquad (1)$$

The coefficient a represents the slope of the natural log of the neutron transmission plotted against the UO_3 density. Note that a

Figure 4. A plot of the natural log of neutron transmission vs. UO_3 powder density

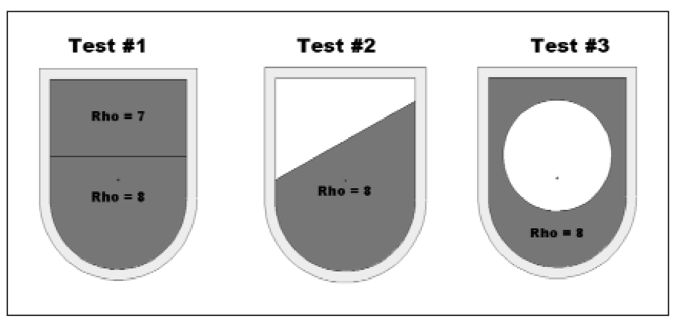


was calculated separately for each pixel, making the parameter geometry dependent. Figure 4 shows such a plot for a typical detector pixel. Because neutrons can elastically scatter off the heavy uranium nuclei with very little energy loss, slightly scattered neutrons will reach the detector with only a slight delay and will be counted with the unscattered neutrons in the neutron peak. This causes the measured transmission values to be higher than the value calculated using the total cross sections for the material.

After the attenuation coefficients were determined using the two reference cases, new MCNP-PoliMi models were constructed for three unknown cases. The three cases were chosen to test the ability of the measurement process to estimate the mass in containers with varying densities, uneven surfaces, or voids in the UO_3 powder. A cross section of the three unknown cases is shown in Figure 5. The first two test cases were also simulated for varying lengths of time to estimate the accuracy that could be expected for a given measurement time.

For each unknown simulation, the total number of neutrons in the 14.1-MeV neutron peak was measured exactly as it was for the reference simulations. This value was then divided by the value for the empty container to determine the neutron transmission. Equation 1 was then inverted, and average density at that detector position was measured.

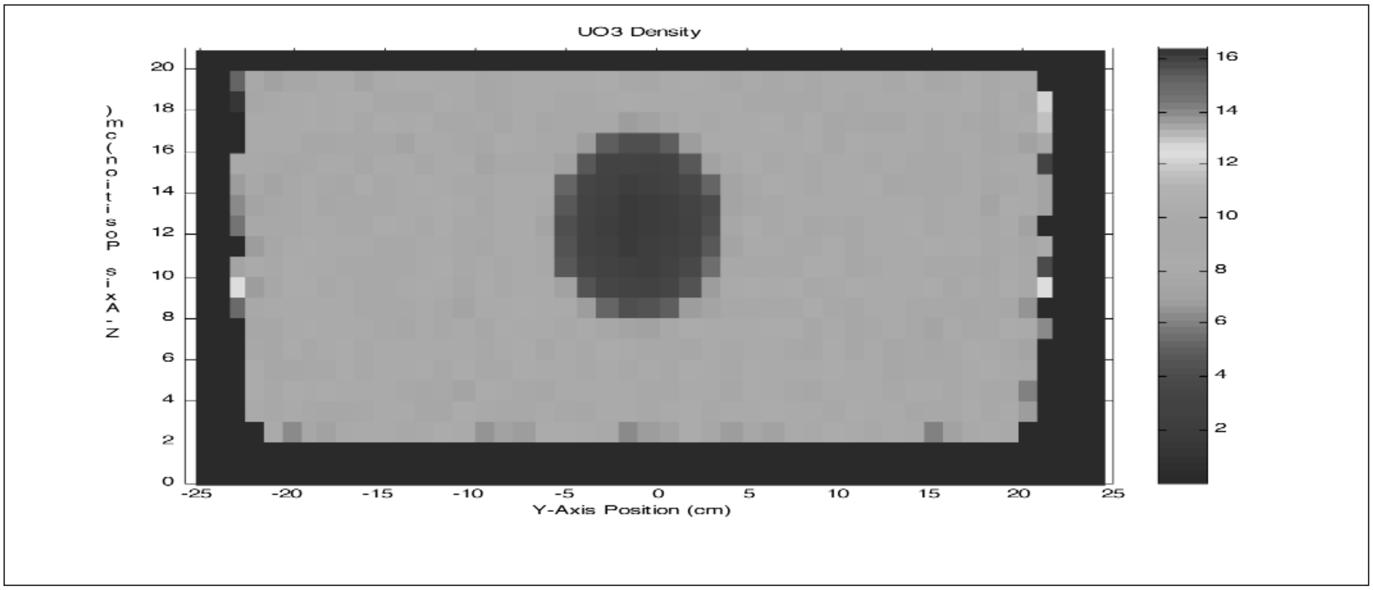
Figure 5. The three test cases modeled in MCNP-PoliMi



$$\rho = \frac{-\ln(I/I_0)}{a} \qquad (2)$$

Once the average density for each detector position was calcu-

Figure 6. A simulated radiograph of unknown case 3 showing the computed density of each pixel.



lated, it was multiplied by the volume of the container that shadowed that particular pixel to yield the mass of UO_3. Each of these mass elements was then summed to derive the final calculated value for the mass of UO3 powder. Figure 6 shows the density plot of the UO3 powder that was created for test case 3.

Results

Table 1 shows the results of the seven different unknown simulated measurements conducted. The number of the test indicates the container configuration and the letter indicates the number of source particles. The number of source particles can then be

Conclusions

Despite the different measurement times and powder configurations, all of the simulated measurements produced a UO3 mass estimate that was within 1.5 percent of the true value. Longer measurement times did not produce more accurate results within the range of times modeled. This finding can most likely be attributed to the algorithm used to determine the mass of the container. A pixel in one of the long test cases (the "c" tests in the table above) typically received 3-400 counts during the test, which would yield a random fractional error of ~5 percent. However, summing the pixels together tends to cancel out the random statistical fluctuations in individual pixels. Over the entire volume of the trough, approximately 300,000 total counts were recorded, which would yield ~0.2 percent fractional error. Systematic errors, such as volume element errors involving the resolution of the pixels, are on the order of the random fluctuations in the data—even for the shortest measurement times.

In an actual NMIS measurement, there will be many additional sources of error that are not present in the MCNP-PoliMi models. Uncertainty in the detector positions, uncertainty in the neutron output of the APSTNG, and differences in detector efficiencies would contribute to the error. High background count rates would also produce some error, although most of the background could be subtracted, leaving only random fluctuations in the background level behind. In a physical measurement the configuration of the UO_3 powder in the reference measurement will most likely be unknown. Therefore, the coefficient a will have to be calculated by adjusting the value of the coefficient a using the total mass of the powder in the reference container and the relative densities at each pixel. Despite this requirement, because of the accuracy with which the mass could be estimated using very short simulated measurement times, it is expected that a physical measurement could determine the UO_3 mass to within ±10 percent in a reasonable (<1-h) measurement time.

Table 1. MCNP-PoliMi simulated measurement results

Test Number	Measurment Time (min)	Modeled Mass (kg)	Estimated Mass (kg)	Estimated Error (percent)
1a	3.75	65.567	65.7	+0.16
1b	15.02	65.567	65.4	+1.30
1c	37.55	65.567	65.9	+0.55
2a	3.75	45.339	45.2	-0.23
2b	15.02	45.339	45.4	+0.19
2c	37.55	45.339	45.0	-0.72

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Multiplicity Analysis During Photon Interrogation of Fissionable Material

J. D. Williams Student Paper Award—2nd Place

S. D. Clarke, School of Nuclear Engineering, Purdue University, West Lafayette, Inidiana, USA

S. A. Pozzi, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA

E. Padovani, Polytechnic of Milan, Milan, Italy

Abstract

For accelerator-based active interrogation systems, direct simulation of multiplicity distributions with the Monte Carlo method is difficult because (i) secondary particles from gamma interactions are not treated correctly on an event-by-event basis and (ii) each source event is treated individually. The Monte Carlo code MCNP-PoliMi corrects the first deficiency. In order to overcome the second issue, the time width and intensity of the interrogation pulse—which specify how many photons arrive at the target simultaneously—must be incorporated into the calculation. To accomplish this, a subroutine that operates on the MCNP-PoliMi output file has been developed. The purpose of this subroutine is to assemble the source events into *groups* corresponding to the number of interactions that would occur during a given pulse. This re-ordered output file is used with the MCNP-PoliMi detection post-processor to compute a multiplicity distribution. The multiplicity distributions calculated using this new algorithm capture the higher-order multiplets present due to multiple reactions occurring during a single accelerator pulse. Plans are underway to gather relevant experimental data to validate the methodology developed and presented here. Analysis of this information will determine the feasibility of using multiplicity distributions as an identification tool for special nuclear material. Once validated, this capability will enable the simulation of a large number of materials and detector geometries.

Introduction

The identification of fissile material in the presence of benign material is of great concern to the United States and the world. The principal difference between fissile and benign materials is the multiplicative behavior of the fissile sample. Consider the interrogation of a sample with high energy photons in the presence of a detection system capable of accurately recording the emissions. During the interrogation of a benign material, such as lead, the reaction emissions would largely be single-particle in nature whereas the interrogation of a fissile material would induce multi-particle fission reactions. These fission neutrons could cause further fissions in the sample. The result would be many particles (neutrons and photons) arriving at the detectors in a given time window. A grouping of particles arriving at the detectors within this time window is referred to as a multiplet. The distribution of these *multiplets* holds important information regarding the nature of the interrogated sample. These methods could have direct application in the fields of nuclear nonproliferation and homeland security.

Multiplicity counting has been well established as an assay method for plutonium samples in the area of nuclear materials control and accountability.[1-3] The multiplicity distributions are acquired by specialized electronics packages that separately record the number of times specific numbers of neutrons are detected during a fixed time window. These passive counting systems rely on neutrons emitted in the spontaneous fission of ^{240}Pu within a given fission chain; these neutrons are counted typically using polyethylene-moderated ^{3}He proportional counters.[4] More recently, the use of liquid scintillation detectors has been explored.[5] These detectors have several advantages over the traditionally used ^{3}He counters. In fact, due to their sensitivity to fast neutrons and gamma rays, they (i) eliminate the need for bulky neutron moderators (ii) extend the measurement of multiplicity to neutron and gamma ray multiplicity, and (iii) decrease the width of the multiplicity time window from hundreds of microseconds to hundreds of nanoseconds.

The goal of the work here is the development of methods to apply these counting techniques to active photon interrogation systems using a pulsed accelerator source and liquid scintillation detectors. The excellent pulse shape discrimination properties of liquid scintillators will enable multiplicity distributions to be recorded in a gamma ray field; this was not possible with previous ^{3}He-based systems. Multiplicity distributions have not been simulated for active interrogation systems because the source (multiple reactions of multiple types occurring simultaneously) is more complex than the simple spontaneous fission sources in passive systems. The detailed information available from the MCNP-

PoliMi code makes explicit characterization of this source possible.

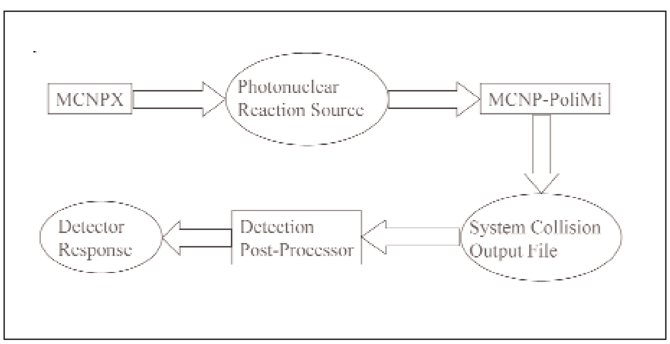
However, direct simulation of such distributions with the Monte Carlo method is difficult because each history is treated individually. In order to accurately model the multiplicity distribution, the time width and intensity of the interrogation pulse, which specify how many photons arrive at the target simultaneously, must be incorporated into the calculation. To accomplish this, a subroutine that operates on the MCNP-PoliMi output file has been developed. The purpose of this subroutine is to assemble the interactions into groups corresponding to the number of interactions that would occur during a given pulse. This re-ordered output file is used with the MCNP-PoliMi detection post-processor to compute a multiplicity distribution.

Monte Carlo Simulations

Description of MCNP-PoliMi Code System

In standard MCNP secondary gamma rays are sampled from a distribution that is not dependant on the associated neutron interaction. Similar deficiencies exist in the MCNPX models of photonuclear interactions resulting in these reactions not being accurately modeled on an event-by-event basis.[6] A recently developed, enhanced version of MCNP4c, MCNP-PoliMi, preserves standard MCNP code structure while correcting this deficiency, although it introduces several assumptions.[7,8] The enhanced code simulates time-analysis quantities and includes a correlation between individual neutron interactions and the corresponding photon production. The primary modification inverts the order of two sampling routines: the secondary photon production and the neutron-collision-type determination.

Figure 1. Calculation flow of the MCNPX/MCNP-PoliMi Code System

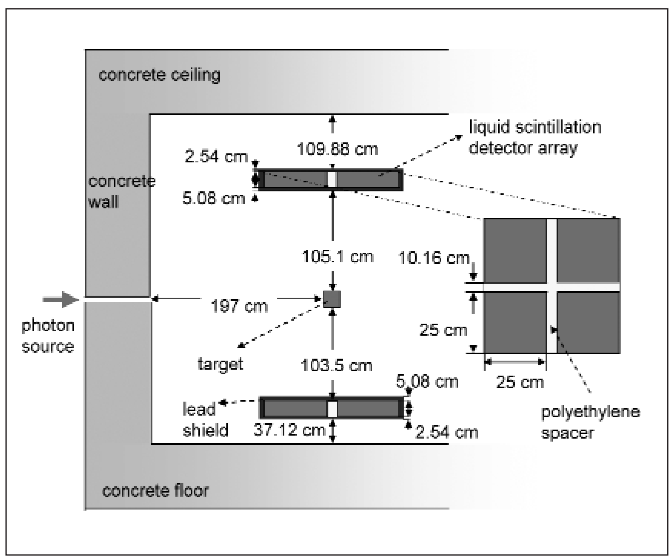


MCNP-PoliMi version 1.2.4 is capable of running with all standard MCNP source types and includes several specific spontaneous-fission-source definitions (i.e., ^{252}Cf, ^{240}Pu, ^{242}Pu, ^{242}Cm, ^{244}Cm), as well as Am-Li and Am-Be isotopic sources. In addition, a photonuclear source file may be generated using a modified version of MCNPX and read by MCNP-PoliMi.[9] This technique has been shown to provide excellent agreement with measurements performed at the Idaho Accelerator Center.[10] Figure 1 shows the calculation flow for a photonuclear interrogation problem performed with the MCNP-PoliMi code system.

The photonuclear source file is generated by simulating the interrogation of the target material by the photon beam and recording relevant information on all photonuclear events, including photofission, (γ, n), and (γ, 2n) reactions. The information recorded to this file includes the location and multiplicity of neutrons and gamma rays emitted by the photonuclear events. This source is read by MCNP-PoliMi, and the particles are transported through the system and into the detectors. The energy released during each collision in the detectors, the corresponding time, the incident particle type, and the target nucleus are saved in a dedicated output file.

A post-processing code is then used to load the required data from this file and compute the detector-specific response. In the case of a scintillation detector, the incoming radiation must deposit enough energy to overcome a specific threshold for light output. Different incoming particles interact in very different ways; photons interact primarily through Compton scattering on electrons, while neutrons interact through scattering on hydrogen. The event-by-event interactions modeled in MCNP-PoliMi enables the simulation of detailed detection physics, which is typically disregarded in other simplified code systems.

Figure 2. MCNP-PoliMi model of photon interrogation of a fissionable target; the emissions are recorded and computed using two arrays of four liquid scintillation detectors (not to scale)



Model Description

The simulated target was a 6.4 by 6.7 by 12-cm^3 block of depleted uranium, 100 percent ^{238}U, metal placed 197 cm from the exit of collimator; a highly-enriched uranium, 93 percent ^{235}U, target was also simulated in this same configuration. Eight

25 by 25 by 8.2-cm^3 liquid scintillation detectors were arranged in two arrays of four detectors separated by 10.16 cm of polyethylene. One array was placed below the target and the other above approximately 1 m from the target. Each detector array was shielded by 5.08 cm of lead on the side facing the target and 2.54 cm on the other sides. The floor, ceiling, and walls of the room are also included in the model and are assumed to be 50-cm thick concrete. Figure 2 shows an illustration of the model.

The source was a 15-MeV bremsstrahlung photon spectrum modeled entirely incident on the target. The energy spectrum and electron-to-photon conversion factor were determined in a separate MCNPX model containing the electron source, tungsten converter, collimator and target. Because the interrogation source was held constant for all of the results described here, this separate source model expedited all further portions of the simulation by eliminating computationally expensive electron transport.

Table 1. Parameters for calculating the average number of photonuclear reactions per accelerator pulse for the two target materials

Target Material	N_{PN}	C_{PE}	Q	$\overline{N}r$
DU	1.350×10^{-3}	5.393×10^{-5}	0.38	173
HEU	1.267×10^{-3}	5.393×10^{-5}	0.38	162

Grouping Algorithm

An algorithm has been developed to operate on the MCNP-PoliMi collision output file to re-arrange the histories into groups that are representative of the time-width of the accelerator pulse. During the time-width of the accelerator pulse, the number of photons generated in the accelerator is proportional to the total charge of the electron burst interacting with the accelerator converter. The number of these photons that hit the target is affected by the electron-to-photon conversion efficiency in the accelerator, collimator configuration, and the solid angle. The number of reactions that occur during the pulse is then proportional to the reaction cross sections of the target material. The average number of photonuclear reactions that occur in the target per accelerator pulse, $\overline{N}r$, can then be expressed as

$$Nr = \frac{N_{pn} \cdot C_{pe} \cdot Q}{e},$$

where N_{PN} is the number of photonuclear reactions in the target per source photon, C_{PE} is the number of photons on target per source electron, Q is the charge per accelerator pulse and e is the unit of fundamental charge. The parameters N_{PN} and C_{PE} are computed MCNPX: NPN is computed by dividing the total number of photonuclear reactions occurring in the target by the number of source photons, C_{PE} is computed using a photon 4 surface flux tally on the target per source electron and takes into account the effects from the converter, collimator and system solid angle. Table 1 lists these parameters for both the depleted uranium (DU) and highly-enriched uranium (HEU) targets. Because the geometry and source were fixed in these simulations, the values for C_{PE} and Q are constant. However, the average number of reactions per pulse is different because the cross-section and material density of the two materials are slightly different.

The MCNP-PoliMi collision output file contains a list of all particle histories that interact in any of the detectors. Because the source for the MCNP-PoliMi simulation is a series of photonuclear reactions, each source event corresponds to a single photonuclear reaction and not a single particle. In a standard simulation, each of these events is treated individually thus neglecting the real-world, pulsed nature of the interrogation source. In reality, a given pulse will produce multiple reactions in the target simultaneously. The new algorithm combines the events in the collision output file into "groups" with average size equal to. The actual size of each group is Poisson sampled about this mean.

The preliminary version of the grouping algorithm is written in MATLAB for testing and proceeds as follows:

1. the MCNP-PoliMi data file is loaded
2. the expected number of reactions in the first pulse, Nr1 is sampled from a Poisson distribution with mean equal to
3. the event number, Nh, of each source event is tested to find the end of the pulse
4. all histories in this pulse are numbered to be equal (1 for the first pulse, 2 for the second pulse, …, etc.)
5. the expected number of reactions in the second pulse, Nr2 is sampled from a Poisson distribution with mean equal to
6. the end of the second pulse is calculated as Nr1 plus Nr2

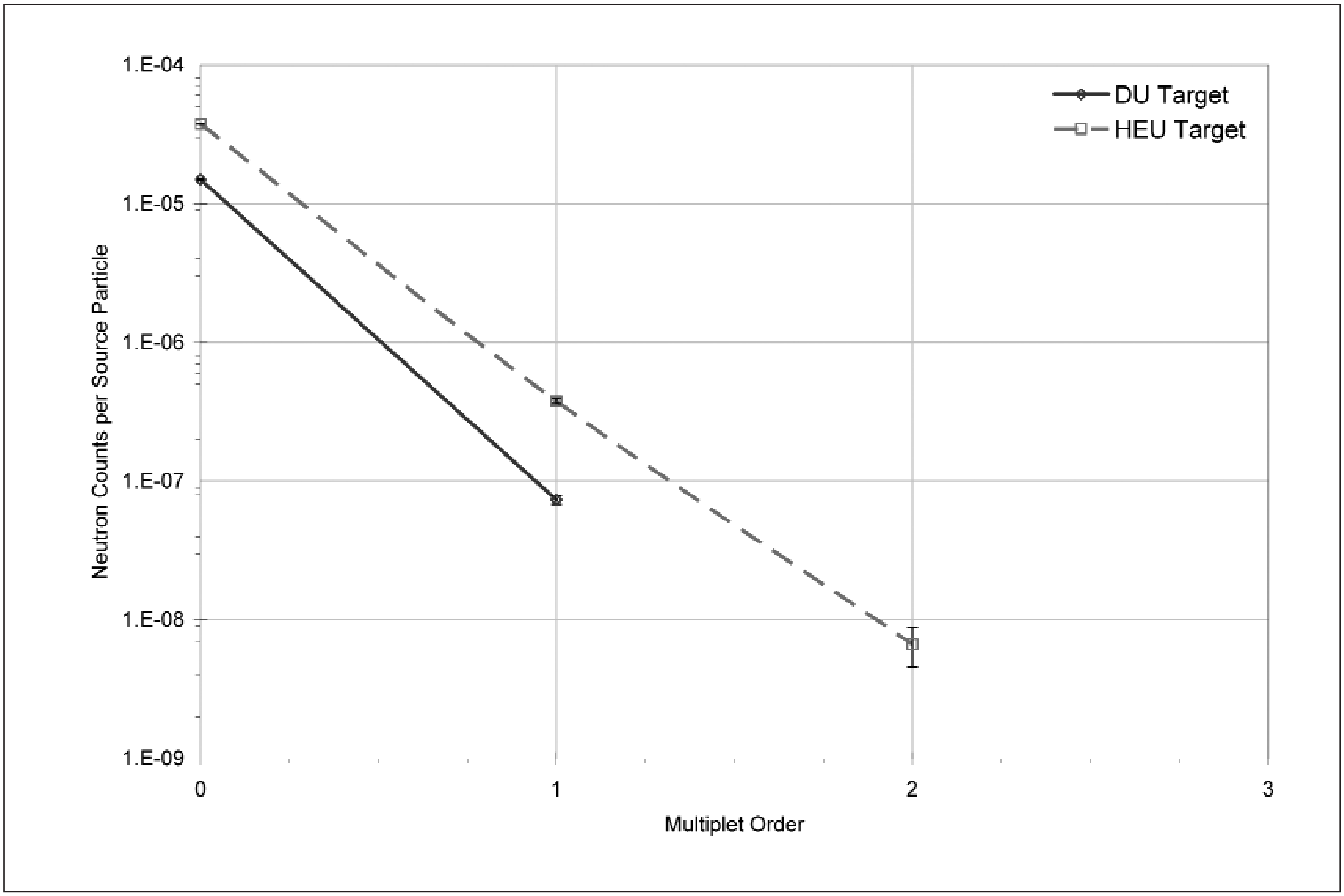
This process is repeated until the end of the collision file is reached. The resulting, re-grouped, collision information is written to an output file which is then post-processed to compute the detector response, in particular the multiplicity distrinution.

Results

Depleted and highly-enriched uranium targets were simulated using MCNP-PoliMi in the configuration described above. The MCNP-PoliMi post-processor was then used to directly generate detector-triggered multiplicity distributions from the results. The first particle to interact in any of the detectors opens the multiplicity time-counting window – in these cases, 512 ns – and the subsequent multiplets are counted. Figure 3 shows these distributions for both DU and HEU targets.

The highest-order multiplet observed before applying the grouping algorithm is 2 (for the HEU target). This phenomenon is directly related to the Monte Carlo method treating each history individually. Each history corresponds to a photofission, (γ,

Figure 3. Detector-triggered multiplicity distribution before grouping the MCNP-PoliMi data file into accelerator pulses; one-sigma error bars are shown.



n), or (γ, 2n) reaction. An order-two multiplet corresponds to the detection of three neutrons—the first served as the trigger. At a separation of 1 m from the detectors, the probability of detecting three neutrons from a single reaction is very low; this is reflected in the results. However, this is not physical because in a single pulse, multiple reactions will occur simultaneously increasing the probability of detecting higher-order multiplets.

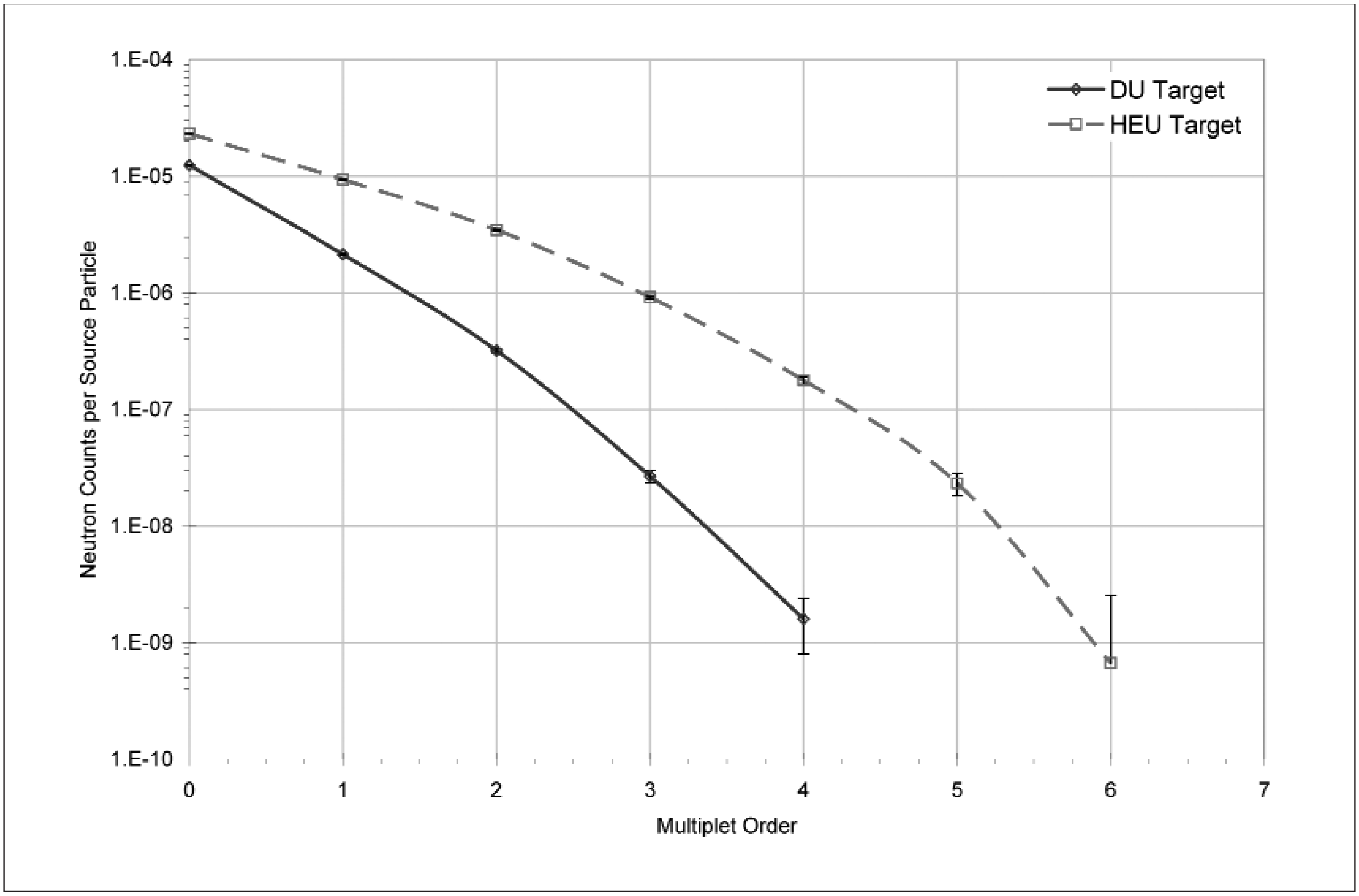
Using the accelerator pulse parameters discussed above, the MCNP-PoliMi output was organized into representative groups prior to computing the multiplicity distributions. Figure 4 shows these results. As expected, the number of higher-order multiplets has increased greatly. This increase of multiplet order is due to multiple reactions being generated, and modeled, simultaneously; this results in an increased probability of multi-particle detection within the multiplicity time window. With the HEU target, multiplets as high as order 6 are observed while the DU target produces multiplets as high as order 4. The increased multiplet order of the HEU target, relative to the DU target, is due to subsequent fissions occurring in the target; the higher concentration of ^{235}U results in a much higher fission cross section than that of ^{238}U. Even in this example, it is clear that the multiplicity distribution contains information indicative of the presence of fissile material. Once validated, this method could be used in conjunction with existing methods to increase the reliability of the detection process.

Summary and Conclusions

A method has been presented to model the time width of accelerator pulse in active interrogation systems for computing neutron multiplicity distributions. A subroutine was developed that organizes the MCNP-PoliMi collision output file into groups that are representative of the simultaneous reactions that occur during an accelerator pulse. The MCNP-PoliMi code system was used to model the photonuclear interrogation of both depleted and highly-enriched uranium targets and the resulting multiplicity distributions were computed using the new algorithm. The results capture the higher-order multiplets that are present due to multiple reactions occurring during a single accelerator pulse.

Plans are underway to gather relevant experimental data to validate the methodology developed and presented here. Analysis of this information will determine the feasibility of using multiplicity distributions as an identification tool for special nuclear material. Once validated, this capability will enable more accurate simulation of a large number of materials and detector geometries for the development of systems to identify concealed fissile material.

Figure 4. Detector-triggered multiplicity distribution after grouping the MCNP-PoliMi data file into accelerator pulses; one-sigma error bars are shown



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DOE's Former Rocky Flats Weapons Production Site to Become National Wildlife Refuge

The U.S. Department of Energy (DOE) in July announced the transfer of nearly 4,000 acres of its former Rocky Flats nuclear weapons production site to the U.S. Department of the Interior's (DOI) U.S. Fish and Wildlife Service (FWS) for use as a national wildlife refuge. After more than a decade of environmental cleanup work, the transfer creates the Rocky Flats National Wildlife Refuge, sixteen miles northwest of Denver, Colorado, and marks completion of the regulatory milestones to transform a formerly contaminated site into an environmental asset.

From 1951 until 1989 the Rocky Flats Plant manufactured the trigger mechanism for nearly every nuclear weapon in the United States. The manufacturing processes resulted in radiological and hazardous material contamination; including plutonium, uranium, beryllium, and hazardous chemical compounds, that were released into the air, ground, and water surrounding the plant.

In 2005, DOE certified the environmental cleanup work at the former Rocky Flats site complete. The ten-year environmental cleanup of the site cost approximately $7 billion and finished more than fifty years ahead of initial forecasts and for nearly $30 billion less than estimated in 1994. The Rocky Flats site encompasses approximately 6,200 acres of high prairie that has been closed to the public for more than fifty years. During production and cleanup, a 5,800-acre buffer zone surrounded the 400-acre industrial area where the trigger mechanisms for nearly every nuclear weapon in the nation's arsenal were manufactured.

In May 2007, the U.S. Environmental Protection Agency completed regulatory certification and released the lands for unrestricted use as a national wildlife refuge. DOE will retain approximately 1,300 acres in the center of the site for long-term surveillance and maintenance. This area is protected by physical and institutional controls and contains surface and groundwater monitoring equipment, four groundwater treatment systems, and two closed landfills.

To date, DOE has restored eighty-four sites that played a role in the Cold War era mission across the nation. In the past two years, DOE has cleaned up nine sites and is on track to close five more by 2009.

DOE Initiates Formal Enforcement Action in Los Alamos National Laboratory Classified Information Breach

In July 2007, following extensive investigations, the U.S. Department of Energy (DOE) and its National Nuclear Security Administration (NNSA) took formal enforcement actions against the University of California and the Los Alamos National Security, LLC (LANS), the prior and current management and operating contractors of the Los Alamos National Laboratory in New Mexico, for violations of classified information security requirements under their respective contracts. Investigations revealed that management deficiencies of both contractors were a central contributing factor in a laboratory subcontractor employee's unauthorized reproduction of and removal of classified matter from the site.

In response to this serious security breach, the NNSA in July issued a Preliminary Notice of Violation to the University of California with a $3,000,000 proposed civil penalty (the largest the department has ever assessed) and a Preliminary Notice of Violation to LANS with a $300,000 proposed civil penalty.

In addition, Secretary of Energy Samuel Bodman issued a Compliance Order to LANS that requires the contractor to take specific corrective actions on a prescribed timetable in the physical protection and cyber security of classified information at the laboratory. Violation of a Compliance Order is itself a violation of departmental regulations, which may result in the imposition of civil penalties up to $100,000 per day for each violation.

From 1943 to May 2006, the University of California managed and operated the Laboratory for the DOE and its predecessor agencies. On June 1, 2006, LANS, a limited liability corporation comprised of Bechtel National, Inc., the University of California, BWX Technologies, Inc., and the Washington Group International, Inc., took over as the new management and operating contractor. As one of the country's three nuclear weapons laboratories, the Los Alamos National Laboratory performs sensitive national security missions, including helping to ensure that the U.S. nuclear weapons stockpile is safe, secure, and reliable.

DOE Awards Up To $340,000 to Eight Graduate Fellows Studying Nuclear Fuel Cycle

The U.S. Department of Energy (DOE) will award up to $340,000 in fellowships to eight graduate student fellows to advance research in the nuclear fuel cycle. These awards are part of the American Competitiveness Initiative, which seeks to meet the growing demand for nuclear-educated scientists and engineers. Fellowships are valued at up to $42,500 per student over two academic years and are part of the Advanced Fuel Cycle Initiative (AFCI)—a program within DOE's Office of Nuclear Energy — aimed at increasing research into closing the nuclear fuel cycle and recycling components of used nuclear reactor fuel.

AFCI fellowships are awarded annually to students who plan to pursue research in technical areas related to the separation of nuclear waste components, the fabrication of these components into recycled fuel, and the preparation of new waste forms with increased long-term stability. This research furthers the Global Nuclear Energy Partnerships (GNEP), which supports the expansion of nuclear power in the world while reducing the risks of weapons proliferation, and increasing the efficiency of waste recycling programs.

Selected AFCI fellows are full-time students who have an interest in advanced fuel cycle research and who are pursuing master's degrees in nuclear engineering, applied physics, or other fields of science and engineering relevant to the GNEP or AFCI missions. This summer, the new AFCI fellows will visit DOE Headquarters in Washington to become better acquainted with the AFCI program, and many will have summer jobs at DOE national laboratories before entering graduate school in the fall.

Selected AFCI fellows include:

- Brett Dooies, University of Florida, nuclear engineering
- Eddie "Trey" Holik, Texas A&M University, applied physics
- Brendan Kochunas, University of California-Berkeley, reactor physics
- Kyle Oliver, University of Wisconsin, nuclear engineering
- Kathryn Wright, Texas A&M University, nuclear engineering
- Shen Zang, North Carolina State University, nuclear engineering
- Shannon Yee, Ohio State University, nuclear engineering
- Shadi Ghrayeb, Graduate University Currently Undecided, nuclear science and engineering

DOE Moves Forward with Final Performance Requirements for Yucca Mountain Canister System

The U.S. Department of Energy (DOE) has announced the release of final performance requirements for the Transportation, Aging, and Disposal (TAD) canister for disposal of spent nuclear fuel at a repository to be located at Yucca Mountain in Nye County, Nevada. This canister approach will minimize the need for repetitive handling of spent nuclear fuel by using the same canister from the time it leaves a nuclear power plant to its placement in a waste disposal package at Yucca Mountain.

DOE will initiate procurement for the development of final TAD canister and cask designs. DOE also plans to enter into discussions with nuclear utilities to amend their disposal contracts with DOE to facilitate the use of TAD canisters. DOE anticipates that TAD canisters will be available for commercial use as early as 2011 and expects that up to 90 percent of commercial spent nuclear fuel could be placed in TAD canisters, resulting in the need for about 7,500 TAD canisters for the proposed repository.

In November 2006, DOE released the preliminary TAD performance specification followed by a proof-of-concept phase that resulted in the development of designs by four cask vendors. The TAD-based approach, announced in October 2005, eliminates the need for the construction of several multi-million square foot, multi-billion dollar facilities for handling spent fuel at the Yucca Mountain repository.

Yucca Mountain was approved by the Congress and the president as the site for the nation's first permanent spent nuclear fuel and high-level radioactive waste geologic repository in 2002. The department's license application for authorization to construct the repository, which is scheduled to be submitted to the U.S. Nuclear Regulatory Commission on or before June 30, 2008, will incorporate the TAD approach.

New Symbol Launched to Warn Public About Radiation Dangers

With radiating waves, a skull and crossbones, and a running person, a new ionizing radiation warning symbol was introduced earlier this year to supplement the traditional international symbol for radiation, the three-cornered trefoil.

The new symbol has been launched by the International Atomic Energy Agency (IAEA) and the International Organization for Standardization (ISO) to help reduce needless deaths and serious injuries from accidental exposure to large radioactive sources. It will serve as a supplementary warning to the trefoil, which has no intuitive meaning and little recognition beyond those educated in its significance.

The new symbol is aimed at alerting anyone, anywhere to the potential dangers of being close to a large source of ionizing radiation, the result of a five-year project conducted in eleven countries around the world. The symbol was tested with different population groups—mixed ages, varying educational backgrounds, male and female—to ensure that its message of "danger—stay away" was crystal clear and understood by all.

The new symbol, developed by human factor experts, graphic artists, and radiation protection experts, was tested by the Gallup Institute on a total of 1,650 individuals in Brazil, Mexico, Morocco, Kenya, Saudi Arabia, China, India, Thailand, Poland, Ukraine, and the United States.

The symbol is intended for IAEA Category 1, 2, and 3 sources defined as dangerous sources capable of death or serious injury, including food irradiators, teletherapy machines for cancer treatment and industrial radiography units. The symbol is to be placed on the device housing the source, as a warning not to dismantle the device or to get any closer. It will not be visible under normal use, only if someone attempts to disassemble the device. The symbol will not be located on building access doors, transportation packages or containers.

Nonproliferation Developments

Mark Maiello, Ph.D.
Ossining, New York USA

I would like to discuss some recent developments regarding nonproliferation that may be of concern to the readership of the *Journal of Nuclear Materials Management*.

Over the past year or so, the Non-Proliferation Treaty (NPT) has been weakened by a number of factors including the recent India/U.S. nuclear agreement (Maiello 2007), and the recent pull out of Iran and North Korea from the treaty. The NPT has been further diminished by the slow reduction of armaments by the original five signatory nations of the treaty. This is not to say that little has been accomplished in nuclear arms reduction. We have in fact achieved partial disarmament. In 1985 there were about 70,000 nuclear warheads stockpiled worldwide. Twenty years later, this has been reduced to about 26,000 (UNEP 2006 and NIP 2007). America's nuclear arsenal presently consists of about 10,000 warheads but only half of these are considered operational (?5500 warheads). Many are associated with submarine launched ballistic missiles (?2000). The rest are components of intercontinental ballistic missiles (ICBMs) (?1000), bombers (?2000), cruise missiles, and other types of bombs such as "bunker busters" (?500). Under the Strategic Offensive Reductions Treaty (SORT) signed with Russia in 2002, 4000 U.S. warheads will be dismantled leaving only 2200 operationally deployed strategic warheads by 2012. However, about 3800 warheads may be held in reserve as non-operational units for a total of 6000 (Norris and Kristensen 2007). At present, Russia has a nuclear arsenal of about 5700 operational warheads (about 15,000 if non-operational warheads are included) (BAS 2007b). These are still substantial numbers.

As an illustration of the slow pace of disarmament progress, consider that both the United States and Russia still operate hair-trigger nuclear retaliatory programs that can launch about 10 megatons between them within a few minutes (Blair 2007). This launch-on-warning to a real or perceived attack despite relatively improved post Cold-War relations may no longer be necessary. Of concern is that the early warning capabilities of both nations are susceptible to computer attacks, technical failures and human error that may falsely indicate the launch of an enemy nuclear strike (BAS 2007a). In addition to improving the health of the NPT, much could be gained if both nations took their nuclear arsenals off hair-trigger alert. The time gained could be used by government and military leaders for rational thought, dialogue with their counterparts, and to verify the validity of an attack.

The United States may inadvertently be slowing disarmament progress by considering the design of new nuclear weapons. Capitol Hill subcommittee meetings this past March illustrated the Bush administration's desire for "Complex 2030," a revamping of the nation's nuclear weapons production capabilities that includes the new Reliable Replacement (nuclear) Warhead (RRW) (Johnson, 2007). Development of the RRW, which should be easier to maintain and rendered useless if stolen by terrorists, has some lawmakers concerned because it may begin a new round of nuclear testing, something the U.S. has not done since 1992 . Testing critics say, can be exploited by our adversaries (Fox 2007a). If testing is not permitted, development of the RRW could still proceed. But, once the RRW is deployed, it is feared that some government official, concerned over its operability, could call for testing. We then have the United States developing and testing nuclear weapons but espousing that other nations should not.

In all fairness, the Bush administration has explained that Complex 2030 will allow a further reduction in stockpiled nuclear weapons because weapons production will be more efficient and only increased as the world situation demands. On March 29, Thomas D'Agostino, chief of the National Nuclear Security Administration, said that U.S. nuclear weapons deter nuclear and other weapons of mass destruction (WMD) threats against the United States, its forces and its allies. He added that the U.S. nuclear umbrella removes the incentive for our allies to develop their own nuclear weapons (UPI, 2007). Further, there is concern that the brain-power of our nuclear weapons experts is stagnating under present conditions (Fox 2007b). This all may be true, but any change to a nation's military nuclear program raises anxiety and concern internationally. A review of the relevance, usefulness, and future purpose of U.S. nuclear weapons was called for (GSN 2007a). The military says that we will need the deterrence that nuclear weapons provide. But, we will have to determine how many and if development of a new design is worth the price to international relations.

It is a testimony to nonproliferation activities and common sense that there has not been an increase in nuclear armed nations in decades. However, Iran may change this unless something can be done. In May 2007, the United States called for punishments for those nations that back out of the NPT (GSN 2007b). This is a minor but good step in the right direction. Unfortunately, the latest NPT meeting ended in discord (GSN 2007c). One of the reasons cited by developing (non-aligned) nations was the slow pace of disarmament by nuclear-armed nations. These challenging times call for a strengthened and/or revamped non-proliferation regime and continued treaty-based, verifiable arms reductions.

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Mark L. Maiello, Ph.D.
Ossining, New York

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