JNMM

Journal of Nuclear Materials Management

Published by the Institute of Nuclear Materials Management • Volume XXI, Number 1 • October 1992

JNMM 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 Vickie Zombolo at (708) 480-9573, Fax (708) 480-9282. Allow eight weeks for a change of address to be implemented.

ISSN 0893-6188

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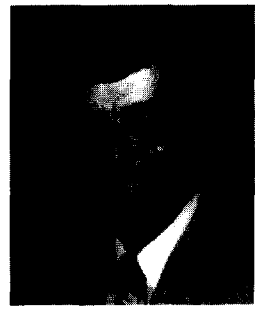


As I reflect on the accomplishments of our Past Chair Darryl Smith, the efforts put forth in the restructuring of our Institute have definitely resulted in a stronger organization that can better serve its members. Over the next two years as chair, I hope to build on these excellent changes in the INMM with the intent to provide services to our members and friends, and create an enhanced environment to better enable all of us to grow professionally and contribute in areas appropriate for our multidisciplined expertises.

The focal points for our technical endeavors will be the chairs of our six newly formed Technical Divisions. These people are being asked to provide leadership and vision for their respective divisions, including the coordination of their divisions' contributions to the technical program of our Annual Meeting, and the responsibility for planning and conducting topical workshops.

INMM's Technical Divisions and the chairs are:

- *Arms Control Verification Division*, Ruth Kempf, Brookhaven National Laboratory, (516) 282-7226;
- *International Safeguards and Nonproliferation Division*, Cecil Sonnier, Sandia National Laboratories, (505) 844-2124;
- *Materials Control and Accounting Division*, Rich Strittmatter, Los Alamos National Laboratory, (505) 667-7903;
- *Physical Protection Division*, J.D. Williams, Sandia National Laboratories, (505) 845-8766;
- *Transportation Division*, Bill Teer, E.R. Johnson Associates, (703) 359-9355; and
- *Waste Management Division*, Ed Johnson, E.R. Johnson Associates, (703) 359-9355.

Each of the above individuals would welcome a call from you offering support and the willingness on your part to become an active member of their Division; but realize, you are not restricted to just one choice.

Nine standing committees serve the Institute as well and are likewise important. These committees include:

- *Annual Meeting Oversite*, Jim Tape, Los Alamos National Laboratory, (505) 667-6394.
  - *Local Arrangements Committee*, Deanna Osowski, Westinghouse Hárford, (509) 376-7822.
  - *Technical Program Committee*, Charlie Pietri, DOE, (708) 252-2449.
  - *Registration Committee*, Gary Carnival, EG&G, (303) 966-2403.
  - *Exhibits Committee*, Earl Horley, Los Alamos, (505) 667-0639.
- *Awards Committee*, Yvonne Ferris, EG&G, (202) 646-7886;
- *Communications Committee*, Laura Thomas, DOE, (505) 845-4713;
- *Constitution and Bylaws Committee*, Roy Cardwell, Consultant, (615) 576-6240;
- *Government Liaison Committee*, John Matter, Sandia National Laboratories, (505) 845-8103;
- *Professional Recognition Committee*, Paul Ebel, BE Inc., (803) 259-2346;
- *Membership Committee*, co-chaired by Bruce Moran, Martin Marietta Energy Systems, (615) 576-8269 and Don Six, Westinghouse Harford, (509) 373-4119.

There are two additional committees, namely the Fellows Committee and the Long-Range Planning Committee. Jim Tape, who has capably served as our Long-Range Planning Committee chair, will no longer serve in that capacity because of his new vice chair position. In order to bring the expertise, wisdom and experience of our Fellows into a more active role in the Institute, I have asked Shelly Kops, consultant, (312) 761-0644, to chair the Long-Range Planning Committee and request the Fellows to provide assistance.

The INMM also serves as the secretariat for two ANSI standards. The INMM chairs for these two committees are:

- *N.14 Packaging and Transportation of Radioactive Materials*, John Arendt, Oak Ridge Associated Universities, (615) 483-6622; and
- *N.15 Methods of Nuclear Material Control*, Sharon Jacobsen, Martin Marietta Energy Systems, (615) 574-8707.

Our membership is likewise served by five local chapters:

- *Pacific Northwest*, Debbie Dickman, Battelle Northwest Laboratories, (509) 376-1584;
- *Central*, Walt Strohm, EG&G Mound, (513) 865-3462;
- *Southeast*, Fran Davis, Westinghouse Savannah River Co., (803) 725-5009;
- *Japan*, Mitsuho Hirata, Japan Atomic Energy, Nuclear Material Control Center, 03-593-2551; and
- *Vienna*, James Larrimore, IAEA, 43-1-23600.

There exists the possibility that two new chapters may be formed in the future, with one serving the southwest part of the continental United States, and the other serving the Scandinavian section of Europe.

At our Annual Meeting in Orlando, a renewed interest was expressed in the role INMM can play in education and training. Larry Glick, Meridian Corp., (505) 293-2725, has been asked to form an ad hoc committee to revisit this activity and report to the Executive Committee on recommendations to be

continued on page 7

U.S. Assistance Necessary for Russian Nuclear Dismantling

The first three papers in this issue will be of great interest to all members of the Institute, so I shall keep this editorial very short.

The United States has set aside $400 million to assist Russia and the other Commonwealth members in transporting nuclear warheads to a central storage depot, dismantling them and disposing of the fissile materials. Russian Ambassador I. M. Palenykh and General William F. Burns describe the activities, which have been agreed on and are likely to follow. Several members of the Institute interviewed them following their talks.

Assistance on the safe transfer of nuclear warheads is under way. Although facilities for dismantling the warheads are not mentioned, these may need to be upgraded in Russia and in the United States. Discussions are to start soon on long-term storage facilities for the recovered high-enriched uranium and plutonium. It is likely that Russia and other Commonwealth states will need assistance in designing and implementing national systems for the protection of and accounting for all of their nuclear materials and facilities.

The United States will also bring back thousands of nuclear warheads, dismantle them and dispose of the fissile materials with provision for bilateral or international verification.

On Sept. 6, it was announced that the United States has agreed to purchase 500 tonnes of the Russian high-enriched weapons uranium during the next year. If the similar quantity of high-enriched uranium in the U.S. weapons stockpile were also blended with depleted uranium, I figure that it would supply low-enriched fuel for all of the light-water reactors in the world for five years or more, which would have a great impact on the already depressed market for national uranium and enrichment services.

Several other major countries are providing similar assistance to the states of the former Soviet Union. What happens there and in the United States will be of great importance to the world as a whole.

The INMM is an international organization whose members have experience in all of these areas. We have the opportunity to offer our assistance as individuals and as an organization to those involved in dismantling nuclear weapons and strengthening the nuclear non-proliferation regime.

William A. Higinbotham
Brookhaven National Laboratory
Upton, New York, U.S.A.

Division Report: IS&NP

On July 19, 1992, the INMM's International Safeguards and Non-proliferation (IS&NP) Division met at the Stouffer Hotel, site of the 1992 INMM Annual Meeting. Thirty-four members of International Safeguards Community participated in the meeting, from the IAEA, CEC-Euratom, CEC-JRC-Ispra, Australia, Canada, France, Germany, Japan, Sweden, UK and U.S.A. Roger Case of Sandia National Laboratories was designated as secretary of the IS&NP Division.

The method of reporting for the IS&NP Division meetings was briefly discussed. It was agreed that the reports of this Division would contain the time/place of the meeting, and the subjects discussed. The chair distributed a revised version of the IS&NP Charter, which included the new name of the Division, as well as a request for reconsideration of the list of proposed topics for discussion by the group.

Discussion then centered on the definitions of international safeguards and non-proliferation, and their interactions. It was generally recognized that non-proliferation is a much broader concept than international safeguards, i.e., international safeguards is only a part of the non-proliferation regime. Pertinent revisions will be made to the charter of the Division so participating personnel will have a common understanding of these terms. A new draft will be produced and distributed.

The participants discussed a wide range of current international safeguards and non-proliferation topics and issues, including:

1. The 1995 NPT review conference;
2. Increased public information flow to/from the IAEA, especially from unclassified open literature sources;
3. Universal reporting;
4. The recent suggestions regarding "streamlined" and alternate IAEA safeguards approaches;
5. Safeguards as a "tool" for non-proliferation policy, and the interaction of safeguards with non-proliferation in general;
6. The net decrease in the IAEA '92/'93 budget and its effect on safeguards implementation;
7. The concept of "transparency," particularly as related to differences in the application of safeguards;
8. Interactions between IAEA and Euratom inspectorates; and
9. Safeguards in nuclear weapon states after 1995.

The time/place of the next two meetings of the Division were discussed in the closing segment of the meeting. The ESARDA C/S Working Group meeting, to be held at JRC-Ispra on Nov. 4-5, 1992, provides a good time frame for the next IS&NP meeting. An IS&NP meeting in November 1992 is desired to allow adequate time to plan for the 1993 INMM Annual Meeting program. It was therefore tentatively agreed that the next IS&NP Division meeting would be held at JRC-Ispra on Nov. 3, 1992.

The possibility of scheduling another Division meeting immediately before or after the May 1993 ESARDA Symposium in Rome, Italy, was discussed. Such a meeting would provide the opportunity for having a significant number of participants from Europe, as well as from other continents. It was agreed to consider this possibility, and further discuss the matter at the November 1992 meeting at JRC-Ispra.

Cecil S. Sonnier, Chair
International Safeguards and Non-proliferation Division
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

Division Report: Physical Protection

During the 33rd Annual Meeting, which was recently held in Orlando, the new Physical Protection Division had a brief organizational meeting. There were a number of persons who indicated interest in being part of this Division, and I have had a few calls since the meeting from people who have indicated an interest and a willingness to actively participate. Some of the items that we should all be considering are:

1. Topics for workshops covering physical protection topics;
2. Suggestions for people who would be willing to serve as organizers of the workshops and to serve as the workshop chair. This should include possible locations and times for the workshops;
3. We should all be thinking about soliciting more papers for publication in the *Journal of the Institute of Nuclear Materials Management*;
4. The responsibility for physical protection sessions at the Annual Meeting has been given to the Divisions. We should be thinking about the general and specific topics that we would like to cover at the Annual Meeting and start soliciting papers to fill those sessions; and
5. Suggestions for education and training or for other aspects of your continued professional development should be submitted for consideration and discussion.

These suggestions should be enough to keep us all busy. One of the purposes of forming the Divisions was to actively involve more persons in the operation of the INMM and to allow more personal recognitions and satisfaction from being a member. We welcome all efforts both large and small. Please contact me with comments or suggestions about how physical protection can become one of the most effective Divisions of INMM. I can be reached by telephone at (505) 845-8766 or fax at (505) 844-0708.

J.D. Williams, Chair
Physical Protection Division
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

Service *continued from page 2*

pursued.

As you can see from the above named individuals, many dedicated people help our Institute. All of them are willing to serve you and likewise can use help and active participation in their committees. You are encouraged to contact those who head a committee that interests you.

Our future looks bright, I hope you will agree. Again, we had an excellent meeting in Orlando (see the summary article in this issue), with the second largest all-time attendance. The plenary session speakers General William F. Burns and Ambassador I. M. Palenykh, provided a unique presentation on weapon dismantlement in the former Soviet Union, which certainly was a timely issue. A colleague of mine from the United Kingdom expressed afterwards that the plenary session was a "moment in history," and I believe you will agree as you read the Annual Safeguards Round Table article in this issue (see page 18). Indeed, it was an honor for the INMM to play a role in this unique experience, and our role can hopefully be expanded. The world situation provides us exciting challenges for our professional society with our unique demonstrated technical competencies. It is up to all of us to meet these challenges. As always, your comments and suggestions are welcome.

Dennis Mangan, Chair
Institute of Nuclear Materials Management
Sandia National Laboratories
Albuquerque, New Mexico, U.S.A.

New Member Service

A new service now is available to INMM members. The new INMM *Journal* article data base allows searches by "key words" in paper titles. Thus, members may now contact headquarters and request topical listings of articles which have been published in *JNMM* by using words or phrases such as "Near-Real-Time Accounting," "Inspection" or "Waste."

For information on this service, contact Laura Rainey at INMM headquarters (708) 480-9573, or fax requests to (708) 480-9282.

33rd INMM Annual Meeting Returns to Orlando

The epochal events occurring throughout the world during the past year were, in part, the stimulus for an outstanding INMM Annual Meeting this year. The demise of the Soviet Union as a political entity, coupled with strife in the Mideast resulting in United Nations military actions, have made major changes in the nuclear safeguards community. And INMM was there to provide that forum to focus issues and explore future courses of action.

Our timing could not have been better in providing a plenary session which gave our membership the opportunity to hear about nuclear weapons dismantlement activities of the United States and the former Soviet Union from General William F. Burns, special envoy to states of the former Soviet Union for Safe and Secure Dismantlement, and Ambassador I. M. Palenykh, head of the Delegation for the Ministry of Foreign Affairs of the Russian Federation, Safety, Security and Dismantlement Initiative, respectively. Of course, only a few individuals know that, at the Annual Meeting in 1989, also in Orlando, Fla., we tried to get the ambassador from the Soviet Union to speak on non-proliferation activities along with U.S. Ambassador Richard T. Kennedy, who spoke on the same topic. (Orlando, Fla., must have some attraction for such international events.) Unfortunately, the timing and global conditions were not favorable for such an East-West union at that time.

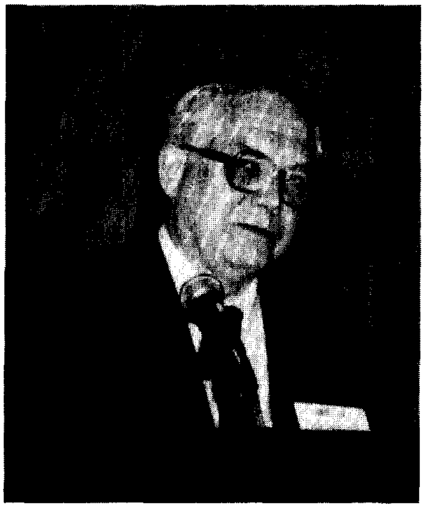
More than 500 attendees listened raptly to Burns and Palenykh reveal common directions of both countries but different resource constraints in trying to achieve safe nuclear weapons disarmament. The private interview with both speakers following the plenary session will be of special interest to INMM members and is published in this issue of the *Journal*.

Attendance at sessions after the plenary session was phenomenal with Tom Sellers (Sandia National Laboratories), chair of the session "International Safeguards & Non-proliferation — Where Do We Go From Here?" taking the prize with more than 140 attendees — standing room only! The other sessions addressed the broad areas of INMM activities — arms control and treaty verification, materials control and accounting, physical protection, international safeguards and nuclear non-proliferation, waste management and transportation with attendance varying from 30 to 115 attendees. Again, Joe Indusi (Brookhaven National Laboratory) complained bitterly that more people would have attended his session on "Arms Control and Treaty Verification — Issues to Consider" if the Technical Program Committee had not placed his session in competition with so many other outstanding sessions. Joe only had about 100 attendees! (We may schedule him for Monday evening next year — no competition at all.)

We had 32 sessions this year and 204 papers; exactly 10 years ago we had one-third the sessions and only 55 papers. In addition, there were 650 total registrants (including family members), 11 posters were presented and 22 technical exhibitors displayed booths at the Stouffer Orlando Resort Hotel.

What are we looking for in 1993 that could top this year? Serious consideration is being given to exploring a joint North Korean-South Korean Plenary Session. (Why not? If it worked once for the United States and the former Soviet Union, maybe we can do it again. Who knows what the world outlook will be by then.) We also have thoughts about drawing China and the former Soviet States into the meeting. However, you can help INMM immensely with any suggestions you may have for program material. Send me your ideas, now.

Few attendees knew that this was not the Program Committee's first attempt at having representatives from both the East and West, such as keynote speakers General William Burns and Ambassador Igor Palenykh (below, respectively), speak to INMM members on nuclear disarmament.



The number of abstracts submitted this year on word processing disks (85 percent) for the review by the committee and subsequent publication in the programs continue to increase. Your cooperation in this new process helps to reduce INMM costs and improves INMM headquarters' efficiency in producing the meeting publications by saving many hours of typing and

Past Chair Darryl Smith presents Charles Vaughan with the Fellow Award during Tuesday night's annual banquet (left). More than 500 conference-goers attended the banquet (below.)

Several sessions had standing room only and entertained questions from the floor.

proofing. You should note that INMM is a leader in using this publishing technique. The other major professional organizations are just now realizing its value. We also plan to provide you with an updated Speakers Manual and improved instructions (a simpler process) for preparing papers for publication in the proceedings of the Annual Meeting.

We have received many compliments about the meeting, several suggestions and very few criticisms. Some observations were that most of the speakers kept to their allotted times and the slides/transparencies were somewhat improved over previous years. However, some participants reported that occasionally a session chair rearranged the speaker order causing a few good papers to be missed. Another criticism was that some speakers did not present their paper well although their subject material was good or even exceptional. INMM plans to address these concerns in the coming year.

This was probably the easiest meeting to prepare and manage that we have had in a very long time. I certainly do not know why. We did nothing different. It was probably a combination of factors: an excellent plenary session, an exciting program, comfortable hotel location and very pleasant accommodations. Noteworthy was the comment made by a United Kingdom attendee to Dennis Mangan, our new INMM chair, regarding the plenary session: "It was a moment in history." So, as in the past, I express my gratitude to the Technical Program Committee, INMM headquarters staff, the many unnamed others and, of course, the contributions of the speakers and session chairs, all of whom worked together for an outstanding Annual Meeting. Let's repeat it in 1993!

Charles E. Pietri, Chair
INMM Technical Program Committee
U.S. Department of Energy
Argonne, Illinois U.S.A.

Members Honored at Annual Meeting

Mitsuho Hirata, Japan Atomic Energy, received the 1992 Distinguished Service Award during INMM's 33rd Annual Banquet. He has been involved in national and international nuclear science since the early 1950s. After receiving his bachelor's and master's degrees in physics, Hirata attended the International School of Nuclear Science and Engineering at the Argonne National Laboratory from 1957 to 1958. Application of these studies to various models of the JRR research reactor led to his receiving his doctorate in nuclear science in 1973.

While pursing his doctorate, he led the development of the core design of the first Japanese fast breeder reactor, which was completed in 1970. From 1970 to the present, he has been deeply involved in and has contributed toward development of non-proliferation and safeguards. His safeguards activities can be classified into four main divisions:

1. Contribution to ratifying the Non-proliferation Treaty;
2. Contribution to the International Nuclear Fuel Cycle Evaluation (INFCE) Conference;
3. Development of safeguards technology; and
4. Contribution to publicity education and the INMM.

Also during the annual banquet, INMM Treasurer Robert Curl, EG&G Idaho Inc., was awarded the 1992 Meritorious Service Award. He has been a highly active member in INMM since joining in 1966. He has served on many standing and ad hoc committees including the Membership Committee, Registration Committee, Association Management Selection Committee and Financial Oversight Committee.

Charles Vaughan of General Electric Co., Wilmington, N.C., was selected and voted to the grade of Fellow. Vaughan began his career in the nuclear field as a chemist for Nuclear Fuel Services in 1965. While there, he contributed significantly to the first private commercial use of plutonium in the SEFOR project and to the improvement in laboratory methods necessary to satisfy the stringent qualification requirements of the navy nuclear program. In 1970, he joined General Electric Fuel Fabrication Plant as a nuclear materials management specialist. Since then, he has assumed added and varied responsibilities and is currently manager, regulatory compliance, with overall responsibility for environmental, health, safety, safeguards and licensing. In addition to being a continuing leader and spokesperson, he has spearheaded notable achievements in automated material control and accounting techniques, regulatory reform for low enriched uranium materials and international safeguards.

Vaughan has been active in INMM since 1971. After serving on several committees, he was elected a member-at-large of the Executive Committee in 1981, and was elected vice-chair in 1984. In 1984, he was elected for two terms as vice-chair of the Institute, serving in this capacity as chair of the Annual Meeting Committee. Following this service, he was elected in 1986 to two terms as chair, followed by two years in the post of immediate past chair. During the period of his leadership the Institute grew and maintained a financially sound posture. Vaughan has continued to be an active and valued contributor and advisor to the Institute as well as his company and others across the industry.

Japan Attendees Tour U.S. Facilities

It was a pleasure to again serve as host and guide for the Japan Chapter's third tour of U.S. nuclear and research facilities following the 1992 Annual Meeting in Orlando, Fla. Six meeting attendees from Japan and I began the tour early on Thursday morning by van from the Stouffer Resort. Tour participants included Japan Chapter Chair M. Hirata; Y. Seki, executive consultant, Mitsubishi Materials Corp.; S. Sudoh, manager administration department, Mitsubushi Nuclear Fuel Co.; A. Furuhashi, senior staff member for R&D, Nuclear Material Control Center; Y. Kojima, engineer, Sumitomo Metal Mining Co.; T. Osabe, deputy chief engineer, Japan Nuclear Fuel Co. and secretary of the Japan Chapter.

Our first stop was the NASA Kennedy Space Center on the east coast of Florida where we were conducted on a tour of the general area that included a full-scale model of the three-section Saturn-5 rocket that successfully launched 16 Apollo missions, six of which successfully landed on and returned from the moon. We were also taken within full sight of launch pad B-1 where the space shuttle Discovery was in place and being prepared for its successful launch that occurred later in July.

The tour proceeded north stopping in Washington, D.C., for a special luncheon and presentation by Don Mitchell and Ed Badolato of ENERGA Technologies. Badolato, the president and CEO of ENERGA, gave a history of the past work of ENERGA and a description of the company's qualifications relative to industrial needs.

A pleasant rail trip on Amtrak took us to New York City where we enjoyed a weekend of sight-seeing before resuming our technical tour. On Monday morning, we arrived at Brookhaven National Laboratory where we were greeted by our hosts, Jim Lemley and Joe Indusi, and enjoyed some personal visits with several of our long-time friends and colleagues who have been co-active with Japan in their cooperative nuclear programs with the United States. Robert Bari, deputy chair of the Nuclear Energy Department, gave a general overview of Brookhaven National Laboratory's organization and programs. An extensive tour of the National Synchrotron Light Source facility was given, followed by a general tour of the BNL area. Of particular interest was that the site where BNL now stands was originally a U.S. Army base, Camp Upton, in 1918.

On Tuesday morning we were received at the General Electric Research Laboratory near Schenectady by our host Tom Cox, manager of the Physical Metallurgy Laboratory, in an impressive visitor's center overlooking the Mohawk river. Cox gave us the unusual history of why this facility, the original General Electric research laboratory, was located in that particular area. Thomas Edison, the founder of GE, wanted to set up a facility with Charles Steinmetz to continue research because of the latter's reputation. Steinmetz was agreeable, but only if he did not have to move to New Jersey, the site of Edison's original laboratory.

Hence the present location was selected and continues to be the prime corporate research facility today. Activities of the day included an overview and briefing on the development the R&D center, a presentation on materials R&D for nuclear energy and a tour of several of their ongoing R&D activities, including an extensive walk-through and equipment description and demonstration of the Materials Processing Facility.

Our last stop on the tour was Boston and the Cambridge Center Marriott, where a short walk on Wednesday morning brought us to the MIT Research Reactor. There we were graciously welcomed by Eddy Lau, operations supervisor, and Thomas Newton, one of the reactor engineers. The 5mw reactor is fueled by an enriched uranium-aluminum alloy element, cooled and moderated by light water, and is so designed as to be very accessible to a variety of experiments. If I may be permitted to reminisce, an original all-aluminum model of its first MTR-type fuel element was on display and was of particular interest to me. I began my nuclear materials fabrication career on these MTR-type fuel elements in 1952 in Oak Ridge, Tenn., and we built several loadings for low-power research reactors during that time period. Their fuel element has since been redesigned and improved, but is basically the same configuration as the original MTR unit.

At the end of the tour we met the director and plant manager, Dr. Kwan Kwok, and discussed his reactor and its programs. The youth and enthusiasm of Kwok and his engineering and technical staff were a very encouraging sign that the U.S. nuclear program is still very much alive and active. I believe that, after several discouraging years, the value of nuclear energy will soon come to be accepted by the general public; both as a reliable, safe source of power and a friend of the environment.

On Wednesday, the tour came to an end with an excellent dinner at Jimmy's Harborside, the famous seafood restaurant on the Boston Harbor. I believe that the entire tour, beginning in Florida, was very worthwhile and enjoyable to everyone and that much was learned from our various technical visits. I appreciated the opportunity to be the traveling host and guide, and I enjoyed the several days spent with my Japan Chapter friends and colleagues.

Roy Cardwell
ESA Inc.
Oak Ridge, Tennessee, U.S.A.

Y. Seki; A. Furuhashi; Y. Kojima, T. Osabe, Tom Oversluizen and James Lemley, S. Sudoh and Roy Cardwell (left to right) visit the National Synchrotron Light Source facility at the Brookhaven National Labratory during the Japan Chapter's 1992 U.S. technical tour.

United States Assistance for Dismantlement of Former Soviet Nuclear Weapons

General William F. Burns
Head, U.S. Safe and Secure Dismantlement Delegation
Orlando, Florida

This paper was presented during the plenary session of INMM's 33rd Annual Meeting in Orlando, Fla.

The collapse of the old order in the former Soviet Union has been well-documented. The rapidity of the collapse, the extent of change and the implications for the future have, however, been explored by both former Soviet officials and the West in only superficial detail. Once in a great while, a government is provided the opportunity to act decisively to advance the process of peace and stability. The government of the United States was offered this opportunity last summer and seized upon it with alacrity.

How to maintain stability in a period of change has always challenged political leaders. The existence of tens of thousands of nuclear weapons in the arsenals of the United States and the former Soviet Union complicated the problem in ways that world leaders of old could not have imagined. To maintain stability through strategic nuclear deterrence while, at the same time, to eliminate any vestige of an arms race and actually to reduce nuclear arsenals is a complex and daunting task. President Bush seized the opportunity and was quickly joined by former President Gorbachev, followed by President Yeltsin and the leaders of other states of the former Soviet Union with nuclear weapons on their soil.

On Sept. 17, 1991, President Bush, responding to the events of the previous month in the former Soviet Union, announced a far- reaching program of tactical nuclear weapons withdrawal. This unilateral declaration of arms reduction was met the next month by President Gorbachev, who announced a similar move. Since that time, additional reductions have been announced or are being contemplated by both sides.

These events created a problem unimagined just months before: the deactivation, dismantlement and eventual destruction of components of nuclear weapons rendered surplus by the end of the Cold War. The problem was exacerbated in the former Soviet Union by serious economic problems. The problem was further complicated by the breakup of the Soviet Union and the creation of a much looser Commonwealth of Independent States to which many of the former constituent states of the Soviet Union adhered. Continuing the thrust of the policies announced by President Bush in September, Secretary of State Baker discussed with authorities of Russia and other states, on whose soil former Soviet weapons existed, on how the United States could help in dismantlement.

Seven areas were identified for further investigation:

1. The utility of flexible armored blankets to increase the safety and security of weapons and fissile materials in transit;
2. Provision of containers for the safe and secure transportation of fissile elements of dismantled nuclear weapons;
3. Assistance in improving transportation of nuclear weapons and fissile material by rail;
4. Provision of equipment and training to be used to respond to potential accidents or incidents involving the transportation or storage of nuclear materials;
5. A system for nuclear materials control and accounting
6. A facility for the safe and secure storage of nuclear materials pending their ultimate disposition; and
7. The ultimate disposition of nuclear materials derived from the dismantlement of nuclear weapons.

At the same time, amendments to the 1992 Defense Authorization and Appropriation bills were offered which provided funds for the U.S. assistance to the then-Soviet Union to achieve safe and secure dismantlement of nuclear and chemical weapons and to avoid proliferation of weapons of mass destruction and their associated technologies.

Preliminary meetings were held in November 1991 and January of this year. In March, following a meeting between Secretary Baker and Foreign Minister Kozyrev in Moscow, Ambassador Igor Palenykh and I were charged by our governments to achieve agreement on the seven issues identified earlier and to determine to what extent U.S. financial support would be useful.

After intensive meetings in March, our Department of Energy hosted a week-long orientation at Sandia National

Laboratories to acquaint the Russian side with our techniques for nuclear accident response and the equipment we employed in that regard. In May, a two-week meeting in Moscow produced agreements on protective armored blankets, storage containers for nuclear components and accident response equipment and training.

Our schedule calls for another session in Moscow in late August during which we hope to reach agreement in additional areas of common interest. These meetings, I might add, have been characterized by a spirit of cooperation on both sides not seen in many years. I am particularly indebted to Ambassador Palenykh for the wise leadership of his delegation and his personal friendship as we chart a course for future cooperation in essentially unknown waters.

World events, policy formulation and legislative action rarely operate in careful synchronization, and our efforts to assist in dismantlement of nuclear weapons of the former Soviet Union is no exception. The Soviet Union, for example, ceased to exist in late December, and we began our substantive discussions with the government of the Russian Federation shortly thereafter. The status, role and level of participation for other states now independent, but which still maintain nuclear weapons on their soil, was a particularly thorny issue for both the United States and Russia. Throughout the spring, the Russian government and the governments of Byelorussia, Ukraine, and Kazakhstan worked diligently to meet commitments already made and to agree on future cooperation in dismantlement. While this process continues today, it appears to be progressing positively.

For our part, the U.S. government has opened discussions with two of the other three republics concerning the safe and secure dismantlement of nuclear weapons on their territories. We hope to initiate a dialogue with Kazakhstan shortly. In these discussions, we have tried to help each government develop its unique requirements and to consider how the United States might assist.

Current legislation provides up to $400 million for assistance to former states of the Soviet Union in dismantlement of nuclear weapons. Of this, about $150 million has been formally committed to Russia. Several projects remain under active discussion, and consideration. Tens of millions more is under consideration for the other three republics. My goal is to have the entire amount committed to the four republics by the end of this fiscal year.

There is still much to accomplish, as you can see. The question of how to deal with the storage of nuclear components of dismantled weapons while the components wait in queue for ultimate disposition is complex, and its solutions are uniformly expensive. How to make ultimate disposition of several hundred tons of highly enriched uranium and large quantities of plutonium is particularly difficult.

I am convinced, however, that the cooperation already demonstrated between the United States and the five nations in question — and my presence here today with my Russian friend and colleague — is the best evidence of the high level of cooperation between our country and Russia in this matter — augurs well for resolution of these problems. In this new era, this post-Cold War period in which we must chart new courses far from the assumptions and presumptions of that time, an effort which results in the safe and secure dismantlement of tens of thousands of nuclear weapons can only enhance stability and make the positive changes of the past few months irreversible.

William F. Burns retired from the United States Army in March 1988 to accept an appointment as the ninth director of the U.S. Arms Control and Disarmament Agency. In March 1992, he was appointed special envoy and head of the U.S. Delegation for Safe and Secure Dismantlement of former Soviet nuclear weapons (SSD Delegation).

Born in Scranton, Pa., General Burns retired to Philadelphia where he attended La Salle College, graduating in 1954 with a bachelor's degree and a regular commission as a second lieutenant of field artillery.

His assignments for the first 15 years of his service were typical of a line officer, serving in several field artillery battalions. After graduating from the Command and Staff College in 1966, he served as operations officer of the 1st Infantry Division Artillery and as a battalion executive officer in the Division of Vietnam.

He received a master's degree in public affairs at Princeton University in 1969, then commanded two field artillery battalions. He graduated from the U.S. Army War College in 1972 and remained on the faculty for four years as director of politico-economic studies. In 1976, he assumed command of the 42nd Field Artillery Brigade, Germany; two years later, he was assigned as chief of the U.S. Army Liaison Office to the German Army. In 1980, he returned to Fort Sill as the deputy assistant commandant of the Field Artillery School. Shortly thereafter, he was promoted to general officer and became director of a task force developing the requirement for the follow-on system to the Lance short-range missile.

General Burns was selected as the representative of the Joint Chiefs of Staff on the INF Delegation in Geneva in 1981. He remained with the delegation for five years. During the hiatus in the talks in 1984 to 85, he served as deputy commandant of the Army War College. In December 1986, he became principal deputy assistant secretary of State for Political-Military Affairs. A year later, former President Reagan announced his nomination as director, U.S. Arms Control and Disarmament Agency.

Weapons Dismantlement Activities of the United States and the Former Soviet Union

Ambassador I.M. Palenykh
Ministry of Foreign Affairs of the Russian Federation
Moscow, Russia

This paper was presented during the plenary session of INMM's 33rd Annual Meeting in Orlando, Fla.

The subject raised for discussion at the INMM Annual Meeting is directly related to — I would even say predetermined by — the current state of the whole disarmament process. The latter has recently acquired such a scale that we may quite legitimately talk about essential qualitative changes related to it. Previously, if we first dealt with limiting further growth of armaments and only then with their reduction, at this stage we are facing a situation where the parties to the disarmament process, to a greater extent ever, are commencing the actual destruction of armaments. Initially, this included delivery systems of mass destruction weapons. Now the time has come for eliminating the lethal charges themselves that are dismantled from their delivery systems.

New tendencies in the field of disarmament are finding their reflection both in bilateral, multilateral interstate agreements as well as in unilateral obligations. The most recent important step in this direction was made in Washington last June where the presidents of Russia and the United States reached an agreement on the subject of further fundamental reduction of strategic offensive arms. This signifies that the parties, in addition to earlier agreements and obligations, will have to engage in destruction of ever greater volumes of primarily nuclear weapons rendered unnecessary by the strategic weapons reduction process.

Thus, the subject inscribed on the agenda of the INMM Annual Meeting equally concerns weapons destruction in the United States as well as in Russia. Nevertheless, in my statement, I would like to focus primarily on the measures implemented jointly by Russia and the United States in making practical use of the American assistance to nuclear weapons dismantlement in Russia.

The aforesaid does not mean that Russia is not capable of sustaining this process independently. But taking into account the complicated economic situation of the country and the lack of stability on the territory of the former Soviet Union, the U.S. assistance in the dismantlement of weapons released as a result of tactical and strategical nuclear weapons reduction will, undoubtedly, help safe and secure dismantlement of such weapons.

Now, about the situation with nuclear weapons on the territory of the former Soviet Union. In regards to tactical nuclear weapons, last May, we completed their withdrawal from the territory of other states of the Commonwealth of Independent States (CIS) by removing the remaining tactical nuclear weapons from the Ukraine. Before that, tactical nuclear weapons had been withdrawn from Byelorussia, Kazakhstan and other states of the CIS. Therefore, now all tactical nuclear weapons are on the Russian territory and are being involved in the dismantling process. Together with this, one has to note that, pursuant to a specific agreement on this matter between the Ukraine and Russia, Ukrainian representatives will be conducting appropriate verification activities over the dismantling of the tactical nuclear weapons withdrawn from the Ukrainian territory, which will be done, naturally, in accordance with the provisions of the NPT Treaty.

The next important stage envisaged for several years will include the withdrawal of strategic nuclear weapons from the territories of the Ukraine, Byelorussia and Kazakhstan. As is known, the aforesaid states have undertaken appropriate obligations according to the Lisbon Protocol to the Treaty on the Reduction of Strategic Offensive Arms between the USSR and the United States of which Russia has been a legal successor instead of the former Soviet Union. They specifically stated their intention of early codification of their adherence to the NPT Treaty. This is a very significant circumstance indeed, and we hope that it will be implemented.

The acceleration of the nuclear weapons dismantling process will require, as a consequence, investment of additional material and financial means for the purpose of nuclear weapons dismantlement. That is why we attribute a high priority to the cooperation between Russia and the United States in this area.

The fundamental decision to start such cooperation was reached by Russia and the United States at the meeting of their presidents at the end of last year. As you will understand, the U.S. readiness to allocate $400 million to assist the dismantlement of nuclear weapons on the Russian territory served as a basis for such cooperation.

With a view to implement the aforesaid decision, three rounds of talks were held by U.S. and Russian experts in Moscow and one — in Albuquerque, N.M., upon the instruction of their governments. During those negotiations, we, on the one hand, tried to explain specific Russian requirements in materials and equipment and, on the other hand, to learn about U.S. technical capabilities to provide such materials and equipment. In the process, there was an agreement reached that the U.S. assistance financed from the $400 million will be provided primarily in the form of U.S. fabricated materials and supplies, rather than by direct financing of their production in Russia. Although one should not exclude that in some cases, there will be a need to finance the construction of certain facilities, for example, storage facilities for weapons-released plutonium and highly enriched uranium.

Without dwelling on technical details, one may say that the nuclear weapons dismantling process in Russia is not limited by our own dismantlement industrial capabilities. The matter is that it is necessary to develop, within the shortest time, additional appropriate infrastructure. Taking into account the aforesaid, the Russian side outlined its requirements during those negotiations.

They are caused, specifically, by the following factors:

• The need for additional means of transportation for safe and secure transportation of nuclear weapons from the CIS states to Russia;

• The need to transport nuclear weapons inside the Russian territory from storage facilities of the armed forces to destruction facilities;

• The need for transportation within destruction facilities;

• The need for containers used in transporting and storing fissile materials;

• The various requirements in technical equipment for eliminating possible failures related to nuclear weapons; and

• The need for new storage facilities for fissile materials released in the process of nuclear weapons dismantlement. In this regard, we attach a special importance to the U.S. assisted construction of a long-term storage facility for nuclear materials.

Proceeding from these factors, the Russian side has tabled specific requests.

I would like to note that experts' direct familiarization with examples of the equipment operated by both sides effectively contributed to finding mutually acceptable solutions. In this sense, fruitful work was done by Russian and U.S. experts in Albuquerque at Sandia Laboratories and at the U.S. naval base. American experts undertook a useful trip to Tomsk in Syberia to visit the planned site for a fissile materials storage facility.

Let me point out the positive results that have been reached already as a consequence of the negotiations between Russian and American experts. Those results were reflected in the agreements signed during the recent summit of the two presidents in Washington. The agreements package consists of four documents. One of the latter is the framework agreement on safe transportation, storage and dismantlement of weapons and prevention of their proliferation. This document was personally signed by the presidents. The high level at which it was signed reflects the document's significance.

Three other agreements involve the following directions for U.S. assistance to Russia:

• Delivery of armored blankets used for transportation of nuclear weapons;

• Delivery of containers for transportation and storage of fissile materials; and

• Providing equipment and materials for eliminating consequences of failures involving nuclear weapons, and training of personnel to handle such equipment and materials.

The means allocated by the United States as a grant for implementation of the stated specific agreements totals $65 million. Although this is but a small part of the overall $400 million, it does not in any way diminish the significance of those specific agreements. It is important to have those agreements that entered into force from the date of their signature implemented as soon as possible. I would like to draw your attention to the fact that the Russian Ministry of Atomic Energy has been appointed as the structure in charge of coordinating the issues related to the implementation of the aforesaid agreements. Its U.S. counterpart is the Department of Defense.

You are, of course, aware that a number of other Western states also participate in assisting Russia in safe and secure dismantlement of nuclear weapons. We are conducting negotiations on this issue with Britain and France as well as with Germany and Italy.

It's important to note that in the process of those negotiations, Russia seeks to develop cooperation with each country in the specific areas where the countries in question have already accumulated corresponding experience. Therefore, one may say that the program of Western assistance to Russia in this area of paramount importance is all-encompassing, which, undoubtedly, will contribute to increasing the volume of assistance and cooperation along several directions.

We have, in essence, completed our talks with Britain, although without concluding an agreement on this matter as was the case in Washington recently. Russia will receive supercontainers for transportation of nuclear weapons and protected vehicles. Let me emphasize that, just as in the case with Britain and other cases, such negotiations lead to significant broadening of contacts between scientists and experts, which helps to establish ties in new spheres. Here, specifically, I have in mind cooperation and joint operations to use nuclear materials — highly enriched uranium and plutonium — for peaceful purposes and for nuclear safety. Intensive negotiations are being conducted with France, and a wide program of cooperation and assistance is scheduled, ranging from deliveries of various types of equipment to the conversion of nuclear materials.

As for our talks with Germany and Italy, they proceed with due regard to the obligations of all parties to the NPT Treaty and on the basis of understanding that both countries may participate in this process only to the extent that corresponds to their non-nuclear states status. Again, I would like to point out that the on-going negotiations impart an impetus to the development of wider-ranging scientific relations between Russia, Germany and Italy.

Returning to the Russian-U.S. cooperation, I must note with satisfaction that, during the last round of the negotiations between Russia and the United States, both sides outlined a program of further actions with a view of reaching agreements leading to the use of the remaining $400 million allocated for assistance to Russia.

A significant part of this sum, as it seems, should cover the activities related to the construction of storage facilities for plutonium and highly enriched uranium released from the munitions. In this regard, one cannot bypass, in general terms, the problem of using special fissile materials that will be accumulated as a result of nuclear weapons dismantlement. Especially if we take into account the fact that the volume of such materials will be increasing as the disarmament process develops. Here we encounter the problem of their disposal. It would seem most rational to use them for peaceful atomic energy purposes. Nevertheless, currently it is difficult to use unprocessed plutonium and uranium from dismantled weapons for energy purposes. It is necessary to subject such materials to appropriate processing with a view to turn them into atomic energy fuels. Today, activities that are conducted in this area are more of a research nature. Although it is appropriate to admit that certain positive results in processing plutonium accumulated at energy reactors have been achieved with a goal to turn it into a mixed type of fuel and its further application in atomic energy. But the latter case does not yet involve weapons plutonium processing.

Besides, new types of reactors are required for application of new types of fuel. Such reactors are being developed, but they have not yet substituted for previous generation's reactors. Evidently, research and development activities aiming at creating new type of reactors and at application of new types of fuel should continue with due account of mankind's requirements.

As for processing plutonium for energy purposes, in Chelyabinsk, Russia, we commenced the construction of a facility which may be prospectively used for producing mixed oxide fuel. However, its construction had to be stopped due to a lack of funds.

There is yet another problem related to the prospect of dismantled nuclear weapons fissile materials utilization.

This is the problem of access to the world market with such materials. It has been determined that, currently, there is enough uranium on the world market. I have to note that Russia also experiences certain difficulties related to exporting raw uranium. It is understandable that all uranium producers should ponder over a solution to the world market problem when there is a new possibility of additional supplies of fissile materials coming from nuclear weapons dismantlement in the process of disarmament. Serious questions will also arise in relation to the compliance with nuclear weapons non-proliferation regime.

In regard to the problem of the utilization of fissile materials released as a result of nuclear weapons dismantlement, some say that one of the options includes their burial, which would exclude any of their use in the future. Apart from a lot of critical comments from the ecological point of view, it would hardly be reasonable to bury a product of labor that, after some time, may be used one way or the other with benefit to mankind.

Therefore, it would be most appropriate to place released fissile materials in storage facilities in the short-term prospect. Such storage facilities represent a bottleneck in the process of nuclear weapons dismantlement in Russia. That is why we positively evaluate the understanding reached at the last meeting of Russian and U.S. experts to continue to study in detail the plan to construct a safe and secure storage facility for highly enriched uranium and plutonium in Russia. At the same time, the sides agreed that U.S. technical experts will participate in this project starting from its design stage. Both sides proceed from the assumption that possible specific U.S. assistance should significantly reduce the schedule of the design stage as well as of first stage of construction of such a long-term storage facility. The construction phase envisages U.S. supplies of necessary construction materials and equipment, as well as equipment for the storage facility. Joint meetings of Russian and U.S. design engineers are scheduled to take place soon in St. Petersburg, Fla., and Omaha, Neb., with a view to work out a joint construction plan of the facility.

U.S. and Russian technical experts will have to discuss other questions, specifically upgrading Russian railcars used for transportation in the process of nuclear weapons dismantlement. The goal here is to increase safety and security of such Russian railcars.

We plan to start a new round of expert talks in Moscow on Aug. 24.

The main task of such negotiations, as we see it, should consist of working out additional specific agreements for U.S. assistance to Russia in dismantling nuclear munitions on the basis of using the $400 million allocated by the United States. By helping Russia in this area, the United States will contribute to the stabilization of the situation on the former Soviet Union's territory. I would like to say once again that joint work on the problem of nuclear weapons dismantlement, as experience shows, also helps to develop ties between Russian and American scientists and experts. Thus, a new type of relationship is being formed, and the latter is in consonance with the new character of relations between the two states. We positively evaluate such developments.

All the subjects discussed today represent a totally new process — the process of elimination of nuclear weapons accumulated over many years — which should turn into a main avenue in Russian-U.S. cooperation by the beginning of the year 2000. Efforts by our two states will gain momentum, with each year creating a realistic chance of living in a world free from weapons of mass destruction.

Ambassador Igor Mikhailovich Palenykh heads the Russian delegation to the Russian-U.S. negotiations on assisting Russia in the safe dismantlement of nuclear weapons. He is the first deputy director of the Administration on International Scientific and Technical cooperation at the Ministry of Foreign Affairs of the Russian Federation.

Ambassador Palenykh graduated from the Moscow State Institute of Foreign Relations and has been working within the system of the Foreign Affairs Ministry since 1952. He was delegate to the Soviet Mission to International Organizations in Vienna at the end of the 1950s and the beginning of the 1970s. He was involved with International Atomic Energy Agency issues, in particular, the problem of guarantees and non-proliferation of nuclear weapons. He worked in New York from 1978 to 1985, first at the USSR Mission to the United Nations and later at the United Nations Secretariat (Security Council Issues).

Ambassador Palenykh has been a frequent participant in multilateral and bilateral negotiations. From the end of 1987 until 1990, he headed the Soviet delegation to the Soviet-U.S. negotiations on the limitation and cessation of nuclear testing, during which new verification protocols to the 1974 Treaty on the Limitation of Nuclear Weapon Tests and to the 1976 Treaty on Peaceful Nuclear Explosions were negotiated and signed at the highest level. He was a Russian representative to the Bilateral Consultative Commission for the 1974 Treaty. He heads the Russian delegation to the negotiations on the cooperation in elimination of nuclear weapons with a number of Western European states.

Seventh Annual INMM Safeguards Round Table

July 19, 1992
Orlando, Florida U.S.A.

General William F. Burns
Special Envoy to States of the Former Soviet Union for Safe and Secure Dismantlement

Joseph Indusi
Member at Large, Institute of Nuclear Materials Management
Brookhaven National Laboratory

Ruth Kempf
Technical Division Chair for Arms Control Verification, Institute of Nuclear Materials Management
Brookhaven National Laboratory

Dennis Mangan
Chair, Institute of Nuclear Materials Management
Sandia National Laboratories

Ambassador Igor M. Palenykh
Head of the Delegation for the Ministry of Foreign Affairs of the Russian Federation, Safety, Security and Dismantlement Initiative

Charles Pietri
Technical Program Committee Chair, Institute of Nuclear Materials Management
U.S. Department of Energy

Darryl Smith
Past Chair, Institute of Nuclear Materials Management
Los Alamos National Laboratory

James Tape
Vice Chair, Institute of Nuclear Materials Management
Los Alamos National Laboratory

Each year INMM leaders interview the plenary session speaker or speakers in a relaxed setting immediately following the plenary session. The purpose of the interview is to further explore issues presented during the plenary session and provide Journal readers with additional depth and understanding regarding the issues as they affect the nuclear safeguards community.

This year, the unprecedented presence of the leaders of the U.S. and Russian nuclear disarmament negotiating teams provided a forum for discussion on matters of worldwide importance and far-reaching implication in the nascent post-Cold War geo-political structure. Topics of discussion include the upcoming NPT review conference, the fate of scientists and materials in the former Soviet Union, safeguards and "transparency" and American and Russian public responses to the dismantling of nuclear weapons. General Burns' and Ambassador Palenykh's presentations directly precede this interview.

SMITH: Thank you for being here and sharing your very unique experiences. There are exciting things going on, and we are hoping that we can participate. Is there any particular way that the INMM as an organization can help?

BURNS: This kind of organization is essential in helping to investigate not only the process, but the technical aspects of what we are doing. There are a number of unanswered questions. A principal one, of course, is how to dispose of all this excess material. The present system we have for disposition is designed to deal with a relatively small amount of nuclear material generated by the dismantlement of obsolete weapons. And, on our side, a lot of the materials went back into weapons. It was a regeneration process. Now that is not going to happen. The issue really is how to best dispose of the material in an ecologically, environmentally safe way that is not going to cost the American or the Russian taxpayer an arm and a leg. That is the kind of issue that this kind of organization, and the kind of programming you have here this week, can help to resolve.

PIETRI: We have always considered ourselves a professional forum. If you look at our history over the years, that is exactly how we have acted. Where there are no answers, we have tried to develop those answers from the community expertise that's available. We have been reasonably successful in sponsoring things like this. That would be my concept for the role that we could play, hopefully, for more than just the U.S. and Russia, but for all the other countries that would be involved in similar activities.

BURNS: Have you been involved, as an organization, with any similar organizations outside the U.S., particularly, say, the Russian Academy of Sciences?

SMITH: No, we have not had that opportunity. We are looking forward to it, and we are trying to develop contacts.

MANGAN: We have a good friendship with the IAEA [International Atomic Energy Agency], most certainly. But it is not a professional society as we are.

PIETRI: ESARDA [European Safeguards Research and Development Association] is our largest counterpart.

PALENYKH: The same question came to my mind. What about your possible relations with some counterpart in Russia? Such contacts are lacking for the time being. Maybe this will improve.

MANGAN: Is there a society in Russia that is identified as the "safeguards society"?

PALENYKH: No. But there has been a question of whether to create some sort of public affairs group to work on NPT [Non-Proliferation Treaty]. But I am not sure that this will succeed, because they are mainly not people from scholarly circles but people from the political side.

SMITH: We are an international organization, and we have a Vienna Chapter, which is mostly IAEA people. And we have a very strong Japan Chapter. In our Executive Committee meeting yesterday morning, we talked about ways of generating interest in Russia — perhaps to have a Russian Chapter.

PALENYKH: It is necessary to find a good contact. I am not sure if it would be the Ministry for Atomic Energy or whether it should be the Academy of Sciences. Maybe some specific institute from within the framework of the Academy of Sciences. They are doing something along the lines that you are, but I am not sure that they are covering all problems. Your organization is broader.

MANGAN: This concept of having a chapter in Russia might be rather unique from the standpoint of a unified position. For public relations, it may be very, very beneficial.

PALENYKH: Yes it may, but I am not sure that for [the Russians] it can be realized.

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INDUSI: If it is not too early to ask, what transparency provisions are part of the dismantlement process? Is there some language about transparency in the current dismantlement [agreements]?

BURNS: The agreements are set up in such a way that we have a general agreement, which specifies the general terms of the work that would be done cooperatively. This is designed to have appended to it implementing agreements. For instance, an agreement on the manufacture and transfer of 250 protective blanket sets, the manufacture and transfer of 10,000 safe and secure storage and transportation containers. In these agreements, there is a provision for U.S. access to the equipment which is provided during the lifetime of the equipment and guarantees from the Russian side that this equipment will not be diverted to other uses or disposed of without consulting the United States. If, for some reason, the Russian government wants to transfer 1,000 containers to Ukraine — for whatever reason — then it would be necessary to consult with the United States. With regard to access to the containers, there is a notification procedure in the agreement, and there is agreement that we are not going to demand, on a daily basis, access to the containers.

With regard to the possible cooperative construction of a facility, those provisions would be more detailed. Access to containers is one thing, access to a facility that has doors and windows and so forth is another. That still has to be worked out. I really wouldn't want to speculate on how extensive that transparency would be.

In my mind, the big difference between now and former kinds of relationships is a new openness on both sides. Two years ago, I doubt that we would have taken a group of Russian experts to Sandia [National Laboratories] and shown them the things that we showed them. I don't think two years ago that the then-Soviet government would have allowed visits, such as we have had in the last six months, to various Russian facilities.

So when you start to have that kind of openness, and that kind of access, the kinds of transparency required to be formalized change. They aren't necessarily reduced, but they change. You remember what President Reagan said several years ago, the old Russian quotation — which he may have invented: "Trust, but verify." As the trust component goes up, the necessity for the details of verification goes down.

The INF Treaty [Intermediate Nuclear Forces Treaty] is an absolutely verifiable treaty where we really didn't need that level of verification. Because, right now, none of those weapons exist. The verification provisions were designed assuming that some level of weapons were going to exist on both sides. When we designed the verification side and insisted on a level of verification, we had no idea that the Soviet government was going to accede to total elimination. We proceeded with those provisions in the INF Treaty because we were in the process of educating the Senate, to a degree, as to what verification was under those terms.

The START Verification Treaty [Strategic Arms Reduction Verification Treaty] is essentially a clone of the INF Treaty. And the issue of verification isn't a very hot one right now because of that. I think the same thing is going to happen as trust develops. The notion of transparency is going to change in its application and also its extent.

INDUSI: You mentioned the facility in your response: access to containers would be easier to achieve than access to a facility, which would require further detailed negotiations. It is conceivable, in the future, that the Tomsk facility [Tomsk Storage Facility, located in Russia] would not be unique. There could be other facilities built in other countries with the same purpose in mind: to be a storage facility for nuclear materials. Could the Tomsk facility, in the future, or some other facility, incorporate the capability to support IAEA-type, multilateral verification of nuclear materials?

PALENYKH: We should develop such safeguards on that basis. It is connected with a very special field, and the United States and Russia have more at stake than other countries. For the time being, we cannot simply invite the IAEA inspectors to take part in this business. Perhaps some time in the future. For now, let us do it on an individual basis.

SMITH: It should move faster that way.

PALENYKH: I think so. We will gain experience, and then we can share that experience with the IAEA itself.

BURNS: It is too early to really speculate because the facility is still to be designed. So to start talking about specifics in terms of what kinds of safeguards would be applied, what kind of electronic devices, say, might be employed — who knows?

TAPE: Anticipating that may be important at this time.

BURNS: Yes. And I am sure we will have detailed discussions on just that. The problem is to achieve a level of capability so that the Russian government is totally satisfied that what goes in as safeguarded is not only safe from a physical sense but that it is secure. And that, to the degree that the Russian government agrees, the United States has "access," so that we are assured that the commitments made are being followed, not just by this government but by any successor government.

It is important that this level, which has to be mutually agreeable, is reached. Until we see the design of the facility, it is hard to really make judgments. Personally, I think the key is to design in that level of safety and security in terms of oversight and safeguards, that is required. The world of electronics provides all sorts of approaches to that. The MC&A [materials control and accountability] side has to be considered in the facility. There are some ideas floating around as to how that could be accomplished. Right now, what we are trying to do is understand the Russian design capability and then understand what our capability is so that we can get down to the design part of this. We are far from being able to speak authoritatively or intelligently about these kinds of things.

TAPE: Is this process developing precedents for the U.S. side as well? For our storage?

BURNS: It certainly would. The more we think about it the more we see advantages and disadvantages of various systems. I am sure that a lot of the work being done is applicable to the U.S. side.

TAPE: What is the Russian view of that question?

PALENYKH: Both sides will receive further information and further knowledge of how to construct this sort of facility. I don't have doubts that we have something interesting to show to you and to share with you. It is a beneficial process.

BURNS: I have had people from DOE [Department of Energy] say, for example, that they only wish that Congress had appropriated $400 million for DOE to do this kind of thing. And they sort of look wistfully across the fence at what the Russians might be able to accomplish. The problem, of course, is to convince the Congress that the U.S. needs a sister facility and so forth and so on.

PALENYKH: Maybe sometime after construction of such a facility in Russia you will build yourself something like that.

MANGAN: Or we will hire the Russian general contractor...

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PIETRI: There is a whole raft of military and scientific people who have made careers out of the nuclear weapons field — not only their careers but their livelihood. That issue has been identified. But there is significant concern that the Third World countries are now in a position to provide the livelihood and career direction for these scientists and military people. What specific plans have been made to deter this "brain drain" to other countries?

PALENYKH: Secure for them jobs related to their profession. It is difficult to convert the scientists themselves to something new. Those who worked in the military field and in the military industrial complex — they *used* to work there. For the time being, certainly some of them are experiencing difficulties because of the reduced production. The new scientific/technical center which is planned for Moscow will help. But I am not sure that it will solve all of the problems of the scientists. The number of scientists is too big, and they live in different parts of Russia, in different cities which were closed some years ago because they worked for military purposes only. It is a problem. We see often on TV how they are trying to solve their problems and are not always succeeding. There is temptation there from some countries which invite them. Up until now, according to my information, scientists have not left...for the time being.

BURNS: One of the things that we are doing to attempt to help the Russian government to resolve the problem is that, as part of this $400 million, we have set aside $25 million to support the so-called science center in Russia. We have already assembled the staff, and it is in the process of becoming organized. The purpose of the science center is to provide funds to employ Russian scientists who are less than fully employed now because of the decrease in demands on their talents for the construction of nuclear weapons and so forth. In the areas which will directly involve their expertise, for instance ecological cleanup required because of the presence of nuclear weapons or nuclear waste, or whatever. This has been developed under the aegis of Assistant Secretary Bob Gallucci [Senior Coordinator Office of the Deputy Secretary]. It is now being extended to other countries of the former Soviet Union, particularly the Ukraine, to assist them in a transitional phase, if you will, so that these scientists and engineers can be employed.

There are possibilities that this concept can be extended beyond nuclear scientists with nuclear expertise. But this is really only a month or so old, so it is hard to see how far it is going to go. But it is another effort on our part to assist the Russian government in resolving this issue in the short term.

SMITH: Is there any U.S. counterpart to that concern? We have a similar number of scientists who have spent their lives designing weapons and now the weapons budget and the defense budget are decreasing. They too will be displaced and seeking employment in a climate of rapidly decreasing budgets. What are we going to do with them?

BURNS: That is a problem that DOE and the labs are wrestling with right now as the functions shift. Some of the labs have already started their own programs on how to deal with this. There is a great deal of interest, of course, on the part of the labs, in the kinds of things we are doing because their [Russian] labs are involved in this process.

PALENYKH: Let us find some joint ventures for scientists from your military industrial complex and from our Russian military industrial complex. Maybe together they can come up with some very good new scientific ideas.

INDUSI: Are most of the former Soviet weapons designers living in the Russian Republic?

PALENYKH: Most of them live in Russia. But some live in Ukraine. But the military industrial complex connected with nuclear weapons is in Russia. And those plants where the weapons will be disassembled are in Russia.

BURNS: There is a ripple effect. It is not just nuclear scientists dealing with nuclear weapons. But it is delivery system designers, construction firms that have been employed in building bases for nuclear weapons and so forth and so on.

For example, the aircraft industry has direct carryover experience in designing commercial aircraft as you design bombers. In the missile field, you don't have that. There are only so many scientists that can be tied up in a space program, particularly as money dwindles for such things.

And, beyond just nuclear scientists, you run into scientists and engineers involved in the broader spectrum of strategic weapons.

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TAPE: Moving from people to facilities: In the U.S., we have always kept a strict separation between civilian nuclear facilities and those with military applications. It has been our impression that, in the Soviet Union, they were always commingled. There was not a distinction. As we move into this new era, will there be a policy taken on the part of the Russian Federation to separate the military from the civilian?

PALENYKH: It is difficult to separate them. Now some of them are being closed, and we are looking for ways to convert them for peaceful purposes.

TAPE: So there will be some attempt made to separate the two?

PALENYKH: Maybe not to separate them but to completely convert them to peaceful purposes.

KEMPF: When you convert facilities from nuclear weapons production and chemical weapons production for peaceful uses, there is a need to allow what we have known as verification, or some kind of extensive surveillance to see what is happening in those facilities, just to make sure they aren't doing something else. Right now, incorporating verification is almost taken to be offensive. Do you have any sense of how that will progress in the future?

PALENYKH: I cannot give you a technical answer. But we are interested in converting those plants, both chemical and nuclear. Mainly it is a technical process. We need to know whether it is possible from a technical point of view and how much it will cost. Maybe it is easier just to dismantle them completely. Certainly we should not lose the industrial capacity we have created, but learn how to better use it for peaceful purposes. But they still have many technical questions.

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MANGAN: The NPT is going to undergo the review and extension process in 1995. Part of that review process may involve some political pressures from other countries for the superpowers to demonstrate and put forward a well-defined program to show the rest of the world that there is a reduction in nuclear capability. Will this review conference impact the work that you are doing?

PALENYKH: We always have in mind that the extension conference will take place in 1995. I think that what we are doing together will serve as an argument in our favor at the conference. We can present it as the achievements and realization of ideas expressed by other countries. We can also propose for other countries to join the process. While our process is gaining, it will be used in the preparation of the conference. There will be questions on the part of non-nuclear states, especially those that are not participants in the NPT. But they influence some participants. It will be very important to have all republics in the territory of the former Soviet Union join the NPT. Here I think we should work together.

MANGAN: It is one thing for the United States and Russia to stand up and say "We're dismantling." Other countries may stand back and say "We hear what you are saying, but prove to us that you are doing it." Do you expect that kind of political pressure?

PALENYKH: We might get such questions. And I think we will find the answers together.

BURNS: That's a good question. The countries that have the most to lose and the most to gain by the process are the countries of the former Soviet Union that have declared themselves to be willing to adhere to the NPT but still have nuclear weapons left over from the former Soviet Union on their soil. If they are satisfied, then no one else in the world should be concerned. In other words, it is in their interest to see that these weapons are disposed of in a safe and secure manner. There are already agreements within the CIS [Commonwealth of Independent States] to ensure that this takes place.

As I said earlier, we are moving beyond this era of strict verification for events of the future. Events of the past are still going to be under verification regimes.

PALENYKH: It will be very important in preparations for the review conference if Ukraine, Kazakhstan, Byelorussia join the treaty. It will serve as an argument in favor of the NPT.

TAPE: Can you elaborate on the proposals that have been agreed to or are under discussion within the CIS republics to provide assurance?

PALENYKH: We have concluded a special treaty with the Ukraine in connection with the withdrawal of nuclear warheads. In that agreement, there is a provision giving them the chance to verify. They know the process of movement of nuclear weapons, and then they will be present during the dismantling process up until the stage where the NPT does not permit them to see more.

TAPE: This comes back to the transparency issue.

PALENYKH: Yes.

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SMITH: This question is perhaps less technical and more sociological. The events of the last two or so years are perhaps the most significant changes that we have had in the world in 40 or 50 years. Collectively, we have been kind of "holding our breath" all of this time, afraid of a nuclear exchange. Now we don't need to be afraid. Yet I don't sense any excitement on the public's part, at least in the United States. Is this because they haven't been told by the media? Is the same thing true in Russia?

PALENYKH: Russian people are excited and afraid at the same time. Now people are afraid of the growth of nationalism. All of the conflicts that are taking place on the territory of the former Soviet Union are connected with the growth of nationalism. It is very dangerous. The threat of nuclear war has been reduced, but the growth of nationalism presents a new threat.

BURNS: Part of the problem in the United States may be that too many other events have been taking place domestically. So people have not been able to really focus on the long-term effect of the change in the former Soviet Union. There has been nothing as dramatic as the physical collapse of the Berlin Wall, nothing as dramatic as the events of last August in Moscow. The American TV-viewing public is a fickle public. What we are doing is probably too technical for the sound bites.

Also, if I were in the public relations business for the government, I could see some problems trying to advertise the fact that we are giving away almost half a billion dollars during an election year when there are problems in the cities and problems here and there.

The other problem is that the American people took a lot of convincing to accept the concept of mutually assured destruction. That is a bizarre concept for the average individual to accept: "Why should I open myself for destruction and not provide defense in the hope that I will not be attacked." Having said that, how do you say now: "Not to worry. We were only fooling. It is okay for us to reduce nuclear weapons." It is a very difficult thing to explain. Plus, we have not worked out the philosophical basis for this. What are we going to call this thing we have at a level of, say, 4,000 nuclear warheads — probably a level much lower than that. Nobody has written the definitive book, like Tom Shelling or [Henry] Kissinger, on how to think about it.

I went back and read some books written in '46, '47 and '48 and *Life* magazine from around 1946 on nuclear weapons. This is before we embedded deterrence as a concept. It is amazing how we thought about it — or didn't think about those issues then. It gives you a better insight into how the American people think about these things now. They are very confused, just as they were confused back in 1946. As records are opened up that were formerly classified on our side, we see how the consideration of the use of nuclear weapons was made in the '40s sort of offhandedly. It was just another weapon that made a bigger hole in the ground; until we realized that things like fallout have an impact; until things like direct contamination from radiation have an impact; until we built this cosmology of nuclear effects that gave rise to theories of deterrence.

I would not want to try to explain to the American people today what it is we have now that is better than what we had two or three years ago, except that Igor and I are talking regularly and we are exchanging information we both would have been shot for two or three years ago.

TAPE: You don't see this as mutually assured destruction at a lower level? You feel that we are going into a new era?

BURNS: I don't know what it is. I rather doubt that it is going to be mutually assured destruction at a lower level. That presupposes that you could just lower the level to one nuclear weapon on each side and have mutually assured destruction. Obviously you don't have it there. You would be prepared to take that risk.

We haven't factored in other states that may have a handful of nuclear weapons, and what deters them? One of the interesting factors in all of this is that theater nuclear weapons — tactical nuclear weapons — may or may not have had much role in the deterrent process between the superpowers. But they certainly have a deterrent effect in a country that might possess a few of them in the Third World. That's why both Russia and the United States are very concerned about getting nuclear weapons back home as soon as possible.

INDUSI: As we get down to lower and lower levels of deployed weapons, each weapon counts a lot more than it used to. Is it possible that politicians in the U.S. and politicians in Russia will then start to demand the reintroduction of verification?

BURNS: I wouldn't want to leave anybody with the idea that verification is dead. All I am saying is that, in this particular period of time, we are moving through a phase, and during this phase, because of the nature of things in the dismantlement effort, verification in the strict arms control sense is not the appropriate methodology.

But let's say that the United States and Russia determine 10 years from now that each side needs 500 weapons; 500 very sophisticated, highly accurate weapons, highly reliable weapons. Let's just say it was 500. Then it would be very important that both sides had very high assurance that both sides had 500, not 501 and not 495. It would also be important to know how many the other "x"-number of nuclear weapons states had, down to the exact number of operational warheads on weapons.

We probably wouldn't go to low numbers unless there was an airtight system of verification that applied to everybody, not just to our two countries. This is an interesting area of study on the part of those people who specialize in verification: What kind of regime would the superpowers insist upon to reduce below 1,000 or 2,000, whatever the number might be?

PALENYKH: I think that at some stage of our bilateral reduction process we should say that it is time for other countries to join the process. Let us do it together.

BURNS: It may well be that the initiative comes from them, not from us.

MANGAN: I would like to share with you a remark that a gentleman from the U.K. made about the plenary session. He said, "It was a moment in history."

Considerations for Determining the Frequency of Instrument Measurement Control Checks

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ABSTRACT

A new Quality Culture is slowly taking hold in the United States. The premise of this culture is that by considering quality from the start and by continually striving to improve, costs can be reduced while producing a better product. It is not always recognized that this is true whether the product is a manufactured item, a service or a measurement. Thus, the principles of Statistical Process Control (SPC) apply to processes that produce measurements as well as to those that produce items.

In DOE facilities, a major concern is the assurance of quality measurements of nuclear materials. One consideration in the application of SPC to these measurement systems is the choice of the sampling interval, the frequency at which measurement control (MC) checks are performed. This paper gives several considerations related to the choice of the sampling interval for these systems. The considerations include the cost of an MC check, cost of failing to discover a system problem, regulations, specifications, and available resources.

One factor that often is not adequately considered in the choice of a sampling interval is the cost of a response to a measurement system failure. When a system fails, the cause of the problem must be sought and the system fixed. In addition, all measurements made since the last successful MC check become suspect. Moreover, if that last "successful" check is marginal, measurements before that check may also be suspect. Providing assurance of the quality of these measurements, or remeasuring the items if necessary, can be a considerable cost. The procedures for addressing a system failure should be documented in a failure response plan, and the results of the investigation of a system failure should be kept for audit.

1. INTRODUCTION

A new Quality Culture is slowly taking hold in the United States. The premise of this culture is that by considering quality from the start and by continually striving to improve, costs can be reduced while producing a better product.[1-3] It is a common misconception that the term "product" refers only to a manufactured item. In many operations, for example in medical and research laboratories, the most important product is a measurement. In other industries the product is a service. The principles of this new culture apply to measurements and services as well as to traditional products.

At DOE facilities, a major concern is Material Control and Accountability (MC&A), where the emphasis is on assurance of quality measurements of nuclear materials. DOE Order 5633.3[4] states (p.II.6) that "The objective of the measurements and measurement control is to establish nuclear material values and to assure the quality of the data." A similar statement is found on page II.8: "The objective of measurement control is to assure the effectiveness of measurement systems and the quality of measured values used for accountability."

In this paper, "product" will mean measurement. Thus, the Quality Culture premise is that by making the best measurements possible and by providing assurance of the quality of these measurements, total costs will be reduced and measurement systems will function more smoothly.

The primary statistical tool in this assurance is the statistical control chart.[1,5,6] The results of periodic measurements of standards should be plotted on these charts and monitored. This activity can provide assurance that measurement systems are stable and properly characterized. Some brief comments on the use of control charts for measurement control data are given in Section 2. When a measurement system fails an MC check, it is important to have a documented failure response plan to follow. These plans are discussed in Section 3.

An important ingredient in the search for quality and for continual improvement is the sampling interval or frequency[a] with which the measurement system is checked for proper operation. There is no single frequency that applies to all systems. There are, however, definite factors that should be considered when choosing a sampling interval for a specific system. Some of these factors will be discussed in Section 4. Concluding remarks are contained in Section 5, and a check list of considerations is provided in Appendix A.2.

2. STATISTICAL CONTROL CHARTS FOR MEASUREMENT CONTROL

Statistical control charts are generally treated in the literature under the topic of Statistical Process Control (SPC). There are two reasons usually given for statistical control charting data from a process. These apply equally well to a measurement system. The first reason is to monitor the process to see if the process is stable. Here, one wants to be assured that the process mean and variability are reasonably constant. The second reason, which is frequently overlooked, is to provide a means for continual improvement of the process. This is the goal of the first of Deming's famous 14 points.[1]

Statistical control charts provide a systematic method for revealing the presence of system problems. The causes of system variability are usually classified as "common" causes or "assignable" causes. The latter are often called "special" causes. Common causes are those that produce intrinsic system variability. Examples of common causes are radioactive decay, normal electronic instabilities and minor environmental changes. They cannot be removed without essentially changing the system, usually at great cost. Assignable causes are those that produce "unnatural" patterns[7] in the control chart. Strong power surges, storm fronts, loose wires, detector deterioration, changes in background caused by storage of nuclear material near an instrument and operator error are examples of assignable causes. These causes need to be identified and their effects minimized to the extent possible.[b] It is important to realize that every system can be improved.[c] Whether it is cost-effective to do so is another issue.

Statistical control charts provide signals for the presence of assignable causes. An observation beyond the three-sigma control limits is one of these signals. Unfortunately, there is an undue reliance on this one signal. There are other equally important signals[8,9] of the presence of assignable causes. These are present in the trends and patterns of the observations and should not be ignored. However, it must be recognized that not all signals of statistically significant events reflect events of practical significance. Thus, the response to a statistical out-of-control signal must be well thought out. This is discussed more in the next section.

Control chart limits are set to control the chance that a system that is in control will be declared out-of-control. However, there is always a chance that a system which is out of control will be declared in control. In statistics, these are called a type II error. The chance of a type II error would be reduced, albeit at some increase in cost, if the control standard was measured several times rather than just once. This would allow the use of the more powerful X-bar, S (or X-bar, R) charts.

3. FAILURE RESPONSE PLANS

The response to a statistical signal of a problem will be dictated in part by some of the same practical considerations involved in selecting the sampling interval for measurement control. It is likely that for many high-quality measurement systems, a statistical signal of a failure may not mean that the system measurements are outside the desired levels of precision and accuracy.[10] Therefore, the expression "system failure" should mean that the observed result indicates a problem of both practical and statistical significance. The response to a statistical signal alone should be different from the response to a signal of both statistical and practical significance. It is recommended that upon the discovery of a system failure, a number of measurements be made to assess the magnitude of the problem. This can be useful in deciding the corrective action to be taken relative to previously measured items.

Thus, the conditions defining what constitutes a system failure need to be defined. When a measurement system fails measurement control, steps must be taken to put the system back in service. These steps should be documented[3,4,11,12] in a failure response plan created in advance. Additionally, the measurements of all items measured since the last successful MC check are suspect.[3,10-12]

The values assigned to these items must be investigated. Remeasurements may be necessary. If this is not possible, "the custodians of the item shall be notified that the assigned values are suspicious."[12] It is also possible that an investigation reveals that items measured before the last "successful" check are also suspect. (It may be that the successful check was marginal or part of a pattern that became clear later.) The failure response plan should describe how the values are to be assured.

Since it is impossible to know in advance what problems may occur, the failure response plan cannot be completely specific. A statement identifying the personnel who will decide the best approach to quality assurance in unusual situations should be sufficient.

[a]In the statistical literature, the term "sampling interval" is usually used in lieu of the term "frequency." Increasing the frequency of measurement control checks is equivalent to reducing the sampling interval. There are schemes which allow for variable sampling intervals depending on system behavior. In these schemes, the system will have more frequent checking at start-up and after a failure and less frequent checking when it is working well. For simplicity, in this paper the sampling interval or frequency will be treated as a fixed parameter.

[b]Some assignable causes may be impossible or too expensive to remove or control. In these cases, perhaps a decision needs to be made to operate the system only when these causes are unlikely.

[c]Improvement need not be measured only in terms of increased stability or reduction in variation. It may also be measured in terms of reduced cost (dollars, time, exposure), increased efficiency or increased quality.

It is recommended[11-13] that a written report detail the investigation and be kept for audit. The report should include the treatment of the suspect items, the discovered cause of the problem, if any, and the corrective action taken to the measurement system.

4. CONSIDERATIONS FOR MEASUREMENT CONTROL FREQUENCY

The principal considerations that should be involved in deciding how frequently to make measurement control checks on a measurement system might be listed as

1. "Cost" of performing a measurement control check,
2. "Cost" of not detecting a problem,
3. System characteristics (use, system history),
4. Throughput,
5. Regulatory requirements and specifications, and
6. Graded safeguards.

The order of these factors is not intended to suggest a universal order of importance, and there may be other considerations not mentioned. Moreover, there is nothing unique about this list nor are the factors meant to be mutually exclusive. Others[11-13] express many of the same ideas differently. In the following paragraphs, each of these considerations is discussed. A listing of possible questions associated with each factor is given in Appendix A. The decision on the sampling interval should be made only after considering and weighing all relevant factors. Mathematical weighting schemes are sometimes employed to aid in the decision.

The first and second factors concern costs. The costs of extra MC checks need to be weighed against the costs incurred by not detecting a problem as quickly. "Costs" can be measured in a number of different units. There is a dollar cost for performing the MC test, a cost in lost productivity, as well as a potential cost in exposure. There are also other costs that need to be considered, for example, the cost to enter and document the results. Usually, the costs of an MC test are relatively easy to quantify.

The costs associated with failure to detect a significant instrument problem are harder to quantify and yet usually more important. These costs may be borne in large part by organizations other than the one performing the measurements or by the facility as a whole. These are real yet sometimes hidden costs. Instruments whose failure to measure properly results in large institutional costs should be checked more frequently than instruments in less sensitive situations.

As mentioned earlier, when a measurement system fails, the measurements of all items measured since the last successful MC check, and perhaps even before that test, are suspect. The values assigned to these items must be investigated. Remeasurements may be necessary. The shorter the sampling interval, the fewer the number of items that are suspect and the less rework necessary.

Thus, the costs under factor 2 include the cost to investigate, the cost to remeasure suspect items, the cost to change the book values of the items, the costs incurred downstream because of the original poor values and the cost of documentation. There are also the costs associated with possible inventory difference justifications and review boards. If the items have been shipped off-site, there can be significant shipper-receiver differences. Resolution of these differences entails yet additional costs. There also may be a period of lost productivity. Additionally, failure of measurement systems may result in poor accountability values and uncertainty estimates. These may hamper the successful use of propagation of variance techniques.

The third factor, system characteristics, simply recognizes that systems are different and are employed differently. Each system needs to be examined in context. A balance used in a corrosive environment usually requires more frequent checking than an identical balance in a less corrosive environment. An instrument with a history of problems will need a different MC schedule than another instrument that has a history of stability. Other system characteristics that may be relevant are the quality of the standards and system calibration[d] and convenience of performing the MC check. Physical accessibility to the system also is a consideration.

The fourth factor, throughput, is related to the second and third. As discussed earlier, when a system fails measurement control all measurements since the last successful MC check become suspect. Thus, as throughput increases, so should the number of MC checks. Also, throughput increases the wear and tear on some measurement systems. These systems usually need more frequent checking.

The fifth factor is regulatory requirements and specifications. Regulatory requirements sometimes explicitly dictate the frequency of a MC check for a system. An example is found in DOE Order 5633.3,[4] where it is stated that balances should be checked every day they are used for accountability measurements. The current climate is one of moving toward increased required assurance.[e]

Product specifications, which may include the desired levels of precision and accuracy, must be considered. If the specification is for a measurement to be within 0.1g, the instrument may need more frequent checking than if the specification was 1g.

Note, however, that being within specifications does not insure against unwanted costs later. It is possible that the specifications are somewhat loose for practical reasons but

[d]Some systems provide internal diagnostics which might be used to supplement the measurement control checks. The extent to which this is possible would have to be the subject of a study to relate the diagnostic results to the assurance required. It would seem that these results would also have to be control charted. The availability of a system expert to interpret the diagnostics is an important consideration here.

[e]Chemical procedures frequently call for an MC check run with every batch. For NDA measurements within the DOE complex, there have been suggestions that MC checks be performed as frequently as after every fourth item. These sampling intervals are not necessarily cost effective but are mentioned here to show the growing concern for measurement quality assurance. In some areas, 10 percent checking is the rule.

that a system that runs much better than specifications will provide cost savings later. The aim of continual impovement should not be dismissed just because the measurement is within specifications.

Graded safeguards is the last factor and is linked directly to previous factor and to available resources. In a world of unlimited financial, manpower and equipment resources, all systems can be treated optimally. Unfortunately, this world does not exist and the limited available resources need to be used to do the most good. Thus, measurement systems in more critical safeguards areas should receive more frequent checking than similar systems in less critical areas. The desired levels of precision and accuracy should reflect the importance of the measurement.

5. CONCLUSION

It should be obvious why Deming, Ishikawa and all other quality experts recommend that problems be caught as far upstream as possible. You do not build a quality product by waiting for a problem and then trying to fix it. You build quality by preventing the problem.[1,2] This applies whether the product is a manufactured item, a service or a measurement.

The premise of the new quality culture is that by considering quality from the start, total costs can be reduced while producing a better product. An essential ingredient for providing quality output is the frequency with which a process is checked. Factors relating to the choice of the measurement control frequency have been presented. Some of these factors involve policy and some involve cost. These factors should be considered before the decision on frequency or sampling interval is made.

Underlying the choice of sampling interval is the concept of risk. The facilities limited financial, manpower and equipment resources need to be allocated to make the risk "as low as reasonably achievable" (ALARA). Resources devoted to one system are not available for another; the costs of a system cannot be considered in isolation.

From the discussion of the factors it is clear that, besides regulations, the cost of allowing an out-of-control measurement system to operate is probably the most important consideration. As before, some of these costs can be expressed in dollars, some in time, some in terms of radiation exposure. All expose the facility to loss of credibility.

APPENDIX A
SAMPLING INTERVAL CONSIDERATIONS

1. Cost of Performing a Test
   - What is the cost in time and lost production?
   - What is the cost in dollars?
   - What is the cost in increased exposure?
   - Are there other costs?

2. Cost of Not Detecting a Problem
   - What is the cost of investigating the cause of the problem, especially if the problem is not found in a timely manner?
   - What is the cost of loss of production during a search for the cause of a problem?
   - What is the cost of assuring past measurements?
   - What is the cost if items have been shipped?
   - What is the cost if items have been used at the incorrect value?
   - What is the effect on propagation of variance studies?
   - Will inventory differences result?
   - What is the cost of compiling a report?
   - What is the cost of loss of credibility?

3. System Characteristics
   - What is the history of the instrument?
     - Is there a bias?
     - What is the variability?
     - What is the frequency of problems?
     - What is the instrument sensitive to?
   - How and where will the system be used?
     - How does the current use compare to the previous uses?
     - How does the current environment compare to the previous one?
     - What are the "natural" times for MC checks?
   - How good are the standards and the calibration?
   - How do the items measured compare with the calibration and MC standards?
   - How important is the measurement?
   - How physically accessible is the system?

4. Throughput
   - Will the throughput be constant?
   - What is the nature of the throughput?
   - Can items be easily remeasured if there is a system problem?

5. Regulatory Requirements and Specifications
   - What regulatory requirements apply?
   - What are the desired levels of precision and accuracy?
   - Are there administrative or specification limits?

6. Graded Safeguards
   - How important is this system relative to other systems?
   - Given limited financial, equipment and manpower resources, what fraction of these should be allocated to this system?
   - How does ALARA apply?

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A Model for Randomized Unannounced Inspections at Any Time

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ABSTRACT

A general model of randomized inspections for unannounced inspections at any time is proposed. The model is designed to satisfy the inspection criteria including both timeliness and detection probability goals. In addition, the inspection effectiveness is enhanced since inspections may commence at any time. The model does not require changes in the concept of timeliness or the use of "average" detection time. Possible significant savings in inspection resources arising from the application of the model are estimated. While the paper is written in the IAEA context, the model is more general and is applicable to a much wider class of inspections.

1. INTRODUCTION

INFCIRC/153 (Corrected), Paragraph 84 states that: "as a supplementary measure, the Agency may carry out without advance notification a portion of the routine inspections...in accordance with the principle of random sampling." The main advantage of randomized unannounced inspections at any time is their ability to detect possible diversions before concealment. If concealment measures are possible — for example, by borrowing materials from other facilities before inspections — and if inspections can happen only on a small number of scheduled dates, operators are likely to take measures to conceal the diversions before any of the scheduled inspection dates. On the other hand, if unannounced inspections at any time are allowed, the operator may not have adequate time to conceal the diversions.

Allowing an inspection to commence at any time could possibly be a burden on the operators in some instances. Such inspections would enhance the ability of IAEA safeguards to detect possible diversions, but their actual execution would also impose a heavy burden on the IAEA.

This paper proposes a model which integrates unannounced inspections at any time with a general scheme of randomized inspections. Inspections carried out according to the model would satisfy the current IAEA safeguards criteria for both the timeliness and detection probability goals. Application of the proposed model could enhance the IAEA safeguards effectiveness and, at the same time, afford a more efficient use of inspection resources.

The element of randomization in this new model is based on our earlier model of randomized inspection.[1] The original model is unique in that inspections carried out according to it would satisfy the timeliness and detection probability goals as specified in the IAEA 91-95 Criteria. Most models of randomized inspections—for example, Canty, 1991, require changes in the fundamental concept of timeliness and use the expected detection time to evaluate the model. In the cited model, the inspections are allowed at a number of specified times and the timeliness goals are considered as achieved if the average detection time is not longer than that mandated by the criteria. On the other hand, in our model, at each inspection opportunity mandated by the timeliness goal, the determination to carry out an actual inspection is considered as a random variable—in addition to the random material sampling—in such a way that the mandated a priori detection probability is satisfied every time. Our model allows savings by carrying out less frequent although more intensive actual inspections on the average.

In this paper, the original model of randomized inspections is generalized to the situation where inspections at any time are allowed. It will be shown that both the regular, non-randomized inspections and our original model of randomized inspections are special cases of the new, generalized scheme. The model is designed so that, at a minimum, inspections carried out according to the new model will satisfy the criteria without necessitating changes either in the Criteria or in the fundamental concept of timeliness. An important advantage of the new, generalized model of randomized inspection is that it allows potential detection at any time—instead of only at the scheduled dates according to the timeliness requirement, and thus provides a more extensive coverage than that mandated by the criteria.

Another important feature of the model is that, since more inspection opportunities than those mandated by the Criteria are considered, the model allows more latitude in determining whether and when to carry out actual inspections, thus reducing the difficulties in scheduling randomized inspections. Details of these are described in Section 5.

The price the inspectors have to pay for the benefits associated with the model is the requirement that they perform more intensive inspections when the actual inspections are probabilistically required. The potential savings come from the reduced number of inspection trips and the associated overhead.

2. INSPECTIONS AT A REFERENCE FACILITY

Before going into details of this new model, the current regular, non-randomized inspection scheme for spent fuels at a reactor is briefly described. The reactor serves as a frame of reference, but the application of the model is not limited to reactors. Under nominal circumstances, one physical inventory verification (PIV) and three interim inspections at three-month intervals are performed to satisfy the timeliness criteria. At each interim inspection, containment and/or surveillance measures (C/S) are examined to detect possible diversions. The level of detection probability achievable via C/S has not been quantified. However, when C/S fails, the criteria require that spent fuel at reactors in INFCIRC/153 countries be item counted and verified with 20 percent detection probability (50 percent for INFCIRC/66 countries).

The diversion assumption under which the IAEA operates is that a potential diversion can occur at any time. To provide safeguards against this, an inspection with a certain level of detection probability (1-β) must be executed within a timeliness interval after the diversion. Thus, the time interval between two inspections — each with a certain level of detection probability — must be less than the timeliness limit as specified in the criteria.

Safeguards of spent fuel at a reactor is described here only to provide a frame of reference. The model is applicable to other types of situations, for example, to fresh low enriched uranium in a fuel fabrication plant. It should also be pointed out that if a 100 percent detection probability is mandated at each timeliness opportunity, the model yields correctly that no savings can be achieved by randomizations.

3. MATHEMATICAL MODELING

At t_0, an inspection of the spent fuel inventory at the reactor is completed. Let a timeliness interval T beginning from t_0 be subdivided into N equal segments. (The assumption that time segments are equal simplifies the discussion but is not necessary.) A diversion is assumed to have occurred between t_0 and t_1. At each inspection opportunity t_i ($i = 1,2,3,...,N$), an inspection with a detection probability of $1-\beta_i$ is desired. Note that, according to the criteria, no inspections are required before t_N.

A possible way to expand the coverage of the current inspection regime is to include these intermediate inspection opportunities at t_i, such that

$$\prod_{i=1}^{k} \beta_i \leq \beta, \tag{1}$$

where $k \leq N$. In other words, β_i values are chosen such that a diversion assumed to have occurred between t_0 and t_1 is detected with a probability at least 1-β by time t_N. For a diversion which might have occurred between t_j and t_{j+1}, the timeliness limit comes at t_{N+j}. Thus, the inspections carried out according to the model satisfy the criteria, since, within a time interval not greater than T (the timeliness criteria) after any diversion, k inspections opportunities with an integrated detection probability of at least 1-β would have occurred.

In a non-randomized, regular inspection scheme, at each inspection opportunity t_i, the desire that the detection probability be at least $1-\beta_i$ can be satisfied by selection of a proper sampling size such that probability of not including a defect in the sample s_i is no greater than β_i (i.e., $s_i \leq \beta_i$). This would increase the IAEA work load significantly since many intermediate inspections not required under the Criteria will need to be executed.

However, our previous model of randomized inspections can alleviate the problem. According to our model of randomized inspections, the mandated detection probability at each t_i can be accomplished via a combination of the probabilistic determination of whether or not to carry out an actual inspection with a corresponding requirement to execute the actual inspection more intensively than that required in the case of regular, non-randomized inspections.

Let the probability for carrying out the ith actual intermediate inspection be p_i, and the probability of not including a defect in the sample be s_i'. The detection probability requirement becomes:

$$(1-p_i) + p_i s_i' \leq \beta_i \tag{2}$$

This requirement must be satisfied at each t_i. Details of mathematics and the solutions for p_i and s_i' are given in Lu and Teichmann, 1991. The probability to actually carry out an intermediate inspection p_i must be higher than $1-\beta_i$, and the sample size for randomized intermediate inspections must be larger than that for the regular inspections since $s_i' \leq (\beta_i - 1 + p_i)/p_i \leq \beta_i$.

4. EXAMPLES

A few examples will be used to illustrate the merits of the model.

Special Case A: Current IAEA Regular Inspection Regime. By setting $\beta_i=1$ for $i=1...N-1$, $\beta_N=\beta$, and $p_N=1$, one obtains the current IAEA regular inspection regime. No inspection occurs at t_i $i=1,2,3,...,N-1$, and an inspection is definitely carried out at t_N.

Special Case B: Our Previous Randomization Model.

By setting β_i=1 for i=1...N-1, $\beta_N=\beta$, and p_N greater than 1- β, one obtains our previous randomized inspection model. No inspection occurs at t_i i=1,2,3,...,N-1. At t_N as required by the timeliness criteria, a randomized inspection is performed. Whether or not to carry out an actual inspection is determined probabilistically. The detection probability mandated by the criteria is achieved by inspecting more intensively (than Case A) if the actual inspection is probabilistically required.

Special Case C: Non-Randomized Intermediate Inspections.

By setting $\beta_i<1$ for i=1...N, and p_i = 1. In addition to meeting the criteria in timeliness and detection probability, the IAEA enhances inspection coverage at these intermediate "surprise" opportunities. It is noted that a similar scheme is applied by the IAEA to inspections of sealed items. However, more general application of the model to inspections at facilities may be difficult since many intermediate inspections are needed.

Special Case D: Randomized Intermediate Inspections.

By setting $\beta_i<1$ for i=1...N, and $p_i \geq 1-\beta_i$, all goals specified for Case C above are achieved. More importantly, our model of randomized inspections may save the IAEA resources in some cases.

To illustrate the possible savings from this model, assume β=0.5, N=3, $\beta_i=\beta^{1/N}$ for all i, and $p_i=1-\beta_i$, corresponding to complete sampling when the intermediate inspections must be executed as determined probabilistically. In a year, there are 11 opportunities for intermediate inspections. The expected number of actual intermediate inspections is 2.27 using these parameters. Compared with three regular interim inspections, this represents a reduction of interim inspection trips by 25 percent. Inspections executed according to our scheme satisfy the same timeliness and the detection probability goals as that accomplished via three regular inspections. In addition, the safeguards effectiveness is enhanced significantly since inspections may occur at any month, instead of only at a regular three-month interval. A larger value of N, corresponding to more inspection opportunities, can be analyzed similarly.

It should be emphasized again that it is a major concession by the operator to allow the inspector the "surprise" factor. In return, the IAEA may reduce the detection probability requirement. For example, if the mandated detection probability is reduced from 50 to 35 percent for facilities allowing randomized inspections at any time, the expected number of actual interim inspections becomes 1.47, a reduction of inspection trips by more than 50 percent.

5. FLEXIBILITY IN THE MODEL

Scheduling of inspections has been mentioned as a possible difficulty associated with the implementation of our previous model of randomized inspections since many actual inspections at different facilities may probabilistically be required simultaneously. Another possible problem is the fluctuation in budgets due to the randomness of inspections. Although the problems are not trivial, a study to investigate them and find possible remedies is justified, given the potential savings.

The new model presented here could alleviate the scheduling problem. The only requirement in this model is expressed in Eq. (1). Thus, an inspector may skip some intermediate inspections by setting β_i=1, and still meet the criteria. The inspectors would not inform the operators of the decision ahead of time. On the other hand, the inspectors are also free to set a small β_i at any time before t_N to close off the existing timeliness period and to begin a new one. Combination of these two elements provides a large degree of freedom in inspection planning.

6. CONCLUSION

A general model of randomized inspections for unannounced inspections at any time has been developed. Inspections carried out as designed by the model would satisfy the current criteria including the timeliness and detection probability goals. Furthermore, the inspection effectiveness is enhanced via additional inspection opportunities at any time. Potential significant savings in inspection resources arising from the application of the model have been estimated. The model is versatile and is applicable to a much wider class of inspections including flow verification and, for example, arms control verification.

ACKNOWLEDGEMENT

The author thanks F. Houck of the U.S. ACDA and G.P.D. Verrecchia of EURATOM for suggesting the problem. He also thanks T. Teichmann, J. Sanborn, J. Allentuck and J. Indusi of TSO/BNL for their support and many helpful suggestions.

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3. "Analysis of Randomization with Respect to Interim Inspections for Timely detection of Irradiated Fuel at Light Water Reactors," Section for System Studies, IAEA, 1991.

Ming-Shih Lu earned a bachelor's degree in physics from the National Taiwan University and a Ph.D. in applied physics from Cornell University. He has been a scientist at Brookhaven National Laboratory since 1975, first in the Reactor Safety Division of the Department of Nuclear Energy, working on nuclear reactor analysis, and, since 1984, in the Technical Support Organization concerned with nuclear safeguards problems involving nuclear measurement systems and general safeguards problems.

EUROCLEAN Introduces HEPA-Filtered VAC

EUROCLEAN, Itasca, Ill., has announced its Model UZ948 high-performance, HEPA-filtered industrial vacuum designed for industrial clean-up from housekeeping to hazardous dust collection, suitable for wet or dry applications.

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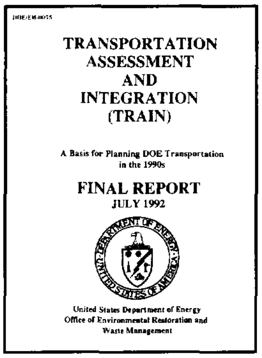
For more information, contact Bill Becker at EUROCLEAN, 905 W. Irving Park Rd., Itasca, IL 60143; or call (800) 545-HEPA, fax (708) 773-6339.

DOE Releases Transportation Assessment Report

The Department of Energy (DOE) has released the Transportation Assessment and Integration (TRAIN) Report: A Basis for Planning the Department of Energy Transportation in the 1990s. The report is the culmination of a study which began in the 1990 to comprehensively evalute the DOE's nonweapon related transportation needs. The report reflects comments and recommendations made by many experts and interested parties, both internal and external to the DOE, which address the transportation and packaging operations, regulatory compliance, training, research and development, emergency management and public involvement requirements necessary for the DOE's future transporation needs.

During the study, particular emphasis was given to ensuring early integration of transportation planning into Environmental Restoration and Waste Management activities. The findings documented in the TRAIN report will serve as a basis for strategic planning and resource allocation.

As the DOE begins to implement these findings and recommendations, there will be opportunities for INMM members to comment and become involved in specific programmatic decisions and activities that require DOE materials to be transported. For copies of the report, contact the Transportation Information and Communication Resource Center, EM-56.1, Trevion II Building, U.S. Department of Energy, Washington, D.C. 20585-0002; or call (301) 903-7281.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TRANSPORTATION ASSESSMENT AND INTEGRATION (TRAIN)

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FINAL REPORT
JULY 1992

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Columbiana Releases New Cylinder Literature

Columbiana Boiler Co., Columbiana, Ohio, has announced publication of a new brochure describing large shipping cylinders for uranium hexafluoride (UF_6). Columbiana manufactures three different UF_6 cylinders for the nuclear industry, including models 30B, 48X and 48Y. All cylinders are produced in accordance with the current American Standards Institute N14.1 standard.

For additional information, contact the Columbiana Boiler Co., (216) 482-3373, fax (216) 482-3390.

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Nuclear Energy Forum, Chicago, Ill. *Sponsor:* U.S. Council for Energy Awareness. *Contact:* Conference Office, U.S. Council for Energy Awareness, 1776 I Street, N.W., Suite 400, Washington, D.C. 20006-3708; phone (202) 293-0770, fax (202) 785-4113.

February 16 – 19, 1993
WATTec '93 Conference and Exhibition, Knoxville, Tenn. *Sponsor:* WATTec. *Contact:* John W. Shipp, Jr., Technical Program Chairperson, Tennessee Valley Authority, 601 W. Summit Hill, OCH 1E, Knoxville, TN 37902; phone (615) 632-6426.

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