INMM
36th Annual Meeting
July 9–12, 1995
Marriott Desert Springs Resort
Palm Desert, Calif.

JNMM

Journal of Nuclear Materials Management

Published by the Institute of Nuclear Materials Management ■ Volume XXIII, Number II ■ February 1995

JNMM

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

SUBSCRIPTION RATES: Annual (U.S., Canada and Mexico) $100.00; annual (other countries) $135.00 (shipped via air mail printed matter); single copy regular issues (U.S. and other countries) $25.00; single copy of the proceedings of the annual meeting (U.S. and other countries) $65.00. Mail subscription requests to *JNMM*, 60 Revere Drive, Suite 500, Northbrook, Illinois 60062 U.S.A. Make checks payable to INMM.

ADVERTISING, distribution and delivery inquiries should be directed to *JNMM*, 60 Revere Drive, Suite 500, Northbrook, Illinois 60062 U.S.A., or contact Mary Dulabaum at (708) 480-9573, fax (708) 480-9282. Allow eight weeks for a change of address to be implemented.

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1995 Budget, Russian Federation Chapter Approved at Fall Meeting

The 1994–95 INMM Executive Committee held its first full meeting on Nov. 15 and 16, 1994, at the Marriott Desert Springs Hotel in Palm Desert, Calif., the site of the 1995 Annual Meeting. The fall meeting is our budget meeting, during which we review the previous fiscal year's activities and approve a budget for the new fiscal year. 1994 was a financial success for the Institute, thanks to the success of the Annual Meeting in Naples and a number of workshops organized by the technical divisions.

INMM's ability to provide technical services to the membership and to the largest international nuclear materials management community is dependent on the continuing support of the Institute through member and corporate dues, advertising in the *Journal of Nuclear Materials Management* and registration fees collected at meetings and workshops. The funds collected are spent on publishing the *JNMM* and Annual Meeting Proceedings, running the Annual Meeting and workshops, supporting INMM chapters, funding member services such as the membership directory, paying ANSI member dues for our two standards committees, and providing a small staff at INMM headquarters to handle the day-to-day management and administrative affairs of the Institute.

The fiscal year 1995 budget approved on Nov. 16 shows $434,500 in budgeted income and $452,500 in projected expenses, including a carryover uncosted obligation from fiscal year 1994 of $18,000 that will be paid out of fiscal year 1995 revenues. In other words, we followed recent INMM custom and approved a balanced budget.

The new budget includes a fixed management fee paid to The Sherwood Group Inc., the professional association management organization that provides our headquarters staff (Barbara Scott, Kathleen Caswell, Greg Schultz, Colleen Cronin and others), and an incentive fee under the terms of a new contract that was signed Nov. 16, 1994. The Executive Committee believes the new contract will provide INMM with continued cost-effective professional management services now and in the future, and will permit our members to focus their time and energy in support of the INMM in the technical aspects of nuclear materials management.

The highlight of the Executive Committee meeting was the board approval of the Russian Federation Chapter. In September, then-INMM Chair Dennis Mangan received a petition from seven Russian INMM members to form a Russian Federation Chapter under the terms of the INMM constitution and bylaws. The chartering chapter members will now develop their own constitution and bylaws for approval by the INMM Executive Committee prior to commencing official operations. We are looking forward to the Russian Federation joining the other INMM chapters and furthering the international management of nuclear materials through leadership of the nuclear materials management profession in Russia.

As mentioned, the 1995 Annual Meeting will be held at the Marriott Desert Springs Hotel, Palm Desert, Calif., July 9–12. The meeting facilities at this hotel are outstanding and will provide ample space for technical sessions and the many informal gatherings that make the INMM Annual Meeting so important to the nuclear materials management profession. With the growing interest in nuclear materials management issues on the part of governments and the public, we are anticipating a number of interesting and timely papers.

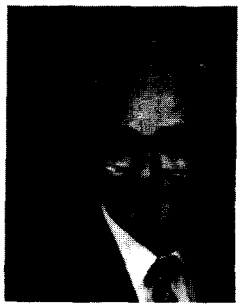
In October, I was once again privileged to attend the INMM Japan Chapter Annual Meeting. The chapter is very active and makes an effort to include overseas contributors to its Annual Meeting. They invited several speakers from the United States, Europe and the International Atomic Energy Agency, and provided simultaneous interpretation between Japanese and English for the duration of the two-day meeting. The technical program was excellent, and the social events lived up the Japanese's well-deserved reputation as outstanding hosts. Professional nuclear materials management is central to advanced nuclear development as it is being carried out in Japan, and the Japan Chapter is playing an important role in support nuclear materials management in Japan.

I close this column on a sad, personal note. William Higinbotham, the long-time *JNMM* editor, passed away on Nov. 10. His accomplishments were many and significant, and he touched many people. Much is written about his impact on other fields. On page 4 of this issue, we remember his contributions to the INMM and nuclear materials management.

Willy was one of the first people I met shortly after I made a career decision to leave basic physics research to get involved with applied research and development in a field called nuclear materials safeguards. At the time, I was concerned about the intellectual contact of my new field; would it be as interesting as physics research? Willy's enthusiasm, his intellect and inventiveness, and his ability to explain why safeguards was so important gave me confidence that I had made a good decision. And he was right about it.

James W. Tape
Los Alamos National Laboratory
Los Alamos, New Mexico, U.S.A.

Carrying On Willy's Tradition and Concern for the *JNMM*



I'm sure that you all heard that William Higinbotham, technical editor of the *Journal of Nuclear Materials Management*, died Nov. 10. He will be very much missed by members of the INMM and by the entire nuclear community for his knowledge, his humor, his accordion and much more. Many of the events of Willy's association with the Institute are recalled in the tribute on page 4.

Among the many roles Willy fulfilled in the INMM was 21 years as technical editor of the *JNMM*. I agreed to take over this responsibility, although, at the moment, I cannot think why. While I certainly will never be able to fill Willy's shoes, I will try my best to carry on his tradition. But I need your help. What would you like the *JNMM* to be? Please give me your ideas. My e-mail address is dbsmith@lanl.gov; my telephone number is 505/667-6394; and my snail-mail address is Los Alamos National Laboratory, MS E550, Los Alamos, NM 87544, USA.

I have already come to share Willy's growing concern about the paucity of technical articles contributed to the *JNMM*. Sure, submission of a paper to the *JNMM* doesn't earn you a trip to the Annual Meeting, but the *JNMM* can be the home for review-type papers and for papers that are too long for the Annual Meeting Proceedings. Perhaps each issue could contain a paper in each of the technical divisions' interest areas. Once again, I ask for your help.

Both of the articles in this issue of the *JNMM* illustrate the truly international scope of nuclear materials management. The first is entirely technical in nature; it describes the details of a cooperative feasibility test of remote monitoring of unattended sensors that was conducted under a bilateral agreement between the United States and Japan. Concepts and technologies developed originally for nuclear safeguards and physical protection might also be used to verify compliance with other arms control treaties.

In contrast, the second article illustrates the Institute's rapidly increasing interest in nuclear policy and issues throughout the world and the influence of technology thereon. The article summarizes the ideas and discussions that took place during a recent seminar held in Kiev, Ukraine. Titled "Toward a Nuclear-Free Future — Barriers and Problems," the seminar brought together Ukrainians, Belarusians and Americans to ponder the legal, political, economic, and safeguards and security dimensions of nuclear weapons dismantlement and destruction. A thought-provoking topic, indeed.

Darryl Smith
Los Alamos National Laboratory
Los Alamos, New Mexico, U.S.A.

Fax us your thoughts and comments about the *Journal* and INMM communications

The INMM Executive Committee is discussing the Journal of Nuclear Materials Management *and its value to INMM members. One idea to increase value and communication among members is to publish the* JNMM *fewer times per year and institute a smaller, more frequent newsletter to enhance communication.*

What do you think? Is the JNMM *valuable to you in its current format? How could it be improved? Do you have a better way to enhance communication and be more cost-effective? Let us know in the space below, or attach another page if necessary.*

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Fax to INMM headquarters at 708/480-9282
or e-mail your comments to tsgi@ripco.com

Safeguards Pioneer William A. Higinbotham Dies

"Safeguards is an international undertaking on behalf of society as a whole. We have the tools, and most of those involved in safeguards at the political and technical levels have the goodwill. But I know that some of us view the purposes and the means to achieve them rather differently, in different parts of the world, and even within its several parts. It is important, very important, to take advantage of the latest developments in electronics and statistical analysis. But it's even more important that all of us involved in safeguards agree on what it is we are trying to do and on how to do it together."

—William A. Higinbotham, in an early *Journal of Nuclear Materials Management* editorial.

William A. Higinbotham, whose pioneering interest in nuclear nonproliferation helped shape the field of nuclear safeguards, died Nov. 10, 1994, of emphysema at his winter home in Gainesville, Ga. He was 84.

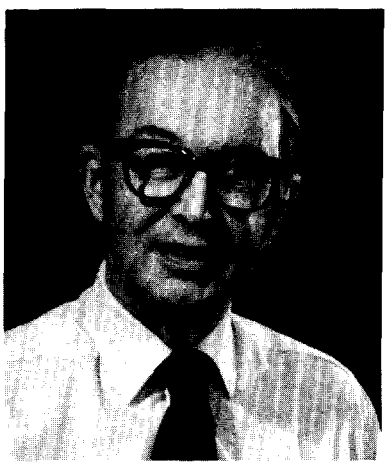
A physicist by training, Higinbotham was an early leader in nuclear nonproliferation efforts and a leading advocate of controlling nuclear weapons.

Born in 1910 in Bridgeport, Conn., Higinbotham's technical legacy began when he was in his twenties and an impoverished graduate student during the Depression, when he found out he was "good" at electronics. He went on to a career that encompassed perhaps the most profound and most trivial developments of 20th century technology.

Higinbotham earned a bachelor's degree in physics from Williams College in 1932 and was a graduate student at Cornell University from 1932 to 1940, but transferred to the Radiation Laboratory at the Massachusetts Institute of Technology when the United States entered World War II in 1941, where he worked on radar.

Promoting Peaceful Nuclear Power

In 1944, he was convinced to join the Manhattan District Project at Los Alamos National Laboratory in New Mexico, where he eventually served as group leader for the electronics division. A witness to the first atomic bomb detonation, he was to become the first chair of the Federation of American Scientists in 1946, an organization founded immediately after World War II to try to prevent nuclear war and the spread of atomic weapons. He believed strongly in the importance of keeping atomic power in civilian hands.



"I became very concerned about nuclear weapons when I was at Los Alamos National Laboratory, at the end of World War II," Higinbotham told an interviewer in 1986. "What we said was that there was no secret which other scientists could not discover, no defense when one bomb can destroy a city, and that we must have world control of nuclear energy.

"Our original statement was that we were going to gather and disseminate information concerning developments in science that would affect world peace and the general welfare. But so far my work on arms control hasn't been that successful. That was my great hope and the thing which I consider the most important. But I can't say that I got there."

The First Video Game

In 1947, Higinbotham began work at Brookhaven National Laboratory in Upton, N.Y. First as associate head and then head of the instrumentation division from 1948 to 1968, he devoted himself to developing specialized, high-performance instruments. But the most well-known instrument he developed is the one he considered the least significant. In 1958, he set up an electronic tennis game on an oscilloscope to entertain visitors to the lab, earning him the title "inventor of the video game."

"We used to have 'public days' at Brookhaven," Higinbotham explained in 1986. "One day we invited high school students, one day college students and one day the general public. We'd wheel out a whole lot of exhibits and give a tour of the place. I thought, 'Well, it's getting awfully dull. Let's have something that people can play games on.' So I looked around and saw that we had the stuff to put together a ping-pong game on a cathode ray tube. So I did that, and it was very popular for about two years. Many years later, when companies started fighting about patents, somebody remembered that I had done this. Now I've been involved in making affidavits with patent lawyers for the past five years or maybe longer."

Although Higinbotham never patented his video game, his electronics work led to more than 20 patents, including one for the Higinbotham Scaler circuit, a breakthrough in the counting of radioactivity in nuclear material, and one for the "bootstrap" sawtooth generator widely used in oscilloscopes.

In 1968, a committee at Brookhaven suggested that the Atomic Energy Commission (AEC) establish a broad-

based safeguards technical support organization at the laboratory. As a result, Higinbotham helped establish the Technical Support Organization (TSO), which worked with the safeguards office of the AEC to supplement the hardware and software research and development groups then existing or contemplated. He headed the TSO from 1973 to 1975. He formally retired from Brookhaven in 1984 as a senior physicist.

In 1988, 20 years after the formation of the TSO, the Higinbotham Nuclear Safeguards Library was formally dedicated at Brookhaven National Laboratory. After retirement, Higinbotham divided his time between homes in Georgia and New York. He served as a consultant to the TSO until his death.

Throughout his career, his input was regularly sought for various projects. And he was always ready for the next challenge. As a result, he was frequently traveling and always busy. He served on numerous government committees, international conferences and professional organizations, providing support for the U.S. Atomic Energy Commission, Energy Research and Development Administration, U.S. Department of Energy and the International Atomic Energy Agency.

His contributions resulted in a plethora of honors and worldwide recognition. In 1992, he received the first annual award for contributions to nuclear instrumentation from the Institute of Electrical and Electronics Engineers (IEEE) Nuclear Science Group. He was named a Fellow of the American Physical Society, American Society for the Advancement of Science, American Nuclear Society, the Institute of Nuclear Materials Management and IEEE.

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Remembering Willy Higinbotham

In 1983 I had the honor to lead an INMM delegation to China to give a series of lectures in the areas of radioactive waste management and safeguards. Willy was one of the delegates involved and served as our *ex officio* entertainment director. (When you spend a month in some of the remote regions of China, you needed entertainment.) Every evening after we had finished our dinner, we would roll up the rug (when there was one), Willy would get out his accordion, and we would square dance until late in the evening. Willy played mostly early American and country-western music, but every now and then would break into a fox trot of the golden forties type. The Virginia reel was one of the most popular. While our Chinese hosts were reserved and formal at the outset, by the end of our trip even the most hard core of them were dancing with us. For some reason they really like "Red River Valley" and "Red Sails in the Sunset."

Willy made a difficult time not only bearable but enjoyable for all of us, and he made a lasting impression on our Chinese hosts. While he made an outstanding contribution to the technical mission of the group, he showed the Chinese that Americans were also warm and friendly fun-loving people. The Chinese who encountered him will never forget him — nor will we.

Ed Johnson
E.R. Johnson Associates Inc.
Fairfax, Virginia, U.S.A.

We were traveling together and delayed on the plane because of bad weather. We were stuck on the ground for hours, but the time flew by because I asked if Willy wouldn't mind giving me a tutorial on nuclear radiation measurements. Off the top of his head he explained γ-ray interactions (Compton scattering, photoelectric effect, etc.), and the different types of γ detectors. We then covered the important γ signatures from uranium and plutonium before moving on to neutron detectors. In addition to being able to explain these things in such an impromptu manner, Willy understood the physics, the electronics and the safeguards implications of all these radiation measurements.

One side of Willy I should not neglect to mention was his kindness to people. He was always helping travellers with their bags, lending a helping hand to a new staff member and taking the time to talk to children.

His contributions to nuclear safeguards made this world safer for us all. This is perhaps his greatest achievement.

Joe Indusi
Brookhaven National Laboratory
Upton, New York, U.S.A.

During the early 1970s, prior to the formation of the Nuclear Regulatory Commission, Willy, myself and several others from the Atomic Energy Commission were part of inspection teams that toured private nuclear fuel fabrication facilities. Our purpose was to review the materials control and accounting systems for fuel processing. Willy was always the "sparkplug" for the team, both professionally and personally. He asked piercing questions about measurement points in the process, set up various scenarios for determining nuclear materials holdup in the system and debated the statistical interpretations of data with the facility operators.

These reviews were at times long, hectic and emotionally draining. However, Willy always managed to keep our spirits and vitality at a high level. For example, on our arrival late one

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Higinbotham

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INMM Involvement

One organization that represented a major commitment for Higinbotham was the Institute of Nuclear Materials Management. Higinbotham was active in the Institute since its early days.

He served as technical editor of the *Journal of Nuclear Materials Management*, beginning with the Summer 1974 issue, until his death. His first editorial for this journal described his introduction to the Institute:

"My introduction to INMM was at the 1969 meeting in Las Vegas, soon after our little group at Brookhaven had plunged into safeguards. We found the meeting very profitable and that all the right people were there ... "

In 1979, he received the Institute's first Distinguished Service Award. He was recognized for his "dedication to the field of nuclear safeguards and for his service to INMM."

Recently, Higinbotham had made plans to train a successor to assume editorial responsibilities, but he enjoyed his assignments thoroughly and intended to continue working in nuclear safeguards and on the *Journal of Nuclear Materials Management.* " I would be bored stiff if I did not have these challenging assignments," he wrote in his October 1994 editorial.

An earlier editorial, published in the late '80s, illustrated his ongoing passion for nuclear safeguards and the scientific process: "It is an exciting time. The tools for research, data storage and analysis have improved by several orders of magnitude during the last thirty years. But these are tools. Ingenuity and wisdom are still essential for their constructive use."

In spite of his scientific focus and the endless flow of projects and requests for technical support, Higinbotham found time for fun and family. He was married three times, outliving his first two wives. He is survived by his third wife, Edna, two daughters, a son, a brother, a sister and two grandchildren. He achieved notoriety for his singing and accordion playing, regularly entertaining at square dances at Los Alamos and Brookhaven laboratories.

Higinbotham will be remembered for his personal charisma and professional achievements. At the time of his death, the Federation of American Scientists was planning to honor him by rededicating its Washington, D.C., headquarters as Higinbotham Hall. The dedication plaque reads: "Our efforts to move the planet rest on the fulcrum he fashioned."

Greg Schultz
Managing Editor, JNMM

Editor's Note: Most of the quotes contained here were excerpted from an interview I was privileged to conduct with Dr. Higinbotham in 1986 as part of an undergraduate journalism assignment. Willy's philosophy, career and spirit will continue to be a source of inspiration to me, as he has been since I began working with him on this publication in 1984.

Remembrances

Continued from page 5

Sunday night in Oklahoma City, a dry spot in the West, Willy managed to find a private club, one that had his personal liquor bottle (marked "Willy") on the top shelf of the bar. The rest of the inspection went well that week because of Willy's club connections. We never did find out how he did it or whether the bottle was real — we didn't ask too much, either.

Charles Pietri
U.S. Department of Energy
Argonne, Illinois, U.S.A.

In the early 1980s, while I was working in Vienna, Willy visited the IAEA. On that occasion, we went up to Huber's Heuriger in Neustift am Walde. Willy loved music and played the accordion. As that evening went on, Willy asked the Austrian accordion player if he, Willy, could play a tune on the Austrian's accordion. That request was not well-received, so Willy danced a little jig while the Austrian played. Taken on face value, this may not seem like much of a story — unless you knew Willy.

Without a doubt, we in the INMM and the safeguards community have been much enriched by our association with Willy.

Cecil Sonnier
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

1994–95 INMM Executive Committee Meets

The INMM Executive Committee held its first full meeting on Nov. 15, 1994, at the Marriott Desert Springs Hotel in Palm Desert, Calif., the site of the 1995 Annual Meeting in July.

INMM Chair Jim Tape was present at the meeting, as were the following committee members and guests: Vice Chair Obie Amacker; N-14 Standards Committee Chair John Arendt; Member-at-Large Gary Carnival; Member-at-Large Jill Cooley; Treasurer Bob Curl; Secretary Vince DeVito; Communications Committee Chair Debbie Dickman; Nonproliferation and Arms Control Technical Division Chair C. Ruth Kempf; Past Chair Dennis Mangan; *Journal of Nuclear Materials Management* Technical Editor Darryl Smith; and Mike White.

Treasurer Bob Curl presented the October financial statement, noting that INMM's current assets are $260,614. The Merrill Lynch trust account is $53,111. The remaining assets include account receivables, prepaid expenses and money market funds. The Executive Committee unanimously approved INMM's move to a new accounting firm, Mann, Cohn and Weitz in Northbrook, Ill.

Following are highlights of other items presented at the meeting.

- The Communications Committee and INMM headquarters staff presented an analysis of the *JNMM*'s communication options. One option is to publish the *JNMM* fewer times per year and instituting a smaller, more frequently published newsletter. The newsletter would contain such items as INMM announcements and calendar items. The purpose behind any change is to find not only the most cost-effective method of communication but also the optimum vehicle of communication. The INMM needs to balance dollars and the needs of the Institute and its membership.

In other *JNMM* news, Tape officially appointed Smith as *JNMM* technical editor.

- The Membership Committee unanimously approved Roy Cardwell and Tom Collopy for Emeritus Membership. INMM headquarters will send letters of congratulations to both men.
- INMM headquarters staff reported that they will send letters to all division chairs requesting them to review and update their division charters. The charters will be reviewed every two years.
- The Executive Committee agreed to support Francis Kovac in chairing the Third International Uranium Hexafluoride Conference at the J.R. Executive Inn in Paducah, Ky., Nov. 28–Dec.1, 1995. INMM is sponsoring the conference, and other participating organizations include Martin Marietta Energy Systems and the U.S. Nuclear Regulatory Commission.
- Mangan reported that the Russian Federation petitioned the INMM to form a chapter. He made a motion to evoke the waiver of dues and request a proposal for a dues structure administered by their chapter, commensurate with the Russian economy, with a fraction of those dues forwarded to the INMM headquarters. Amacker seconded the motion and it passed unanimously. Consequently, a chapter plaque and banner will be presented to the Russian Chapter delegates at the 1995 Annual Meeting.
- The INMM Fellows will review the mission statement in the INMM constitution and bylaws and propose changes at the next Executive Committee meeting, March 8, 1995, in Chicago.

Committees: Government Liaison

Special Session at Annual Meeting

For the third consecutive year, the Government Liaison Committee sponsored and organized a special session at the INMM Annual Meeting in July 1994. The intent of this session is to invite several speakers who are key players in major government nuclear initiatives and are otherwise unlikely to present papers at the Annual Meeting.

The title of the 1994 session was "National and International Initiatives in Nuclear Materials Management." Six speakers addressed new directions in the management of U.S. nuclear materials, nuclear safeguards in the states of the former Soviet Union, and cooperative programs between the United State and the former Soviet Union republics. The speakers and their topics were:

- "Disposition of Plutonium from U.S. Nuclear Weapons Program," J. David Nulton, U.S. Department of Energy (DOE).
- "Atomic Energy Act Review Group," David A. Jones, DOE.
- "IAEA Safeguards on U.S. Excess Fissile Material," Kenneth E. Sanders, DOE.
- "Transparency Under the Agreement Between the United States and Russian Concerning Disposition of Highly Enriched Uranium from Nuclear Weapons," David R. Dougherty, DOE.
- "Prospects for Safeguards Application in Former USSR States," Vladimir Sukhoruchkin, Kurchatov Institute.
- "Safety and Safeguards Activities Between NRC and the Former Soviet Union Republics," Michael F. Kelly, U.S. Nuclear Regulatory Commission.

Attendance at the session grows significantly each year. In July, about 125 Annual Meeting participants stayed after the end of the Technical Program to attend.

Each year, the Government Liaison Committee receives several requests for copies of the presented papers and briefing materials. Written papers are not required for speakers in this special session, and the majority of these speakers prepare only briefing materials. This year, for example, only one speaker provided a written paper while all but one provided briefing materials.

INMM principals considered publishing the available materials in the Annual Meeting Proceedings, but rejected this because of page limitations and the fact that this session is not part of the Technical Program. There are tentative plans for the committee members to write an article summarizing the 1995 session for publication in the *Journal of Nuclear Materials Management.* If you are is interested in obtaining briefing materials or the one paper from this year's session (on transparency), contact INMM headquarters at 708/480-9573.

Committee Meeting at Annual Meeting

In the afternoon following the special session, the Government Liaison Committee met to review the session and consider topics and activities for 1995. Committee members present were William Floyd, James Lemley, John Matter and Bruce Moran. They were joined by new volunteer members Jack Allentuck and Robert Behrens.

Potential topics suggested for the session included U.S. plutonium vulnerability assessment results; weapons dismantlement; long-term storage operations; U.S. inspections experiences; waste management, packaging and transportation; the DOE transition from defense programs to environmental management; and human factors and reliability. This is a fluid list that can easily change as new government initiatives arise.

The committee process for preparing the special session each year is to solicit topics from committee members early in the calendar year, rank the topics and then identify proposed speakers for each topic.

John C. Matter, Chair
INMM Government Liaison Committee
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

Committees: Membership

Five INMM members were awarded Senior Member status at the INMM Annual Meeting in Naples, Fla., last July. They were recognized for their contribution to nuclear materials management and, in particular, their contribution to the INMM.

The addition of Kenneth Byers, Robert Curl, Paul Ebel, Francis Kovac and Donald Six brings the number of Senior Members to 44. Sixteen of these members were chosen to be INMM Fellows. The bylaws require that a person be a Senior Member in order to be eligible for Fellow status. (Please note that females as well as males are Fellows of the INMM.)

Senior Membership is a way to publicly recognize those members who have at least 10 years of nuclear materials management experience, have been a member of the INMM for at least three years and have been contributing to INMM programs and operations for the past five years. This participation could involve holding an organizational leadership position, being active on a committee, attending INMM-sponsored meetings, or contributing technical presentations, articles or papers on the subject of nuclear materials management. The participation does not require attendance at the INMM Annual Meeting, though, because there are many members making major contributions to their local chapters who are good candidates for Senior Membership status.

There are no additional dues for membership as a Senior Member, and the status is for the lifetime of your INMM membership. At the Annual Meeting, the Senior Members wear a different colored name badge to identify them as INMM members who contributed significantly to the Institute.

You must nominate yourself for Senior Membership by completing the application on page 8. If you need more copies, contact INMM headquarters at 708/480-9573. Even if you are not sure that you qualify for Senior Membership, complete the application and let the reviewing committee (the INMM Membership Committee) make that judgement. You might be surprised!

We are certain that there are many times as many Senior Member candidates as there are current Senior Members, and the only reason there are not more Senior Members is the inertia (tendency of a body at rest to remain at rest if there is no outside force) of members in not completing the form.

Return the application to the INMM office by April 1, 1995, in order to be recognized as a Senior Member at the Annual Meeting, July 9-12, 1995. By June, notification letters will be sent to all successful applicants. At the Annual Meeting Banquet, new Senior Members will be officially welcomed.

Complete the form, send it in and see what happens. We are looking forward to greeting you next summer as a Senior Member of the INMM.

Paul Ebel, Chair
INMM Membership Committee
BE Inc.
Barnwell, South Carolina, U.S.A.

Donald E. Six, Chair
INMM Membership Committee
Westinghouse Hanford Co.
Richland, Washington, U.S.A.

N–15 Standards

The need for nuclear materials safeguards is apparent from the interest expressed in obtaining copies of the current and withdrawn standards by personnel from the former Soviet Union countries. Developing a consistent set of standards defining effective procedures for materials control and accounting and physical protection could be INMM's greatest contribution to lessening the SNM theft and diversion concerns in the former Soviet Union countries and in other countries with emerging safeguards programs.

The N-15 Committee was implemented with a management structure to support development of a system of standards that would define a full safeguards system. Unfortunately, of the approximately 30 standards that were developed and approved, only 10 are now active. These standards belong almost exclusively to subgroups INMM-2 (Material Classification), INMM-5 (Measurement Control), INMM-8 (Calibrations) and INMM-11 (Training and Certification).

The standards from the remaining 10 subgroups were withdrawn because they either were no longer needed or had expired from lack of updating. If INMM wishes to restore an N-15 standards program that can effectively support development of emerging safeguards systems in other countries, a major effort must be undertaken. If this level of effort is not feasible, INMM needs to determine what level of effort is feasible, how many standards can be supported and which standards should be supported within that effort level.

The greatest limitation to a large standards redevelopment effort are shrinking safeguards budgets, increasing work loads and changing priorities of the safeguards professionals. Many of those who developed the N-15 standards are retired or no longer available to support the standards effort.

The active support of the international safeguards community may need to be brought to bear on the effort if the standards are to be redeveloped. This would require conversion of the standards to the ISO format and approval within ISO.

An alternative would be to approach the retired members of INMM to determine their interest in chairing the standards committees. These members potentially have the most available time to donate to the standards effort (although they would not have financial backing for travel to meetings). Support for standards (re)development activities is beginning to be explored with DOE and NRC. The safeguards standards support active U.S. government missions within both domestic and international safeguards.

The scope of N-15 was extended to include environmental measurements of nuclear materials. This should permit retaining the support of measurement personnel whose primary responsibilities shifted from safeguards to the environment. The following scope statement was drafted:

"Standards for protection, control, accounting *and environmental monitoring* of nuclear *and related* materials in all phases of the nuclear fuel cycle, including analytical procedures where necessary and special to this purpose, except that physical protection of nuclear materials within a nuclear power plant is not included."

Bruce Moran, Chair
INMM N–15 Standards Committee
Martin Marietta Energy Systems
Oak Ridge, Tennessee, U.S.A.

Divisions: Waste Management

Pierre Saverot, chair of the Committee on Low-Level Waste Packaging and Disposal, is in the preliminary stages of setting up a technical workshop to be held in Spain or France in October 1995. (This is a tentative date.) The workshop will center on the hows of LLW management instead of the big policy programs, such as packaging techniques, vault construction, radionuclide migration, recovery techniques, leakage forecasting, and identification and measurement of radionuclides.

A preliminary agenda for the workshop was prepared and sent to national radwaste management agencies in Europe (including ANDRA, ONDRAF, MIREX and ENRESA), as well as to interested parties in the United States, and positive responses to the format of the proposed presentations were received.

The proposed format is similar to the annual Spent Fuel Management Seminar held in Washington, D.C. The committee anticipates that the workshop will be two or two-and-a-half days long, plus a tour of an LLRW site in Spain or France, with no concurrent sessions. The committee is in the process of developing a final program, meeting location and a budget plan for the workshop.

The committee is making progress on the INMM Monograph on Spent Fuel Storage. It estimates that editing of the chapters will be completed within three months of the last submittal, with another two or three months needed for publication.

E.R. Johnson
E.R. Johnson & Associates
Fairfax, Virginia, U.S.A.

Chapters: Japan

The following officers were elected for 1995-1996 at the Executive Committee meeting in Tokyo:

Chair Tohru Haginoya, consultant;

Vice Chair Kentaro Nakajima, Toshiba Corp.;

Secretary Takeshi Osabe, Japan Nuclear Fuel Co. Ltd.;

Treasurer Nobuo Ishizuka, Japan Atomic Industry Forum; and

Members-At-Large Tetsuchi Kuramochi, Japan Nuclear Fuel Ltd.; Yuzuru Motoda, Nuclear Material Control Center; Kouki Kiawa, Japan Atomic Energy Research Institute; and Tsuyoshi Mishima, Power Reactor and Nuclear Fuel Development Corp.

The 15th annual business meeting was held in Tokyo on Oct. 24 -25. Almost 200 people participated in the two-day session, chaired by Kouji Ikawa from the Japan Atomic Energy Research Institute. Six participants came from overseas, including INMM Chair Jim Tape.

Japan Chapter Chair Tohru Haginoya gives the opening remarks at the chapter's annual business meeting.

Vienna

The following executive committee members were elected on Sept. 30, 1994:

Chair Martha Williams, IAEA;

Vice Chair Reza Abedin-Zadeh, IAEA;

Secretary Barbara Wilt, IAEA;

Treasurer Peggy Scott, IAEA;

Members-At-Large Michio Hosoya, IAEA; and Shirley Johnson, CO;

Past Chair James Larrimore, IAEA; and

Committee Chairs Pricha Karasuddi, IAEA, Chapter Symposium; and Ed Kerr, Annual Social.

Martha Williams, Chair
INMM Vienna Chapter
International Atomic Energy Agency
Vienna, Austria

Pictured are some of the new executive committee members of the Vienna chapter. They are, clockwise from the top left: Pricha Karasuddi, Shirley Johnson, Peggy Scott, Martha Williams and James Larrimore.

Southeast

The following officers were elected for 1995:

President Mary Rodriguez, Westinghouse SRS;

Vice President John Murphy, Ogden Environmental and Energy;

Secretary Heidi Johnson;

Treasurer Lori Brownell; and

Members-At-Large Tom Williams, U.S. Department of Energy; Jane Terrell, U.S. Department of Energy; and Berry Crain, Technical Solutions Inc.

The new slate of officers will help get this renewed chapter on firmer ground. Planning meetings will be held to develop a list of activities for the year. Some suggestions include assisting in developing topics for the annual meeting, sponsoring guest speakers on issues affecting the southeast, and increasing the awareness of key issues facing the nuclear industry. The chapter also needs to address how membership can be increased beyond the Savannah River Site area.

Mary Rodriguez, President
INMM Southeast Chapter
Westinghouse SRS
Aiken, South Carolina, U.S.A.

Cooperative Feasibility Test of Remote Monitoring of Unattended Sensors

K. Ystesund and R. LeGalley,
Sandia National Laboratories, Albuquerque, New Mexico
K.Koyama and Y. Yamamoto,
Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, Japan
N. Kyriakopoulos,
The George Washington University, Washington, D.C.

Abstract

A feasibility test on remote monitoring of unattended sensors was conducted by Sandia National Laboratories (SNL) and the Japan Atomic Energy Research Institute (JAERI) under a bilateral agreement between the U.S. Arms Control and Disarmament Agency (ACDA) and JAERI. The Containment and Surveillance Data Authenticated Communication (CASDAC) system developed by JAERI for nuclear safeguards and physical protection is a prototype system for remote monitoring of sensor status through the international telephone network. Sensor inputs to the CASDAC system are provided by prototype tamper-protected sensor enclosures developed by SNL on behalf of ACDA. The CASDAC system normally operates on a polling basis from the central control console at JAERI, but data transmission may also be initiated from the remote read unit at SNL when a sensor activation is detected. All transmission data are encrypted. Statistics concerning reliability, time delay for anomaly detection, and records of all sensor activations were accumulated since May 1992. This paper describes the objectives and preliminary evaluation of the accumulated data. The U.S. Defense Nuclear Agency (DNA) funded the experiment at SNL to obtain information about the potential of CASDAC for use in Chemical Weapons Convention (CWC) applications.

Introduction

On March 7, 1990, the United States and Japan exchanged diplomatic notes calling for ACDA and JAERI to cooperate in the development and testing of monitoring systems. Concepts and technology developed originally for nuclear safeguards and physical protection could also be used to verify compliance with other arms control treaties such as the Chemical Weapons Convention.

One area of such interest is the remote monitoring of unattended sensors. Reliable data collection systems are needed for applications requiring that information be available on a near-real-time basis. For multilateral treaties, the span of the data collection system is global, the number of data source nodes is large, and the volume of data generated at each node is small. Also, the potential problems that could arise due to the lack of confidence in the validity of the data make it necessary to impose a security requirement throughout the system.

Presently, the only communications medium capable of satisfying the design constraints at a minimum cost is the international telephone network. In the past, ACDA funded the development of a prototype remote monitoring system known as the RECOVER[1] (remote continual verification) system. After a short demonstration, the program was completed to be followed by TRANSEAVER[2] (transportation by sea, verification), which was designed to monitor the shipment of nuclear materials by sea. Communications were through the INMARSAT satellite communication system. TRANSEAVER was field tested on a container ship traveling between Tokyo and Seattle. Data obtained from these programs led to the development of the CASDAC system by JAERI.

To investigate issues related to the security of the data generated by the sensors, SNL, under contract to ACDA, developed tamper-indicating enclosures for temperature and a pressure monitor.[3] DNA provided funding to conduct an experiment using CASDAC, located at the Tokai Research Establishment of JAERI, to monitor the sensors located at SNL in Albuquerque, New Mexico. This paper describes the objectives and preliminary results of the experiment.

The CASDAC System

The CASDAC system is a prototype secure monitoring system designed to remotely monitor sensor status continually and report detected anomaly information in a timely manner. The system is divided into two subsystems, the grand command center (GCC) and the facility subsystem. The GCC includes the communication control equipment (CCE). The facility subsystem consists primarily of an on-site multiplexer (OSM) and monitoring units (MUs),

which are connected to the facility sensors to be monitored. Each facility subsystem is linked to the GCC through the international telephone network. All communication data are encrypted to prevent access by unauthorized persons who may intend to monitor or falsify data. During operation, the GCC is assigned as a master system, while the OSM and its peripheral units are a slave system.

The system is designed to provide secure communication, tamper-resistant and tamper-indicating functions, minimum false alarm rates, and reliable sensor status monitoring to support its intended use in unattended monitoring applications. In addition, cost, performance and maintainability are also taken into consideration. The system control program is written in the C programming language in order to make it transportable to other computer systems.

Monitoring unit (MU)

The basic functions performed by the MU are to sample the analog sensor data, provide temporary storage until transmission to the OSM, and encrypt the data for transmission over a physically unprotected communication cable. The MU samples sensor status once each second. An "alert" level is detected if four consecutive samples indicate a sensor activation; thus the discrimination interval for detecting anomalies is four seconds. The reason for requiring four consecutive sensor activations to determine an alert is to minimize the probability of false alarms due to electrical noise.

On-site multiplexer (OSM)

The facility subsystem OSM manages data communication with the GCC and with the other components of the facility subsystem. These include up to 30 MUs, a data terminal for text message exchanges with the GCC, and a multiplexer unit to enable communication with external devices.

The principal functions of the OSM are:

- Collection of data from the MUs,
- Transmission of sensor data and state-of-health data from the OSM and MUs to the GCC,
- Data exchange and communication control between the GCC and OSM, and between the OSM and MUs,
- Destruction of all information stored in memory, including the data encryption keys, if a tamper condition is detected.

Data collection from the MU

An MU must be initialized from the GCC via the OSM by receiving an initialization request followed by an encryption key consisting of 128 bytes. The OSM initiates a poll of the current sensor status by sending the MU a polling inquiry followed by a random number consisting of 128 bytes. Both the random number and the encryption key are used by the MU to encrypt the response. Data are collected from MUs at programmable intervals through a party line network.

The OSM changes the random number for each poll to enhance data security. Each polled MU identifies itself through a response that also specifies whether the status of the MU is normal or abnormal. The sensor status information transmitted by the MU includes the present status as well as the contents of a history register. In addition, the MU response contains the number of polls received from the OSM and the number of responses given by the MU to polling requests. This protocol is designed to detect any unauthorized polls of the MU. A polling counter mismatch between requests and responses is a condition for system alarm.

Data communication with the GCC

The communication control equipment (CCE) of the GCC controls communication procedures and carries out encryption and decryption of data. Communication between the GCC and the OSM can be initiated by either the GCC or the OSM. Data transmission to the GCC is usually initiated from an OSM by automatic reporting triggered by an alert signal. An alert signal can originate from facility sensors, from the data terminal equipment or from the multiplexer unit. Normal polling is initiated by the GCC, the central node of CASDAC system, at preprogrammed intervals to monitor the status of a facility subsystem.

The data encryption scheme used by the CCE and the OSM is a process developed by JAERI. Two random numbers, a key number and a random number, are used for both encryption and decryption. These random numbers are stored in the system memory when the system is initialized. The CCE (or the OSM) selects two independent numbers to be used for each transmission and transmits the tags of the selected numbers in a message header. The tags identify the positions of the key number and the random number in a random number table. The random number table contains 256 random numbers, each of which is 128 bytes long.

Grand command center (GCC)

At the center of the CASDAC network is the system control and verification unit (CVU) of the GCC. It is designed to communicate with and remotely manage up to 80 facility subsystems, or OSMs, through the international telephone network.

The basic functions of the CVS are to:

- Remotely control the operation of facility subsystems,
- Collect and store data from the facility subsystems,
- Evaluate the received data and determine whether a normal or abnormal situation exists at the monitoring site,
- Indicate the location of the monitored facility on a map display, and
- Automatically report by facsimile the detected abnormal situation with associated information to designated locations on a near-real-time basis. Up to six worldwide reporting points can be identified for each facility subsystem.

Thus, the GCC performs the following principal functions:

- Initializes facility subsystem components (OSM, MUs, and others),
- Responds to a call from an OSM or facility subsystem,
- Encrypts and decrypts data,

• Analyzes the received data and generates an anomaly if the result is abnormal, and

• Files the received data, anomaly data and records about communications and unauthorized interventions.

Back-up power

If external power fails, a back-up power system maintains the data in the OSM memory, and the OSM continues to poll the MUs for one hour. If the primary power is lost for more than one hour, the polling of the MUs is suspended and the OSM goes into a "sleep" mode for up to 72 hours. If primary power is restored within 72 hours, the OSM automatically resumes normal operation. However, after 72 hours in the sleep mode, all data in the memory of OSM is lost. In that case, the OSM does not return to the normal operations mode until initialization procedures are carried out.

Tamper-Protected Sensor Enclosure

The tamper-protected sensor enclosure, developed at Sandia National Laboratories, provided the sensor inputs to the CASDAC system during this experiment. Since the tamper-protected sensor enclosure was designed for use in an unattended mode, the combination of this equipment with the CASDAC system is appropriate. Note that the CASDAC system is a data communications system and its design includes only those tamper-indicating sensors necessary for protection of the CASDAC equipment.

The tamper-protected sensor enclosures were designed to demonstrate how unattended process monitors could be protected. The design includes a temperature sensor and a pressure sensor, each in its own housing. These sensors are activated with a heater and an air compressor, respectively, for demonstration and test purposes. The sensor housings are protected by an array of tamper-indicating sensors including internal temperature and pressure monitors, tilt sensors, magnetic sensors, radiation sensors, door switches, light sensors and an external power monitor. The equipment design includes a battery backup system that provides power for 12 hours in the event of an external power failure.

In addition to providing sensor inputs to the CASDAC on-site multiplexer (OSM), the tamper-protected sensor enclosure illustrated that an unattended data reporting system and associated tamper-protected sensors should be viewed as a system rather than discrete tamper-protected components. Interactions between system elements should also be considered because vulnerabilities could be introduced into the overall system due to characteristics of individual components.

Objectives of the Test

Unattended sensors are utilized in situations where continuous presence of inspectors is not feasible or practical. Continuity of information about the state of a process can be obtained through a properly designed and located set of sensors. In a global monitoring environment, the information would be collected at some central organization, such as the International Atomic Energy Agency in the case of international nuclear safeguards, or the technical secretariat of the Organization for the Prohibition of Chemical Weapons. So far, there is no operational system in international nuclear safeguards or any other multilateral arms control treaty collecting data on a real-time basis. Some of the reasons given for the lack of development of remote monitoring systems were concerns about the reliability of systems based on the international telephone network and about the security and reliability of tamper-indicating enclosures for the sensors.

This experiment was designed to simulate a realistic set of operating conditions for the CASDAC system to identify equipment problems. In addition to evaluating the operational characteristics of the integrated system, the goals of the experiment, in summary, were to:

• Evaluate the integration and operation of SNL-developed tamper-indicating sensors and the JAERI CASDAC system;

• Evaluate the security and reliability of tamper-indicating equipment for use in an unattended monitoring environment;

• Obtain data for evaluating the cost-effectiveness of a remote monitoring system for arms control, safeguards of nuclear materials, and physical protection applications; and

• Evaluate the ability of local and remote data collection systems to provide timely and reliable information about the unattended mode of operation.

Test Description

A goal of this experiment was to test and evaluate a demonstration system for on-site monitoring. The CASDAC system developed by JAERI was connected to the tamper-protected sensor enclosures developed at SNL. The test was carried out in a four-phase program. Phase I was a two-week baseline test. The system was brought on-line, but no sensor activations were deliberately produced. During Phase II, also a two-week test, selected sensors were activated to verify the response of the data communication system. Phase III was a four-week period during which all sensors were activated at least three times. Phase IV was a six-month test of the reliability of the CASDAC system. SNL tested the system response to power failures, loss of telephone communication, cable disconnects between CASDAC and the MUs, and loss of power or ground connections at the MUs. These represent possible methods that sensor reporting could be disrupted either intentionally or accidentally.

During the experiment, SNL carried out tests to identify potential vulnerabilities in the combined communication and sensor systems, but this was not intended to be a complete adversarial analysis. The purpose of this testing was to determine if inputs to the CASDAC system (power, telephone, and sensor inputs) could be manipulated to generate misleading or false reports. The combination of the tamper-protected sensor enclosures and the CASDAC system introduced a potential problem due to the fact that it is possible to open a sensor enclosure door and force a system to reset in less than the four-second period required by CASDAC to define an

event. Therefore, intrusion into a sensor enclosure could not be detected by CASDAC because the sensor system outputs were reset before the four-second period elapsed.

Throughout the experiment, sensor activations were initiated and logged at SNL. The activity that was detected by the CASDAC system was monitored and reported to the data fusion center in Japan. A printed copy of that record was sent to SNL at the conclusion of Phase IV for comparison to the SNL log. Following an initial comparison of the two data logs, SNL coordinated the data analysis with JAERI. Although the final analysis of the Phase IV data is not yet complete, the following section describes the test results based on the Phase III data analysis and on a preliminary analysis of the Phase IV data.

Test Results

No false alarms were known to be reported to the JAERI data fusion center by CASDAC. A single sensor event can be reported more than once depending on the duration of the event and the timing of the report to the data fusion center; however, sensor events are tagged with one of four characters to indicated the status of the sensor event when the report is made.

When CASDAC is unable to report due to loss of telephone service or power loss, it stores a record of whether a particular sensor was activated since the last report. For example, if a sensor is activated multiple times during a period when telephone communication is not possible, CASDAC will report (when communication is restored) just that the sensor was activated, not the number of times or when an activation occurred. For this reason, CASDAC is a near-real-time reporting system if communication is accessible; only the time of the report is recorded, not the time of the sensor activation. To obtain this data, AC power to the CASDAC system was interrupted multiple times and the telephone line was disabled twice during the experiment to evaluate the effects of a loss of communication. When an MU is disabled, the loss of communication is recorded by the CASDAC system.

CASDAC reports to the data fusion center when a sensor activation is detected or when periodically polled by the data fusion center. In order to minimize or eliminate false alarms due to electrical noise, CASDAC is designed to only recognize events that persist for at least four seconds. Because it was possible to open and force a reset of the tamper-protected sensor enclosure equipment within four seconds, it was possible to circumvent the combined sensor monitoring system. This is a special case, but it serves to illustrate the important of examining the interactions between system components.

Tamper resistance of the CASDAC system hardware is difficult to evaluate because the test unit is not a production model, but the penalty invoked by detection of a tamper attempt is that the encryption keys are destroyed and the system must be re-initialized with cooperation from the data fusion center. No potentially destructive tamper tests were attempted during this experiment, but sensor inputs were manipulated to assess the effect of unexpected sensor activations. The tamper-protected sensor enclosures were not sealed during the experiment, but in an actual monitoring application it is expected that there would be additional safeguards measures applied to prevent undetected access to the process monitors. These measures would provide an indication of events that do not persist long enough to be reported by the CASDAC system.

The telephone communication link must be of good quality for reliable communications. During installation of the CASDAC system at SNL, the experiment location had to be moved from a remote area to a building with higher quality telephone service. Noise on the telephone line interfered with reliable communications. CASDAC can also accommodate other modes of communication, such as a satellite link, with minimal development, but only a public telephone link was used during the tests at SNL.

Preliminary Conclusions

The CASDAC and tamper-protected sensor enclosure systems as tested are not field-ready units. The tamper-protected sensor enclosures were built to demonstrate how existing (pre-1987) technology could be applied to the problem of protecting unattended process sensors. During this experiment, the tamper-protected sensor enclosures served as a convenient and appropriate source of sensor inputs for the CASDAC system. A tamper-protected sensor system intended for actual field use in an unattended mode would have to be carefully designed to avoid system vulnerabilities.

A production version of CASDAC would need to incorporate improved tamper resistance and would be smaller than the tested version. The tested unit used an encrypted communication scheme that may be unacceptable in some applications, but data authentication could be used instead of encryption with system design modifications. Within these constraints, CASDAC appears to be a reliable and accurate remote monitoring system. The communication method will depend on the quality of telephone service available in the monitored and monitoring locations. Data transmission can be encrypted or authenticated as required and other communication could be used as well. A thorough analysis of the experimental data is not yet completed. However, based upon the preliminary findings, this experiment has demonstrated that reliable near-real-time reporting of remote sensors can be accomplished.

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2. Kyriakopoulos, N., H. Kuroi, O.J. Sheaks, "TRANSEAVER: A Security System for International Sea Transport," *International Conference on Communications '86*, Toronto, 1986, pp. 949-954.

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Weapons Dismantlement Issues in Independent Ukraine*

Neil R. Zack
Safeguards Systems Group
Los Alamos National Laboratory
Los Alamos, New Mexico

Elizabeth J. Kirk
Project on Europe and the Countries of the Former Soviet Union
American Association for the Advancement of Science
Washington, D.C.

Abstract

The American Association for the Advancement of Science sponsored a seminar during September 1993 in Kiev, Ukraine, titled, "Toward a Nuclear-Free Future — Barriers and Problems." It brought together Ukrainians, Belarusians and Americans to discuss the legal, political, economic, technical, and safeguards and security dimensions of nuclear weapons dismantlement and destruction. U.S. representatives initiated discussions on legal and treaty requirements and constraints, safeguards and security issues surrounding dismantlement, storage and disposition of nuclear materials, warhead transportation, and economic considerations. Ukrainians gave presentations on arguments for and against the Ukraine keeping nuclear weapons, the Ukrainian Parliament's nonapproval of START I, alternative strategies for dismantling silos and launchers, and economic and security implications of nuclear weapons removal from the Ukraine. Participants from Belarus discussed proliferation and control regime issues. This paper will highlight and detail the issues, concerns and possible impacts of the Ukraine's dismantlement of its nuclear weapons.

Introduction

The American Association for the Advancement of Science (AAAS) Program on Science and International Security sponsored a seminar in September 1993 at the Pushcha-Ozernaya Sanatorium on the outskirts of Kiev, Ukraine. The seminar was titled, "Toward a Nuclear-Free Future — Barriers and Problems." The seminar was co-sponsored by the International Institute for Global and Regional Security, headquartered in Kiev. The meeting was supported by the U.S. Institute of Peace, the Arms Control and Disarmament Agency's Public Affairs Office and the Department of Energy's International Safeguards Division.

* Los Alamos work supported by the U.S. Department of Energy, International Safeguards Division

The seminar brought together about 30 Ukrainians, three Belarusians and eight Americans to discuss the legal, political, economic, technical, and safeguards and security dimensions of nuclear weapons dismantlement and destruction. Ukrainian participants included personnel from the International Institute on Global and Regional Security, Kiev University, National Security Council, Ministry of Defense, Ministry of Foreign Affairs, National Institute of Strategic Research, Institute of World Economy and International Relations, and Donetsk University. The Belarusian participants were from the "West-East" Center, Ministry of Defense, and Belarus University. The United States participants were from the AAAS, Los Alamos National Laboratory, Department of Defense, Arms Control and Disarmament Agency (ACDA), International Disarmament Corp. (IDC) and a consulting firm. One U.S. participant acted as a private individual. Two others from the United States who were performing treaty verification activities attended the final two days of the seminar but did not participate in any discussions.

The remainder of this paper will present the exchange of issues and ideas by all the participants to highlight the underlying concerns of the Ukrainian participants. The give-and-take flavor of the discussions during the five days of the seminar is included to help interpret the context of the issues.

Background

During the seminar, the political tensions in the Ukraine were very high. The Ukrainian president had announced his plans to assume the duties of prime minister, a position left vacant by the resignation of the previous minister. Many of the Parliament members were beginners in politics and were savoring their new freedom of speech and self-determination. Several of the Ukrainian seminar participants suggested that after the new elections in 1994, the Parliament was likely to be even more conservative. Large-scale, anti-government demonstrations by nationalists from western Ukraine were

held near the Parliament. The U.S. delegates were informed that these demonstrators displayed some placards expressing the desire for the Ukraine to keep the strategic nuclear weapons left behind by the departing Russian military. Tensions between the nationalists in the west and the industrial east of the Ukraine were increasing. The nationalists were seeking closer ties with Poland, while the east, which contained many Russians, felt that economic survival depended upon maintaining good relations with Russia. It appeared that if a confederation was not established soon, the country might be divided.

Political tensions in Russia began to mount during the seminar as Russian President Boris Yeltsin struggled with the Russian Parliament. These events were of great concern to the Ukrainian people. The U.S. delegates were reminded that the Ukraine had been overrun many times throughout its existence and that it could happen again. The Russians were rethinking the agreement to pay the Ukrainians for the highly enriched uranium and other components to be removed from the nuclear weapons the Russians left behind in the Ukraine. The country's economy was spiraling downward with few consumer goods available except at hard currency stores. Local vendors refused to take the Ukrainian currency (coupons), wanting dollars instead. During the week of the seminar, the coupons inflated nearly 20 percent against the U.S. dollar.

With these issues and politics progressing during the seminar, U.S. and Ukrainian participants discussed a wide range of nuclear security issues, including the costs associated with keeping the strategic nuclear weapons and delivery capabilities in their country.

The Seminar

The first day of the seminar concerned the foundations of nuclear policies and expanded into legal and political issues surrounding nuclear dismantlement and the psychology of being a nuclear state or non-nuclear state. Day two of the seminar included discussions on dismantling and storage problems and pitfalls. U.S. participants presented papers on disabling and dismantling nuclear weapons and silo/delivery systems, storage of nuclear materials, safeguards and security requirements, perimeter monitoring, and health and safety issues. The third day involved presentations concerning control regimes, protection of nuclear weapon technologies, transportation of nuclear materials, and the destruction of warheads and launchers. Day four focused on the economic aspects and related financial burdens of having nuclear weapons. These discussions were based on lessons learned by the United States concerning the costs of disabling and destroying nuclear weapons, both direct and indirect costs. The final day of the seminar centered on nuclear issues as a factor in U.S./Ukraine, U.S./Russian and Ukraine/Russian relations and the prospects for arms control and nonproliferation. While the discussions included many policy concerns, the U.S. participants were not speaking officially for the United States government, but were highlighting important issues that the Ukraine should consider concerning its nuclear weapons.

Treaties and obligations

The meeting began with a broad-scale discussion by the U.S. participants of the treaties and interpretations of START I and II; the Lisbon Protocol; Intermediate Nuclear Forces Treaty (INF); the Nonproliferation Treaty; aspects of missile, bomber and warhead dismantlement; and recent agreements signed by the Ukraine president. Specifically highlighted were the international and legal obligations that the Ukraine was seen to have as a successor state to the former Soviet Union, which would indicate that they were legally bound by the limits of START I and the INF. However, the Ukraine Parliament was debating the issue, and several Ukrainian seminar participants felt that they were under no legal obligations to honor any Soviet Union agreement originated before the independence of their country. Others believed that a future official could readily negate any prior treaty without an agreeing vote of Parliament.

Their reasons for desiring to be a nuclear state were apparently ones of self-defense. Tactical nuclear weapons systems were removed by the Russian military as they left the country. The Ukrainian conventional defense forces were still being organized, but, at this time, were felt to be incapable of protecting the country from invasion. They viewed their strategic nuclear weapons systems as a deterrent to invasion.

Several U.S personnel noted that the Ukraine's 1,800 weapons were only aimed at the United States and western Europe. If the targeting were changed, how would we know? Logically, the U.S. people would have to assume that the intercontinental ballistic missiles were still targeted on the United States. The United States would not support retargeting the ballistic missiles or dismantling them completely. In the current use of nuclear weapons, they were not a deterrence to local aggression. In addition, monies that could be used to strengthen conventional military forces would be required for the maintenance and protection of the nuclear weapons. Several Ukrainian participants rejected the obligation of returning the weapons systems to Russia. They felt that once the Russians had the weapons, they would count them as part of their dismantlement totals, which would allow the Russians to keep more ballistic missiles. At this early stage in the seminar, it became apparent that there were no single issues guiding several participants' insistence that the country be a nuclear weapons state. Many issues, all intertwined, would be brought to light throughout the discussions.

The economy

The economy of the Ukraine was tied to weapons dismantlement and removal in every discussion. The U.S. participants discussed the obligations associated with the offered monies

identified in the Nunn-Lugar appropriations and the domestic law that required the Ukraine to agree to destroy their weapons of mass destruction and forego their replacement to receive the funds. If the Ukraine did not respond and claim the offered support soon, the money may be redirected by the U.S. Congress. It was not the intent of the United States to pay for the complete dismantlement of the nuclear weapons, but rather to provide help to start the process. Regardless of the funding offered by the United States, several of the Ukrainian participants wanted to maintain the weapons to use them as bargaining chips.

The Ukrainians complained that 12 percent of their budget was currently being directed to aid the Chernobyl cleanup. They estimated that nearly $3 billion would be required to stabilize the economy, clean up the environment and destroy weapons. The costs to destroy the silos, launch platforms, nuclear weapons and solid fuels would be very high. Support would be required to build new housing for the military put out of work by the dismantlement or removal of the nuclear weapons. Additional funds would be required to build the conventional military forces for self-protection. A few Ukrainian participants wanted the ecology and economy to be the first priority before removing any weapons or delivery systems because only 1 percent of the Ukraine was deemed ecologically clean and jobs were few.

Further discussions on the economy included the need to recover materials available from the ICBM silos and launcher platforms and reuse those materials. Other participants thought the best way to stabilize the economy and protect the country's resources was to send the nuclear weapons back to Russia. Ukraine had signed an agreement with Russian to receive payment for the nuclear materials from the weapons returned to Russia. This payment could be in the form of direct payment or credits for gas and oil, nuclear reactor fuel, or other goods.

If Ukraine dismantled the missiles and returned the nuclear materials to Russia, the country still would not have the technology to convert the rocket fuels and high explosives to commercial uses. If they did not remove the weapons, it was quite possible that Russia would cut off oil and gas supplies sorely required for the coming winter. Several Ukrainian speakers wanted the United States to furnish the technology necessary to support the economy and solve the problems associated with the weapons and the environment. U.S. participants suggested that with the removal of weapons from Ukraine and its entry into the world community, private investment would flow into the country, the economy would grow and employment would increase. One of the U.S. participants noted that the group of companies comprising the International Disarmament Corp. sponsored his attendance at the meeting to encourage the Ukraine to adopt an environment suitable for foreign investment by removing nuclear weapons from the country. Other Ukrainian speakers said they believed that the United States and western Europe would *not* supply the technology for the country to grow because that would cause competition with their industries. Rather, these countries would sell the Ukraine what they needed to maintain a strong influence and presence with the Ukraine's government.

The Los Alamos participant presented a detailed description, with associated cost estimates, of what is required for building nuclear materials and weapons storage facilities to house the dismantled or functional weapons. These costs included security forces, monitoring systems, environmental monitoring, radiation and contamination monitoring, and specialized structures. The cost estimate for a facility built in the United States under current federal guidelines was $1.5 billion. Although the amount in the Ukraine would be less, it would produce a continuing drain on the economy. However, a Ukrainian participant stated that it would cost their country nothing to maintain the weapons because the United States, England, France and Russia would pay to maintain the weapons in a safe and secure manner rather than risk an accident or theft of the nuclear materials. At this time, a U.S. participant from ACDA stated that the United States and Russia had an agreement not to examine, maintain or perform work on each other's nuclear weapons and delivery systems.

Nuclear materials security and safety

All participants at the meeting expressed a concern with Ukraine's ability to adequately maintain and protect the nuclear weapons even after they were dismantled. One person from the Ukraine presented a description of a nuclear winter to highlight the potential result of an accident. He noted that the Ukraine had 26 terrorist acts in one year against the state and new symbols of authority. Another person stated that although a problem does exist in maintaining the weapons, Ukrainians were trained by the Russians to correct all problems; there are no grounds for concerns.

A U.S. participant from the IDC raised several questions concerning reported safety problems the Ukraine has been having with the stored nuclear weapons. He discussed the general methods required to make a warhead inoperative, the three to six months required to complete an inventory, transportation of the materials, and the likelihood of maintaining the weapons for up to seven years in interim storage. Also presented was the support being offered to Russia by the U.S. government concerning the safe and secure transportation of weapons by rail and road for protection against fire, crushing and terrorism. This kind of support might also be made available through the Nunn-Lugar appropriations to help the Ukraine.

The possibility of an unauthorized launch exists in the Ukraine as long as the weapons remain. The safest way to prevent such an action it to totally dismantle the weapons. But a Ukrainian defense department official pointed out that Ukraine has no guarantees of safety or security if it gives up its nuclear weapons. Although the U.S. participants viewed their country's actions as trying to help, several Ukrainian attendees saw the United States as exhibiting only selfish interests.

A U.S. ACDA participant presented personal hazardous experiences he had with fires and glovebox explosions during his work in various nuclear materials programs as a means to highlight safety problems and issues associated with nuclear materials handling. Another U.S. participant presented a summary discussing the safety requirements that would be demanded of the Ukraine if it kept its nuclear weapons or nuclear materials from any dismantled weapons. The accident at Chernobyl was given as an example of international concerns: the costs of environmental contamination and peoples' radiation exposures. Detailed and extensive monitoring for plutonium, uranium, tritium and propellant materials would be required to provide assurance to the world that the Ukraine was safely maintaining its materials. Examples were presented that discussed the damage to people, the environment, and the earth when materials were mishandled. The means to be ready for any nuclear materials emergency would be costly. Associated with these costs would be those to prevent or mitigate sabotage involving nuclear materials, toxic materials, and their storage facilities.

The discussion concerning the safeguards and security requirements for maintaining the weapons and nuclear materials met with no questions about reasons for safeguards and security actions or costs associated with activities. The presentation highlighted physical protection needs to deny access to the materials, monitoring of the materials and weapons while in storage, and accounting for materials and weapons to provide assurance that they were still in their authorized locations. Examples were given of the wall thicknesses, access control and perimeter monitoring systems, surveillance systems, and procedural guidelines that would require many workers. IAEA inspection requirements were briefly examined to demonstrate the details and procedures associated with international inspection of nonstrategic nuclear materials obligated by treaty as a successor state to the former Soviet Union.

A vivid picture of a sabotage event that involved nuclear materials but not a nuclear weapon was presented to reinforce the security obligations associated with having nuclear materials. The example involved a disgruntled employee who could steal a small quantity of plutonium and use it to contaminate a city's water supply. It was noted that the disgruntled employee could also create turmoil just by threatening to dump the material into a key point in the water distribution system. If the Ukraine were to keep the weapons or the nuclear materials, these safety and protection systems would be required not only by the nearby countries but by the people that these materials and weapons were supposed to protect.

Belarusian participants presented a lengthy overview of the problems associated with keeping nuclear materials and weapons. They expressed a real concern about the illegal removal of low-enriched uranium from their country and the possibility of contamination. They discussed graphic examples of a Belarus customs official accidentally catching smugglers with 100 kg of low-enriched uranium and others with radioactive isotopes. A Belarus speaker noted that many customs officials are afraid of anything in a lead container and, like most people, panic at the mention of radioactivity. But Belarus took steps to ease the situation. It declared itself a nuclear-free state and was removing its weapons to Russia under a bilateral agreement. It also expected some payment from Russia for the nuclear materials in the returned weapons. Dismantling problems were not serious and well-developed procedures were used.

Belarus has a nuclear safety control commission to check the Russian soldiers still remaining on Belarus territory to maintain the nuclear weapons prior to their return to Russia. Belarus does not represent a nuclear threat because it produced only 4 percent of the missile and military products used by the former Soviet Union. However, 17 percent of these products were produced in the Ukraine. They closed their presentation by stating that their country desired that the Ukraine should become a nuclear-free state just as Belarus had declared. Upon completion of this presentation, the U.S. consultant noted that there really is not any unofficial or underground market for nuclear materials. He stated that a possible market may be an unknown organization rather than a country.

Security of the country

As briefly discussed earlier, the security of the Ukraine was directly tied to the nuclear weapons left behind by the departing Russian military. The Ukrainian participants firmly stated that the "common people" wanted the country to keep the nuclear weapons as they felt the weapons provided security and a deterrent against invasion from a neighboring country. Because the weapons were already on hand and the military were trained in their use and maintenance, the nuclear weapons were the cheapest deterrent of all weapons, about 3 percent of the cost of all armaments. They noted that storage was probably not included in those estimates. The weapons could easily be made operational by breaking down the launch codes and retargeting. In fact, a Ukrainian participant announced that the code deciphering was nearing completion. Additionally, the strategic weapons could be changed to be used as tactical weapons for nearby targets. He reiterated that the public sees nuclear weapons as the only possibility of protection from invasion.

Another Ukrainian participant noted that his country is concerned about its sovereignty. It has a lack of confidence in the United States' support, which has caused the country not to ratify the START treaties. Security assurances must be strong but still won't be believed. Only by keeping the nuclear weapons will the Ukraine keep its sovereignty. Forty-eight years after WWII, nuclear weapons are a successful deterrent. He estimated that removing the weapons would only save about 5 percent of the budget, while keeping them will save more.

Belarus stated that the Ukraine should not expect any

help since the other countries are having financial troubles. This participant accused the Ukrainian president of neglecting the interests of the Ukrainian people. Without taking a timely definitive stand, the people are developing a negative impression. This talk produced a variety of further discussions within the Ukraine delegation. One military officer agreed that there is a military threat from a nearby country, while another insisted that Ukraine must get security guarantees to assure its survival. A Belarusian colleague disagreed with the idea of a military threat but stated that an economic threat does exist.

Other Ukrainian participants were concerned with transferring the nuclear weapons back to Russia because of the internal problems that were occurring within the country and believed that Russia may break into three parts. Still other speakers believed that any state that rejected nuclear weapons should be drawn into NATO for protection, as a reward for becoming non-nuclear. At the end of this series of discussions, a Ukrainian retired colonel working in the government noted that "A fighter for peace is failed politician."

Throughout these discussions and arguments occurring among the Ukrainian participants, the U.S. speakers noted that the United States and some western European countries might be willing to provide assurances to the Ukraine to guarantee its security from invasion if the country gave up its nuclear weapons. However, several people acknowledged that the internal strife brewing in the country may develop into a problem more serious than the risk of invasion from a neighboring country.

The last day of the seminar appeared to consolidate the important issues with Ukrainian military personnel who now worked with the various institutes within the government. A colonel detailed the problems with protecting the country from invasion. He stated that Ukraine was not a nuclear state in military terms such as Pakistan or Iraq and only wanted national security. The nuclear weapons can be delivered 5,000 km away but the country cannot protect its own borders. The nuclear weapons in the country are a hindrance to the security of the Ukraine by prohibiting the development of the conventional army forces.

Summary

The participants from the Ukraine represented a selection of personnel from universities, the military, and others who interacted directly with the Ukraine Parliament. The seminar was covered in detail by the local news services. The U.S. participants acted as an information resource during the seminar concerning the ramifications associated with Ukraine's keeping and maintaining nuclear weapons and materials. They responded in an unofficial capacity to questions, concerns and technical issues to educate representatives of the newly independent country concerning problems that were left on their doorstep by the departing Russian military during the collapse of the former Soviet Union. However, the fear of invasion and the collapse of the economy might allow other forces to control the final disposition of the nuclear weapons and components. The nuclear weapons were believed by many in the Ukraine to provide stability and security for the new country. Others believed that the weapons were a means to achieve economic growth and to obtain aid from the West. Until this seminar, the Ukrainian participants did not have an understanding of the complete costs for keeping the weapons.

The meeting was well-received. Several U.S. participants noted that the Ukrainians came to the meeting with a strong desire to keep the weapons. During the five days of the meeting, they assembled the facts presented by the U.S. participants concerning the impacts the nuclear weapons and delivery systems would have on their economy and security. By the end of the seminar, many had realized that the weapons were not a potential cure-all for the independent Ukraine's problems. However, there are still some major issues to be resolved concerning weapons dismantlement that will take time and additional effort to resolve. These issues include:

- Political leadership in the Ukraine. The issue remains concerning who is in charge of making and executing agreements. The executive leadership is taking steps and making agreements without the support of the Parliament. If President Kravchuk were to lose the presidential election, this would cause more disarray in discerning what the Ukraine has agreed to do and not to do in the weapons dismantlement area.
- Reimbursement from Russia. Russia has been reluctant to state in exact terms what reimbursements will be made to the Ukraine. This is still a major issue that these two states must negotiate.
- The costs of dismantlement and safe transport. Although it is understood how missiles can be dismantled, the costs of actually dismantling the missiles can be quite large if looked at in the broader perspective. Such technical issues as to what to do with the liquid fuel have yet to be decided.
- Relations with Russia. Conditions in Russia are as volatile as in the Ukraine, with the Crimea still being a major bone of contention despite official pronouncements. The degree to which the Ukraine will cooperate in the dismantlement efforts will depend largely on the overall political climate between the two states as well as the assurances that can be made by Russia on the safe and secure dismantlement of the weapons themselves. Ukrainians fear that the weapons will be stockpiled in some storage facility rather than be quickly dismantled.
- The future of the Nuclear Nonproliferation Treaty. The Ukraine is also following with great interest the progress or lack thereof on the broad acceptance of the Nuclear Nonproliferation Treaty, which is up for review in 1995. The Ukraine and other potential nuclear states may try to exert pressure on the superpowers, either collectively or individually, to get economic or political concessions in exchange for supporting the treaty.

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April 30–May 3
Nuclear Energy Assembly, Mayflower Hotel, Washington, D.C. *Sponsor*: Nuclear Energy Institute. *Contact*: Conference Office, Nuclear Energy Institute, 1776 I Street, N.W., Suite 400, Washington, D.C. 20006-3708; phone (202) 739-8000.

June 4–6
22nd Annual Meeting and International Conference on Nuclear Energy, Ponte Verde Inn & Club, Ponte Verde, Fla. *Sponsor*: World Nuclear Fuel Market. *Contact*: Donna Cason, Administrative Director, World Nuclear Fuel Market, 655 Engineering Dr., Suite 200, Norcross, GA 30092; phone (404) 447-1144.

July 9–12
INMM 36th Annual Meeting, Marriott Desert Springs Resort, Palm Desert, Calif. *Contact*: Barb Scott, INMM headquarters, 708/480-9573; e-mail, tsgi@rpico.com

September 17–20
American Nuclear Society International Topical Meeting on the Safety of Operating Reactors, Seattle (Bellevue), Wash. A call for papers is in progress. *Sponsor*: American Nuclear Society's (ANS) Nuclear Reactor Safety Division and the Eastern Washington ANS Division. *Contact*: Technical Program Committee Chair Dr. G. Don Bouchey, at *Safety of Operating Reactors*, Box 182, 101B Wellsian Way, Richland, WA 99352; phone (509) 783-1446.

September 17–22
Fifth International Conference on Nuclear Criticality Safety (ICNC '95), Hyatt Regency Hotel, Albuquerque, N.M. A call for papers is in progress. *Sponsors*: American Nuclear Society and OECD/NEA. *Contact*: R. Douglas O'Dell, ESH-6, MS F691, P.O. Box 1663, Los Alamos National Laboratory, Los Alamos, NM 87545; phone (505) 667-4614.

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  2. Jones F.T., *Title of Book*, New York: McMillan Publishing, 1976, pp.112-118.
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